AN

ENCYCLOPÆDIA

OF

DOMESTIC ECONOMY:

COMPRISING SUBJECTS CONNECTED WITH

THE INTERESTS OF EVERY INDIVIDUAL;

SUCH AS

THE CONSTRUCTION OF DOMESTIC EDIFICES; FURNITURE; CARRIAGES, AND INSTRUMENTS OF DOMESTIC USE.

ALSO,

ANIMAL AND VEGETABLE SUBSTANCES USED AS FOOD,

AND THE METHODS OF PRESERVING AND PREPARING THEM BY COOKING; RECEIPTS, ETC

MATERIALS EMPLOYED IN DRESS AND THE TOILET; BUSINESS OF THE LAUNDRY;

PRESERVATION OF HEALTH; DOMESTIC MEDICINES, &c., &c.

BY T. WEBSTER AND MRS. PARKES.

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Illustrated with nearly One Thousand Engravings

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PREFACE

BY THE AMERICAN EDITOR.

This invaluable compendium of useful knowledge, on subjects which intimately relate to domestic happiness, treated in a familiar and practical manner, commends itself to the united head of every family as a standard book of reference on the variety of topics which concern our physical nature, each of which is here exhibited with scientific accuracy and in ample detail. The author, or, as he styles himself, the editor of the work, by his official relation to the "Royal Institution of Great Britain for the Application of Science to the Common Purposes of Life," is undoubtedly possessed of singular adaptation for his task, as indeed is manifest in every part of the work. And the very eminent and excellent lady, whose valuable assistance has been secured for certain portions of the book which treat of matters which are specially within the province of her sex, has shown herself to be worthy of the selection by her admirable contributions to the volume. Her son, Dr. Parkes, has furnished the principal portion of the last chapters relating to Domestic Medicine.

The American publishers have been induced thus promptly to undertake its publication by a conviction that such a work is greatly needed, and by the concurrent testimony of several gentlemen of intelligence and distinction to whom it has been submitted for examination. The extraordinary number of engravings which illustrate its various departments, notwithstanding their expense, it has been deemed important to retain, so as to preserve the integrity of the original. Such additional cuts as have become necessary by the introduction of new matter in adapting the work to the United States, have been engraved for this edition, and will be found superadded in different parts of the volume, thus increasing its value above the original British work.

The American editor has undertaken to introduce such additions to numerous parts of the book as seemed to be called for, in order to conform it to the customs, habits, and taste of this country, and render it useful to the purposes of domestic economy as exemplified practically in America; and while he has seldom felt authorized to abridge or otherwise mutilate the original, although some of it may be uninteresting and almost unintelligible to many of our countrymen, the few omissions being purely and exclusively foreign and of inconsiderable extent, he has not scrupled to criticise and compare the relative peculiarities of British and American manners; and when propriety has dictated it, he has exhibited the grounds of preference for the latter over the former, thus abating somewhat of the English boast in which the authors have sometimes indulged.

The notes and improvements of this edition are brief, though numerous, and are invariably included in brackets, either at the bottom of the page, or at the close of the chapter or section to which they refer. That they may prove acceptable and useful to his countrymen, and increase the practical and utilitarian character of the book, has been the aim of

THE AMERICAN EDITOR.

PREFACE.

Much has been written on various subjects connected with Domestic Economy; and it was the wish of the late Mr. Longman, many years ago, to see collated into one large volume, for the convenience of reference, information useful to persons who have to superintend domestic establishments, but which was then scattered in fragments through thousands of pages. The difficulties attending such a compilation had long prevented its execution, since it was found upon trial that little had been published suited to the advancing state of science.

To conduct such a work became at length the occupation of the present editor, whose task has been to select and arrange the subjects, and to treat them as he best could, consistently with his own views and the limits of the publication. To this labour he has devoted what time he could spare from his professional pursuits during the last ten years, and the work being now completed, it may be proper to inform those to whom he is best known as a geologist what circumstances led the publishers to request him to undertake such a task. He had been educated as an architect, and forty years ago he had been intimately acquainted with Count Rumford, who put him in possession of the principles relating to Domestic Economy, for which he was so deservedly celebrated. He had also been the first officer, in point of time, that was appointed in the "Royal Institution of Great Britain for the Application of Science to the Common Purposes of Life," to the founding of which Count Rumford had so materially contributed. While in that institution, the editor had designed and superintended the building of the Theatre for Lectures and the Chemical Laboratory; and it was his province, during the first years of that establishment, to occupy himself with the subject of warming buildings by the best construction of chimney fireplaces, stoves, and other methods, as well as with ventilating, lighting, and the application of the principles of Count Rumford to the improvement of various useful kinds of apparatus. It was conceived that some of the experience thus acquired might be available in such a work as the present; and that, by incorporating the principal modern improvements in Domestic Economy, the object might, in some degree, be attained.

It may be proper to state the views which have guided the editor throughout the work. Without going into the subject of education, the present state of society, the use and abuse of time, it cannot but be admitted that it is extremely desirable, on many accounts, that those who occupy elevated positions in the social scale should possess that species of information which would assist them in fulfilling their domestic duties. This kind of information, however, is not easily acquired in a desultory manner, particularly at the time of life when it is first wanted and required to be brought into play.

The editor is of opinion that the heads of families should not be contented with the knowledge that may be gained from uneducated persons, who necessarily commit innumerable errors in their reasoning; but that they should understand the rationale of the various processes put in practice by others, which alone can give them the power of distinguishing between what is judicious and what is faulty. To say nothing of the female portion of society, who are more particularly expected to regulate and direct domestic affairs, there are many situations in which some acquaintance with domestic matters is indispensable even to the lords of the creation. This is more especially the case with officers in the army and navy, and with those who emigrate to form colonies.

It is vain to expect many valuable improvements from persons who have only what is termed mere practice to depend upon: by frequently repeating the same operations, they acquire a certain degree of skill, but being without principles to guide them, their attempts at improvement too often prove abortive; and if some scientific acquirements be essential to the progress of the domestic as well as the other arts, to whom should we look for the possession of these advantages? The answer is obvious—to those possessed of affluence and leisure, who have alone the means of attaining it sufficiently. It would be useless to pursue this subject farther; and thus much has been said to account for some peculiarities in the present work, where the editor has adverted to this subject.

The editor ventures to hope, that to many this suggested union of science with practice will not prove irksome; on the contrary, he is satisfied that much rational amusement may be derived from the experiment. It may not be necessary for every one to brew or to bake, make wine, or light a fire; yet to go through each of these operations once, so as to comprehend the principles upon which success depends, may really be made an entertaining occupation.

In another point of view, it may be observed, that some persons, unacquainted with the intimate connexion that exists between the several branches of human knowledge, have wondered how chemistry could be useful to a cook, or the philosophy of heat to a housemaid; and are, consequently, inclined to ridicule what they look upon as the pedantry of science. But it ought to occasion no surprise that the knowledge of the properties of steam should be necessary to those who constantly use it, or that some acquaintance with the theory of ventilation should direct the practice of those who have to change the air of our apartments. The wonder, indeed, is, or should be, that each should perform his duties efficiently, without some acquaintance with those laws of nature which have been included in the term Philosophy.

To illustrate still farther his general views, the editor will now advert briefly to the manner in which he has treated each of his subjects.

The subject of Building naturally claimed his first attention ; but the views by which he was guided in introducing this branch of the work, as well as the nature of the information conveyed, are so fully described in the work itself, as to render it superfluous to enlarge upon it here. The subject of Warming is not so well understood, even by men of science ; and though the limits of the work precluded the possibility of entering so fully into the subject as the editor could have wished, yet he trusts that his opinions, being the result of long experience, will be regarded as sound and trustworthy.

Ventilation is now beginning to be considered important; but it is evident that to practise this with effect, a knowledge of the theory is indispensable. Artificial illumination is more within the power of persons of little science, but valuable improvements, as already remarked, are seldom perfected by them alone. In this part, the Historical Account of Lamps, and the description of the most important Apparatus for Artificial Light, may claim some attention on the score of originality.

The subject of ordinary Furniture is better known; and, indeed, it may appear to some little necessary to have collected so much matter in this branch of the work; but the editor was of opinion that collecting in one work the various articles of household furniture would be useful to those who are beginning housekeeping, to whom the greatest part of the work is particularly addressed.

The subject of Food is one of the most important and interesting in Domestic Economy, and can never be treated satisfactorily without alluding to chemical and physiological science. The editor has endeavoured to steer a medium course between what might be considered as scarcely intelligible to the general reader and the mere form of receipts. He has endeavoured, indeed, to tempt the reader to an investigation of what has hitherto been much neglected by the public in general, and left almost solely in the hands of medical men. On the subject of Beverages, many erroneous opinions prevail, and health demands that it should be better understood. It may, perhaps, be supposed that he is an alarmist with respect to adulterations, and that he has followed the example of the author of "Death in the Pot;" but he has carefully avoided stating anything for which he had not sufficient authority; and he has, in many cases, suppressed what he believed to be true, lest it should appear to throw some doubt upon the rest.

The description of the materials for the cook, and the philosophy of the culinary art, have been kept distinct from the mere practice of cookery, because many might be desirous of understanding the first without wishing to go into the details of the latter; and likewise because the editor was deficient in the practical knowledge which has been supplied by a lady, whose experience in this part of Domestic Economy enabled her to treat it with propriety. And here it may be proper to state exactly what portions of the work were executed by the late Mrs. Parkes. To her are due the whole of Book VI., "On the Duties of Household Servants;" Books XII., XIII., and XIV., "On English and French Cookery;" and Book XXVI., "On the Preservation of Health, with Hints on Domestic Medicine," the latter being principally supplied by her son, Mr. Parkes, a surgeon, and the article on "Bathing," by the editor. For all the rest of the work the present editor is alone responsible.

With regard to Dress, he has contented himself with describing the usual materials, with the arts of manufacturing them, and has added some information on the Toilet, which he trusts will be found conducive to health.

In his project for a Still-room, the editor has suggested a kind of apartment in which certain experiments might be carried on, compatible with modern science, and in which philosophical chemistry, applicable to domestic purposes, might be substituted for the practice of former times.

The account of Carriages is altogether new. Some directions respecting stables and horses are necessarily added. The Dairy, both as to its construction and the operations of making butter and cheese, next succeeds; and this is followed by the management of the various domestic animals. The last article, "On Health," will no doubt be found to convey valuable information in aid of professional assistance.

To treat so many subjects with the necessary care, and within a limited space, has demanded considerable research, great caution in balancing opinions, and much industry in forming the heterogeneous mass of materials of which the work is composed into one compact body. It would have been easy to have published miscellaneous scraps as information was gained, but this would not have answered the end proposed—that of explaining the elementary principles upon which each branch depends.

In conclusion, the editor begs leave to express a hope that his labour has not been misapplied, and that the mass of matter here brought together will be found deserving the attention of the public. He may add, that all the woodcuts have been executed from drawings made by himself, mostly from original objects.

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ENCYCLOPÆDIA

OF

DOMESTIC ECONOMY.

BOOK I.

ON THE DOMESTIC RESIDENCE.

CHAPTER I.

CHOICE OF A SITUATION.

ONE of the first objects which usually engage the attention of those who are just setting out in life, and on the eve of forming a domestic establishment, is the acquisition of a dwelling. In England, it is generally the desire of every one whose finances can afford it, to have a house of his own. In other countries, even wealthy families are often contented to occupy a part of a large mansion; but this practice is inconsistent with those views of domestic comfort which an Englishman looks forward to at his own fireside, where he may plan his arrangements of a permanent nature without molestation. This feeling is peculiarly characteristic of England,* and the anticipation of these domestic pleasures is, perhaps, one of the strongest inducements to those exertions of industry which are not surpassed in any other part of the world. The great improvements which have been made of late in the interior of our houses are, in a great measure, the result of this national taste.

1. *The primary consideration in the choice of a residence is generally the situation;* and the next is the suitableness of the building to the wants of the family that is to inhabit it. It is not always the good fortune of those who are desirous of possessing a house of their own to meet with one that will suit them in every respect, and more particularly when they have limited themselves to a particular locality. A house already built may stand in need of some repair—perhaps to be modernized, or to have additions made to it; and where considerable alterations are required, it may be a question, which is too seldom asked, whether it would not be better to build a new one; for it happens not unfrequently that, from one alteration giving rise to another, the expense of these at last exceeds the cost of a new house. To make a judicious choice of a residence, it is therefore necessary that the intended occupier should not only well consider his principal wants, but understand all the essential points to be attended to in supplying them. An improper choice is often very difficult to remedy, and may destroy much of the comfort that was anticipated. To supply the requisite information on this subject will therefore be our first endeavour.

2. *The situation of a domestic residence* may be conveniently reduced to three classes: that of a town, suburban, and a country house; each of which has its peculiar advantages.

3. *A residence in town* is superior to any other for social intercourse and varied enjoyment by means of public and private parties, theatres, concerts, balls, public libraries, museums, exhibitions of works of art, with numerous opportunities of acquiring general knowledge. In the choice of a town residence, one must be guided not only by peculiar views, but by the comparative healthiness of the street; its aspect, neighbourhood, and many other local circumstances, which are, in general, pretty well understood. Not only the width of the street, but its direction, is important; one running east and west must have one front of the houses looking to the north, and deprived of the sun almost the whole of the day, while the other is exposed to its full radiance.

4. *A suburban residence*, or one in the environs of a city or town, offers some advan-

* [This "peculiar characteristic of England," as it is styled by the author, belongs to civilization, and not to England exclusively. Not even there are the comforts of home desired or enjoyed with greater ardour than in the United States, where families far from being wealthy do nevertheless seek those domestic pleasures which appertain to a separate home, preferring even a small house or humble cottage, rather than to occupy a "part of a large mansion." The "other countries" of which the author speaks are not to be understood as including America, our citizens being generally characterized by their affectionate regard to "their own firesides."

This "national taste" has resulted in the adoption of all the improvements in the interior of our dwellings which British refinement has introduced, besides superadding many which are peculiarly American.]

tages that cannot be obtained by living in town. The situation is, in general, more healthy, the air not being so much contaminated by the thousands of chimneys that are perpetually throwing out smoke and deleterious gases. Ground not being so valuable as in town, many more conveniences can be acquired, such as a garden, and perhaps a field or two, attached to the house; and this additional space may be built upon, according to any proposed plan. Thus this kind of residence, while it possesses many of the advantages of the country, such as good air and plenty of room, may, at the same time, enable the occupier to enjoy occasionally the conveniences of a town life. The pleasure to be derived from a garden, and from the cheerful and enlivening effect of trees and vegetation in general, together with quiet and absence of smoke, and innumerable disagreeable objects constantly presented in cities, are circumstances worthy of consideration. It should be mentioned, however, that in the immediate vicinity of towns the atmosphere is still in some degree charged with noxious matters, particularly when the wind blows in certain directions; and therefore, in order to enjoy the full benefit of pure air, it is necessary to remove to a sufficient distance beyond their influence.

5. *Those who resolve to settle entirely in the country*, at a distance from large towns, must make up their minds to be deprived of many of those advantages of a town and suburban life which we have enumerated. The opportunities for social intercourse must, in general, be more limited, and even the proximity of neighbours may not be agreeable. The varied amusements which town affords can only be expected at long intervals. In return for these deprivations, perfectly pure air may be obtained; also retirement, and a species of independence, with a distinct class of enjoyments. But except those who try a country life have some resources within themselves productive of amusement and agreeable occupation, the want of society will often cause such a life to feel dull. Mere walking or riding to preserve or improve health is frequently irksome, and should therefore be connected with some object. The study of some of the numerous branches of natural history will present an inexhaustible field for agreeable observation. The operations of gardening are to some highly amusing; but the cultivation of plants will prove doubly interesting to enlarged and inquiring minds, if they add to it some acquaintance with vegetable physiology and the theory of agriculture. The resources afforded by reading are well known; but it is not so generally understood how much pleasure is derivable from the power of drawing and painting, nor how much the arts of design unveil to their votaries innumerable beauties in nature.

6. *Very large estates* are commonly subdivided into farms, or portions, which are let off at certain rents to cultivators, with a view of producing income to the proprietor. In this case, he may either have a residence or demesne on the estate, or he may live elsewhere.

7. *The management of a farm*, which includes agriculture and all the arts connected with it, forms a subject of vast extent and importance, and will be best studied in works devoted to that object, such as "Loudon's Encyclopedia of Agriculture."

8. *The choice of a situation for a demesne* on a large estate must depend upon numerous local circumstances; for though it might appear that the centre of the estate holds out most advantages, yet these may be more than counterbalanced by others, depending upon soil, aspect, roads, picturesque appearance of the country, neighbourhood, &c.

9. *With respect to climate*, there can be no doubt that, upon the whole, a temperate climate is best; but the degree of temperature best suited to particular individuals must depend upon their constitution, feelings, and habits. Between the northern and southern parts of Britain, there is a considerable difference in the climate. The south coast of Britain is allowed to enjoy milder winters than any other part, and is therefore much resorted to by invalids, or those whose constitutions demand a mild air. On the contrary, some prefer a residence in a mountainous district, where the bracing atmosphere invigorates the system. Before determining on a particular part of the country to settle in, it would be well to visit it at various seasons of the year; for nothing can be more different than a mountainous region, a plain, and even the seacoast, at different seasons.

10. *The healthiness of the situation* is the most important consideration of all in fixing on a spot to reside in. This depends upon the air, dryness or dampness, soil and exposure, the vicinity of various objects, character of the surface, &c. Regard must likewise be had to the constitution of the occupier. In ancient times, the necessity of defence caused the dwellings of the wealthy to be strongholds built upon the tops of hills, where they were necessarily exposed to cold winds; and when, in peaceable times, this necessity no longer existed, it became the fashion to fly to the opposite extreme, and to build houses in the lowest situations, as being the most sheltered. But this gave rise to still greater inconvenience, that of confined and unhealthy air; and many old mansions may be seen placed in the bottoms of valleys. It is to be observed that, contrary to the opinion often expressed, the richness of the vegetation by no means proves the salubrity of the air in which it grows; for it is known that plants flourish luxuriantly in an atmosphere that would be dangerous, or even fatal to human life.

11. *A gently elevated situation* is generally the most healthy. When the surface of the ground is hilly, there is seldom a perfect calm for a long-continued time during bright

sunshine; for one side of the hills being warmed by the sun more tnan the other, a corresponding inequality is occasioned in the warmth of the air, and this gives rise to currents or breezes; whereas, in a dead flat, this effect does not exist, and there the most steady climate may be expected. Gentle breezes are extremely agreeable in close, sultry weather; but this frequent change from warm to cold is apt to prove injurious to those who have weak lungs: such persons also find a hilly situation inconvenient, as they suffer much from the fatigue of walking up the slopes. Although a level plain exhibits none of the picturesque and beautiful prospects that are seen from rising ground, and may be hot and sultry while a hilly situation enjoys a cooling breeze, yet, on the other hand, it is easiest laid out in walks, and is preferable for gardens and the cultivation of plants.

12. *Exposure and Aspect.*—These terms are employed, the first to express the comparative liability to be affected by certain winds, the latter by the sun's rays. A situation exposed to violent or cold winds from any cause is not desirable; and, in some cases, long observation is necessary to ascertain accurately to what winds particular localities are most exposed. In most places there are prevailing winds that blow more in one direction than in any other; and more particularly in elevated situations. A house is more exposed on the side of the rising ground towards the point from which such winds blow than on the opposite side. When there are many hills together, a prevailing wind may be so deflected that a house may be more affected when not quite facing it; notwithstanding, in some cases, as in the vicinity of large cities, the side most exposed to the prevailing winds will be best, because least liable to be annoyed by the smoke.

13. *The aspect* has much influence on the warmth and general comfort of a dwelling. A southerly aspect has the advantage of the sun's rays during the greater part of the day; an aspect to the north never has full sunshine, and is therefore cold and cheerless. An aspect to the east has the sun only in the morning; one to the west, only in the evening. With respect to the views from the house, with an aspect due south—the objects opposite are all in shade in the middle of the day, and the contrary is the case with one to the north; but in the morning and evening, in both cases, they are partly in light and partly in shade. Grounds sloping to the south are sooner dried by the sun after rain, and are less covered with snow than when they slope to the north; the advantage of a southerly slope is particularly observable in gardens, which produce earlier crops of vegetables, fruit, and flowers, than a northern one.

14. *The seaside* has been much resorted to of late on account of its benefit to health, not merely for sea-bathing, but for the air alone; and it is rather remarkable that its peculiar salubrity should not have been noticed formerly, for it is not, perhaps, above fifty or sixty years that the benefit of sea air has been particularly noticed.

15. *A situation near a lake or broad river* has some of the properties of one near the sea; it is cooler in summer and warmer in winter than an inland situation, because the water, being less warm there than the land, gives out less heat to the air in summer, and the water having lost the least heat in winter, cools the air least. The temperature of the atmosphere, therefore, in the vicinity of large masses of water, is more uniform than that over land. Currents of air or wind are likewise more easily created when water is near; because the land, being most heated by the sun's rays, occasions an ascent of the air in the daytime: hence the sea and land breezes of warm climates. The banks of a river are often preferred for the beauty of the prospects and the convenience of fishing, but they are unhealthy if there is any marsh land near, which gives rise to the ague and fevers, from the noxious effluvia, called malaria, generated by the decomposition of plants that grow in the water. A wide sluggish river like the Thames is apt to have mists and fogs on its surface. Sea marsh is the most unhealthy of all. Peat moss is entirely different from marsh, and is not unhealthy.

16. *The nature of the soil* is an object of great consideration in choosing a spot to build on. When gardens and pleasure-grounds are required, it is very desirable that the soil should be fertile; but when a garden alone is wanted, and particularly if on a small scale, the absence of a rich soil may not be a serious objection, since the soil can be improved by art. But in all cases a dry soil is essential; for though by artificial means the wet may be prevented from penetrating the walls of the house, yet the air in a damp situation is always loaded with moisture, which is not only disagreeable, but unhealthy. An eminence is generally dry, or, at least, it is usually capable of being rendered so by draining, which can scarcely be effected in a valley or very low situation. But a spot may be rather elevated, and yet neither be dry nor healthy; for there may be hills of greater height in the vicinity, or it may be backed or surrounded with thick woods, that render it liable to springs of water and stagnant air impregnated with noxious exhalations from decayed leaves. A strong clayey soil is retentive of surface water, and difficult to drain; hence it is unpleasant to walk upon after rain, and is easily broke up by horses and cattle; it is also the worst for gardens, for which the best is a loomy soil. A gravelly soil on an eminence is dry, but on a flat it is apt to generate damp in the lower parts of a house, because the water finds its way from all parts of the gravel into the hol-

low made by the foundation. The richest soil on an estate is not always the most suitable for the mansion, though the most valuable for agriculture.

17. *The subsoil* is sometimes of more importance than the soil; for though the latter may be improved, the former scarcely ever can. A bad subsoil is extremely injurious to the thriving of trees, which constitute one of the greatest ornaments of a country.

18. *Trees* near a mansion are agreeable, forming a pleasing composition with the architecture, affording shady walks in summer, and sheltering the house from high winds; but if near the house, and too tall or too close together, they obstruct the light, prevent the free circulation of air, and render the ground damp; also the decaying of the leaves in autumn, and the rank vegetation under them, sometimes give rise to unwholesome exhalations.

19. *In general, fine prospects from the house* are desirable; but tastes differ in this respect, some preferring that the place of residence should be rather secluded, and that the prospects should be at a little distance, to be reached by a short walk. It is agreeable if the views from the house have a kind of intricacy by which successive distances may be marked, and prevent any positive limit from appearing, the boundary of the property being surrounded by a haha instead of a wall.

20. *A good supply of water* is essential to the comfort of every residence, and should be one of the first things inquired about in choosing a spot to build on: the supply should not only be abundant, but the water should be of the best quality. The water of a river or stream is, in general, the softest, though sometimes that of wells or springs is equally so. If there is no water apparent, it will be proper to try by boring whether a well can be sunk with advantage; but on no account should any building operations for a dwelling-house be commenced until the existence of good water at the place be ascertained, or the means of transporting it from a convenient distance. Artesian wells may sometimes be formed. When no other supply can be obtained in a spot where it is resolved to build, recourse may be had to the rainwater collected on the roof, and conveyed, after having been filtered, to well-constructed tanks. It has been calculated by Waistell that the average quantity of water which falls on a square yard of surface in Britain, in a year, is 126 gallons; consequently 100 square yards of roof will give 12,600 gallons: this will serve to show what roofing will be required. For farther information on the subject, we refer the reader to Book viii., chap. 1, "On Water."

21. *The best situation for a mansion* is, in general, on the south side of a gentle eminence, as the soil is most likely to be dry, or capable of being rendered so by draining. This situation is also most likely to be free from noxious exhalations and mists, and to enjoy the full advantage of the sun's rays. We may observe that the above hints for assisting in the choice of a situation will apply equally in the case of a house already built as to that of selecting a spot to build upon.

CHAPTER II.

CLASSES OF DOMESTIC BUILDINGS.

THE subject of situation having been discussed, the attention will now be directed to the kind of domestic building required. In the following considerations we will suppose that a new house is to be erected, since it is evident that by this means alone all the varied wants of different individuals can be completely supplied.

22. *The kind of house* must evidently be determined by the rank and wealth of the person who is to occupy it, the extent and habits of the family, their tastes, and, indeed, all those circumstances in private life that are too well known to be enumerated.

Domestic residences in this country vary in size and style by an infinity of shades; but in ordinary estimation they are divisible into several classes: as the palace—the extensive town and country mansions of any of the royal family, or of noblemen—the town house or villa of the wealthy commoner—the residences of an almost infinite variety of the middle classes—the house of the tradesman and mechanic—the cottage of the labourer. No rule can be laid down by which these different classes of dwellings can be accurately separated and defined; yet there is, and ought to be, a general feeling of propriety as to the character which each should possess.

23. *The Legislature, by the "Building Act,"* has divided all buildings in London and Westminster, and places within the bills of mortality, into several rates or classes, for the purpose of subjecting them to various regulations, partly for strength, and partly for security and the prevention of fires, and in part to improve the ventilation. Many of the regulations will be mentioned when we treat of "Construction."*

* [In America, the individual taste of our citizens is not restricted or interfered with by any "Building Act," although municipal regulations in many of our cities require a conformity to certain rules in the material and strength of walls having reference to the common safety, and especially to guard against the occurrence of fires.]

CHAPTER III.

ON THE VARIOUS STYLES OF ARCHITECTURE EMPLOYED IN DOMESTIC EDIFICES IN GREAT BRITAIN.

Introduction.—Having resolved on building, there still may be some difficulty in fixing on the style of architecture. In some countries custom and fashion are so dominant that one style is universal; and then there is no embarrassment, except as to size, and the arrangement of particular details. So it was in England a few centuries back; but in the present day we can scarcely be said to have a prevailing, certainly not a national style. The styles of architecture of various countries have been imported, and forms long since obsolete have been revived. Thus we have the Grecian, the Græco-Roman, the Norman, the Gothic, the so-called Elizabethan, &c.; and of these several modifications. Those who have studied antiquities and architecture may have some predilection in favour of one of these styles, or their architect may; and then it may be easily decided which is to be adopted. But when this is not the case, it becomes a grave, and not always an easily solved question, "In what style shall the new house be built?" Architecture not being a subject very generally understood, some remarks upon it may be proper before we proceed; sufficient, at least, to direct attention to the chief distinctive points that characterize the several styles.

24. *Architecture, considered as a subject of taste*, demands, like many other subjects, a peculiar study of its principles. Taste is always the result of actual knowledge and experience added to sound judgment, and is not an intuitive faculty. Some, no doubt, have minds so organized, as to perceive more readily than others the relations of various ideas and feelings, and so far appear to have naturally more taste. But architecture requires a great variety of acquired knowledge to estimate it truly; even an acquaintance with its history is essential towards forming a good architectural critic. In painting and sculpture there is nature to refer to, of which all men are more or less judges, but in architecture, though its forms may at first have been in a great measure imitative, yet the original prototypes enter but in a small degree into the whole subject in the present state of the art, which is founded more upon utility and customs arising out of our wants. The genuine beauty and merit of architecture, indeed, consists mostly in fitness and adaptation to a purpose; and when this principle is lost sight of, as is too often the case, nothing can be more unmeaning, and even ridiculous, than descriptions of its imaginary or supposed character and excellences. No art requires more than architecture the curb of philosophic inquiry into its principles. If permitted to run wild under the influence of certain feelings produced by the imagination, it loses its true dignity, and degenerates into affectation.

25. *Notwithstanding, however, that the chief merit of architecture consists in its application to useful purposes*, yet it is universally admitted that it is capable, like other branches of fine art, of producing pleasurable ideas, and of displaying the progress and refinements of society. Indeed, so important is it in this point of view, that the very character of a nation depends, in no small degree, upon the style of its buildings, both public and private. But if the general diffusion of a taste for ornamental architecture be desirable, the introduction of a spurious taste is to be guarded against. Bad taste, like bad habits, is difficult to eradicate; and some persons become, after a time, wedded to their opinions or feelings, which they persevere in with an obstinacy often great in proportion to the degree in which they are erroneous. It is likewise unfortunate for this art, that its errors cannot be rectified so easily as some others. An absurd fashion in dress may be changed in a season, but a house erected in bad taste remains for many years a monument of the want of judgment in the architect, and, perhaps, in the possessor.

We have stated that, in order to understand the various styles of architecture, some acquaintance with its history is essential. In the following slight sketch we shall confine ourselves to domestic buildings.

SKETCH OF THE HISTORY OF STYLE IN DOMESTIC ARCHITECTURE.

26. Our knowledge is extremely limited respecting the private dwellings of the various nations of antiquity. We have, indeed, the descriptions of a few in classical writings, and there are some actual remains in Pompeii; but though from the latter we may derive much information as to the distribution of the apartments and their manner of decoration, yet they are in too ruined a state to exhibit completely the designs of the interior of the houses. Notwithstanding the taste exhibited in many parts of these antique domestic dwellings, yet they were very deficient in many circumstances which afford so much comfort in modern times, particularly in their want of glass windows, and the various modes of producing artificial warmth which renders our houses so agreeable in all weath-

ers. It does not appear that it was the custom among the ancients, until a late period, to effect in the exterior of their ordinary domestic dwellings any approach towards the magnificent style of their public edifices; and we may, perhaps, consider this as a proof of their judgment, since it preserved the great distinction of character, which ought to form one of the elements of architectural design. For the Temple was reserved the lofty and conspicuous portico, with its pediment filled with rich sculpture; and on the Forum and other national edifices were lavished those examples of superbly decorative architecture, whose fragments, having survived the wreck of ages, still excite our admiration. But the habitations of individuals were at first, in all probability, but sparingly so ornamented, and were chiefly remarkable for their interior arrangements. The same thing may be observed in those parts of the world where the style of domestic architecture is still influenced by the habits of the classical period. Wealth, and its attendant luxury, at length produced ostentation, and with it bad taste.*

27. *It is remarkable, that at an early period in the history of Greece,* architecture as well as sculpture had arrived at the highest degree of perfection; and the exquisite taste exhibited in what remains to us of their edifices excites our utmost admiration. But these remains consist chiefly of temples, which, though individually different, have a great similarity of character; and there is little to guide us in forming ideas of the style adopted in other buildings. The columns, with their entablatures, that always surrounded their temples, gave them their chief character; and these are distinguished into various kinds, which are now termed the "orders" of Grecian architecture. Three orders are properly Greek—the Doric, Ionic, and Corinthian, named from the several places where they were invented, or chiefly employed. We have perfect examples of them still remaining in antique buildings.

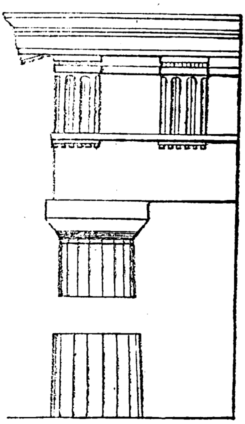


Fig. 1.

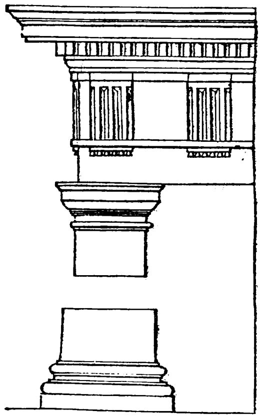


Fig. 2.

Fig. 1 is a part of the shaft of a *Greek Doric* column, with its entablature, such as it is seen in the Parthenon at Athens: it is distinguished by the peculiar flutings on the column, and the want of a base to the shaft. A good example may be seen in the portico of the Colisseum, Regent's Park, London.

Fig. 2 is an example of the Doric order as altered by the Romans, and such as had been used by the architects of the Cinque Cento period; it is still employed under the name of the *Roman Doric.*

Fig. 3 is an example of the *Greek Ionic,* from the "Antiquities of Ionia;" it is remarkable for the beauty of the large volutes in the capital.

Fig. 4 is *the Ionic order as executed by the Romans,* and as used by the moderns previous to their knowledge of the Greek Ionic. The capitals have smaller volutes.

Fig. 5 is the *Greek Corinthian* order, as it is seen in the Choragic monument at Athens.

Fig. 6 is the *Corinthian order as executed by the Romans,* and as it is generally adopted by the moderns. The capitals are decorated with the sculptured leaves of the acanthus.

Two other orders have been added, but these are not Greek.

Of the *Tuscan order* we have no antique example; and what has been given by modern writers and architects (*fig.* 7) is founded merely upon the description of Vitruvius. The other, called the *Composite* (*fig.* 8), is altogether a Roman invention, formed by placing the Ionic volutes on the leaves of the Corinthian capital.

* Vitruvius, an architect probably of the Augustan age, has described the interior arrangement of Roman dwellings; and to his work, and those of his commentators, we refer the reader who is desirous of inquiring into the subject. But information may be more easily obtained from "Gell's Pompeii," the "Library of Entertaining Knowledge," and other modern works.

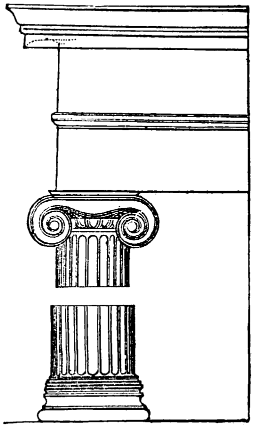


Fig. 3.

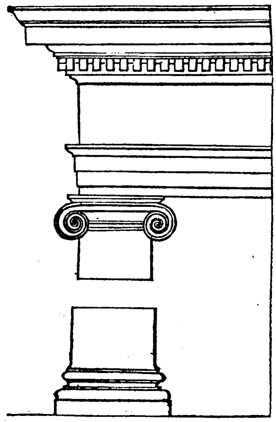


Fig. 4.

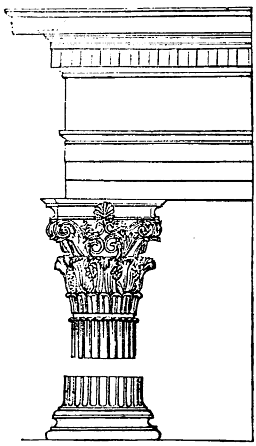


Fig. 5.

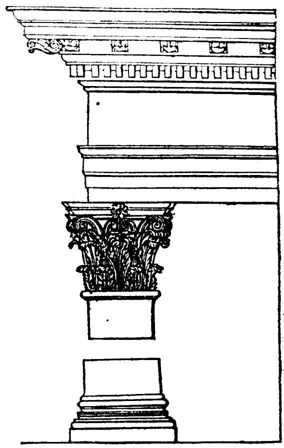


Fig. 6.

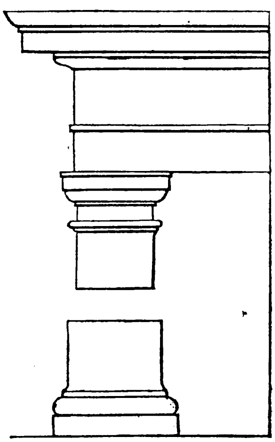


Fig. 7.

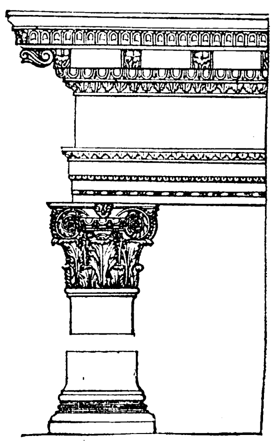


Fig. 8.

Fig. 9 is the front of a Greek temple, which has served as the prototype to so many modern porticoes.

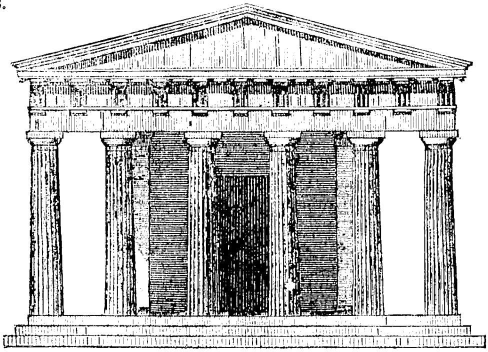


Fig. 9.

28. *What was the earliest style of architecture employed in Rome* is not known; but it appears that on their conquest of Greece the Romans borrowed from that country much of the style of architectural decoration; they did not, however, copy the Greek manner entirely, but altered it, probably to adapt it to their own taste, and for other reasons with which we are not well acquainted. Suffice it here to notice, that the style observed in the ruins of antique Roman buildings is very different from what is to be seen in the ancient remains of Greece, as may be observed in the examples we have given above.

29. *On the revival of the arts*, the Italian architects borrowed from the antiquities of Italy, and not from those of Greece; and as it was known that the Romans were indebted to Grecian art in a great measure, it was supposed that the styles of architecture in Greece and Italy were not materially different; the whole, therefore, passed under the name of Grecian architecture. The visit, however, that was paid to Greece by Messrs. Stuart and Revett, disclosed to us the actual style of the Greeks, and proved that it was very distinct from the Roman style. The accurate and beautiful publication of the "Antiquities of Athens," by Stuart, put architects in possession of the true Greek style; and after some contest as to its superiority, long-rooted prejudices being difficult to eradicate, it came into fashion here as well as the Roman. It does appear, however, that each of these varieties of style possesses a peculiar merit; hence they are both preserved, and we have now a Greek and a Roman architecture; but the difference is observable rather in the detail than in the general appearance, as may be observed in the above wood-cuts. One difference we may also notice. It is a remarkable fact that the ancient Greeks do not appear to have been acquainted with the use of the arch; at least no authenticated antique example proves that they were; nor does it seem clear by whom this very useful kind of construction was discovered. But it appears to have been practised by the Romans in the time of their kings, the great sewer of Rome, the Cloaca Maxima, still remaining entire, being supposed to have been executed under Tarquinius Superbus. Roman architecture is characterized by the frequent use of arches, vaults, and domes, in addition to their employment of columns and other parts, which form a vast source of variety and interest. *Fig.* 10 is an example of a mode of employing the arch in a composition by Bramante: the manner is Roman.

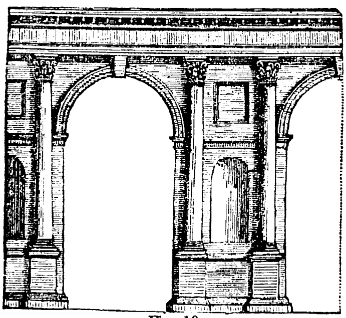


Fig. 10.

30. *The few remains of ancient Roman villas in Britain* prove that the antique style was introduced here; but it was annihilated, and probably forgotten, during the subsequent inundations of Saxons and Danes, of whose domestic buildings we possess scarcely any knowledge. The ecclesiastical architecture formerly termed Saxon, and now early Norman, distinguished, among other things, by its peculiar clumsy column, circular arch, and zigzag ornaments (*fig.* 11) observable in many of our

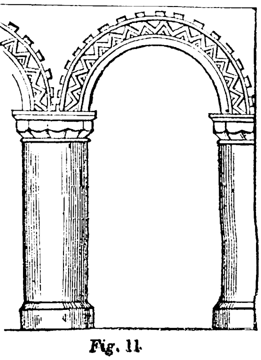


Fig. 11.

oldest churches, may evidently be traced to a barbarous imitation of the latest Roman style. It appears also in some of our earliest castles; but probably was not employed in the inferior domestic dwellings of the Norman period, which, for a long time, were entirely of wood, and, consequently, have disappeared. Nor does this style appear to have sufficient attraction to be imitated in our modern houses, and therefore we need not dwell upon it.

31. *The slender column and pointed arch* (*fig.* 12) *are the distinguishing characteristics of what has long been termed Gothic architecture;* a designation which, whether strictly proper or not, we shall not attempt to set aside for any of those which have been invented to supersede it. The origin of the pointed arch is still involved in obscurity. It appeared all over Europe nearly about, or soon after, the period of the Norman conquest, as may be traced in the numerous ecclesiastical and other buildings both in England and on the Continent, and arrived, in a progressive manner, to a wonderful perfection. Though it possesses merit of a very high degree, yet its character is so very distinct from the Greek and Roman style, that it is difficult, and perhaps useless here, to institute a comparison between them; while, at the same time, we must observe that this would require numerous graphic illustrations, and entering into numerous details inconsistent with the plan of this work. Farther information must therefore be sought for in works devoted expressly to this subject: for actual examples, the reader has only to look at the cathedrals and churches in most of our principal towns. Gothic architecture, in its various stages, prevailed all over the island for several centuries, from the time of Henry I. to that of Henry VIII. Its admirable adaptation to ecclesiastical purposes is generally acknowledged, which may be seen in our ancient ecclesiastical buildings, and the remains of monastic edifices. The houses of private individuals during that period were chiefly of timber, and were ornamented occasionally with parts in the same taste.

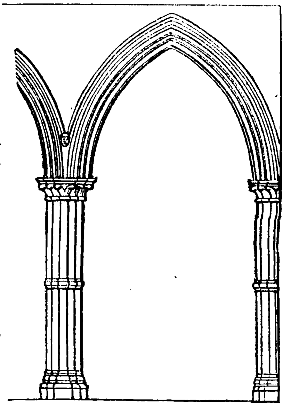


Fig. 12.

32. *In the reign of Henry VII. a considerable change took place* in the style of English Gothic architecture. The arches, which always before that time had been more or less high-pointed, as at *fig.* 12, were lowered, and formed by uniting portions of circles of different sizes, as *fig.* 13. The windows of private houses were generally made rectangular, though divided by mullions, each bay being sometimes filled up with a low-pointed arch. Extremely ornamental chimney-tops were also displayed, giving altogether a peculiar character. Independently of the ecclesiastical architecture in this style—such as King's College Chapel in Cambridge, St. George's Chapel at Windsor, Henry VII.'s Chapel in Westminster, &c.—there are still remaining many perfect examples of domestic architecture, chiefly manor houses, of the times of Henry VII. and Henry VIII., and some so late as that of Queen Elizabeth. It has received by modern architects the title of the *Tudor style*, from the royal families during whose reigns it was general. See *fig.* 21.

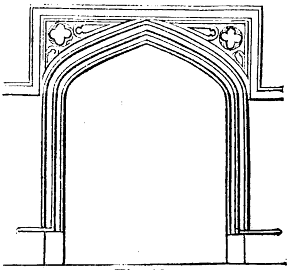


Fig. 13.

33. *In Italy*, where there were still remaining so many antique buildings while it was in the possession of the Goths and Lombards, the Roman architecture, which had fallen into a debased state on the decline of the empire, was imitated in a rude manner during the Middle Ages; and the buildings erected during that period, a few of which are still to be seen, belong to what is known as the Lombard style. Afterward appeared a mixture of this barbarous architecture with Gothic pointed arches. In the same building, and even in the same front, portions in both styles are seen in sad confusion mixed with conceits of a puerile kind; an example of which occurs in the church of San Antonio at Padua, begun by Nichola Pisano in 1231.

A reformation in architecture was begun early in the fifteenth century by Brunelleschi, a Florentine architect, and was followed up by Alberti, Bramante, Vignola, Serlio, and others; but their style of design was far from being free from the faults of the former period. Indeed, in this old Italian school were produced numerous absurdities, which, to the present day, have not wholly disappeared; and by the revivers of Roman architecture the beautiful character of the antique was never well understood. One of their great errors was the endeavour to reduce the parts of what are termed the orders of architecture to positive rules in their proportions; thus subjecting the art to trammels that have proved inconvenient, and which, indeed, tended in time to reduce architectural design almost to a mechanical trade, contrary, as would appear from antique remains, to the practice of the ancients, although, in some degree, sanctioned by the writings of Vitruvius.

A taste for good sculpture long survived the decline of general architectural design in Italy, and hence were retained, in the architecture of that country, many ornaments and parts of beautiful form and execution, with much of the spirit of the antique. But these cannot preserve the buildings to which they are attached from the severe censure of the architectural critic; and the *Cinque Cento*, or Italian style of the fifteenth century, though possessed of many excellences, is not deserving of being perpetuated as a whole. But, notwithstanding this general censure, which applies more particularly to churches and other ecclesiastical buildings, it must be admitted that in the Cinque Cento style of architecture there are innumerable beauties as well as absurdities, and abundant proofs of genius in the architects of that period displayed in their fertility of invention. The modern architect will find in the buildings of Italy an inexhaustible field for study, and, perhaps, a cure for that monotony and insipidity now so prevalent among us, provided he has sufficient knowledge of fine art to select what is good, without copying the whole. In particular, many of the palaces of Rome, Florence, and other Italian cities have been generally admired by the best judges for their simplicity and grandeur of design in the exterior, as well as for the picturesque effects produced in the interiors. As specimens of fronts of these, we present the Farnese Palace in Rome, by San Gallo (*fig.* 14), and

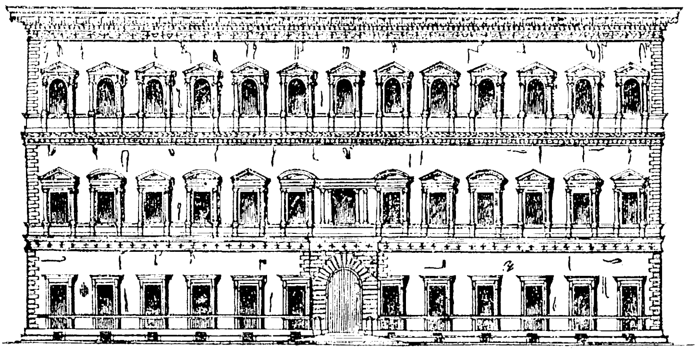


Fig. 14.

the Pandolfini Palace at Florence (*fig.* 15). The Venetian territories have been enriched

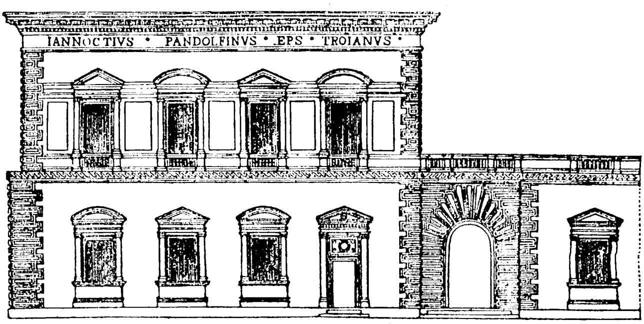


Fig. 15.

by numerous palaces and villas designed by Palladio; one of which, the celebrated Villa Capra, is represented in *fig.* 16. In the Italian villas may be seen beautiful examples of the truest taste in the combination of architecture with garden and picturesque scenery.

34. *Several circumstances conduced to produce an entire change in the architecture of this country* during the latter end of the Tudor period. Classical literature began to be more attended to, which, with the reform in religion, gave rise to new ideas, and the fine arts received a greater degree of attention. The style of architecture then prevailing in Italy was first imported partially into this kingdom in the latter part of the reign of Henry VIII., and appeared here occasionally as an incongruous mixture of the antique Roman style debased with many details, which, though not strictly Gothic, were evidently of Gothic origin. Many considerable mansions were executed in this manner during the

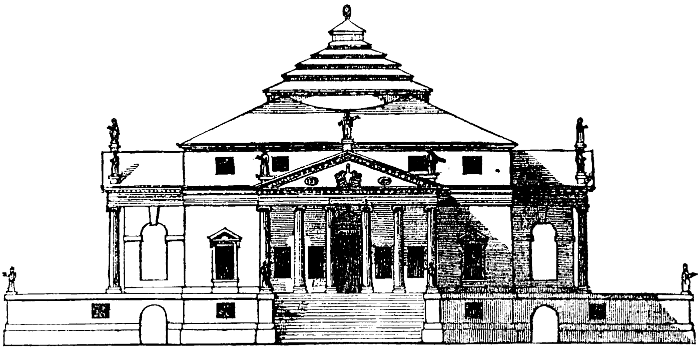


Fig. 16.

succeeding reigns, including that of Elizabeth, some of which yet remain tolerably perfect, and have acquired for the style itself, among English architects, the appellation of "Elizabethan," although it is evidently of foreign extraction. Good examples of it may be seen in the recent publications by Shaw, Nash, and others. *Fig.* 17 is a doorway in that style.

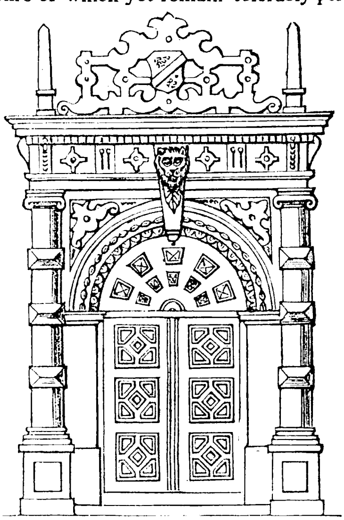


Fig. 17.

A kind of architecture so radically defective, notwithstanding a certain degree of merit which is allowed to it, could not long resist the effect of studying with diligence the remains of classical art in Italy; and from that country better ideas of antique Roman architecture were brought to this country by Inigo Jones, who imitated the manner of Palladio with success. With him commenced, in England, what is termed the Grecian (more properly Roman) style, but in which many of the errors of the *Cinque Cento* were long retained.

In the banqueting house of the Palace of Whitehall we see one of the best examples of the architecture of Inigo Jones. This architect was followed by Sir Christopher Wren and a host of others, as Hawksmoor, Vanburgh, Gibbs, &c., each of whom designed in the same general style, though with certain modifications of his own. At a late period improvements were introduced by Sir William Chambers (the architect of Somerset House), Wyatt, Soane, and those now living; but to describe these would be to write the detailed history of modern architecture. Suffice it to remark, that by far the greater number of large mansions erected in this kingdom for the last century and a half are in the style which we have just mentioned, of which *figs.* 18, 19, 20, are specimens. But this style of building,

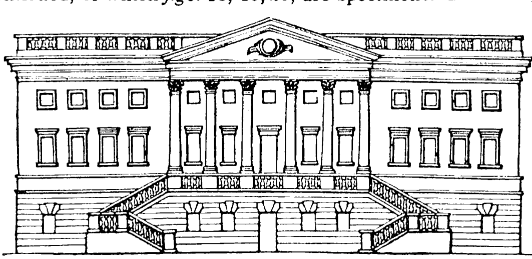


Fig. 18.

though termed in general Grecian, was, in fact, rather Roman; the difference, however, cannot be easily understood except by those who have learned the elementary part of the science. The whole is therefore still commonly designated as Grecian architecture.

35. *Later architects, enlightened by a more careful study of antique remains,* had, in general, given up most of the absurdities of the Italian *Cinque Cento* school, preserving what

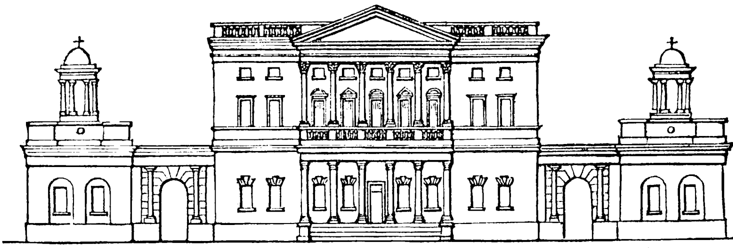


Fig. 19.

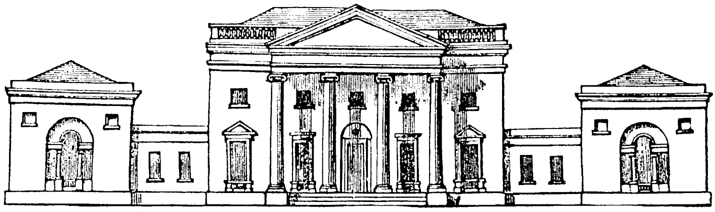


Fig. 20.

was most pure; and by their acquiring the knowledge of antique remains still to be seen in Greece, Sicily, and Asia Minor, architecture has been gradually improving.

OBSERVATIONS ON THE CHARACTERS AND PROPERTIES OF THE VARIOUS STYLES OF ARCHITECTURE, AS FAR AS THESE ARE APPLICABLE TO DOMESTIC PURPOSES.

36. It is generally allowed that the Greeks and Romans carried architecture to the highest degree of perfection; but it is unfortunate that, though we possess many remains of their public buildings, yet few traces of their domestic edifices exist. In reviving their style, therefore, after the long period known as the "dark ages," and applying it to domestic use, their public, and not their private buildings, necessarily became the prototypes; and certain parts and ornaments, which were, in all probability, limited by the ancients to religious and sacred structures, were employed by the moderns in the decoration of town mansions and villas; although there is great reason for supposing, as we have already observed, that the style and character of the private dwellings among the classical nations differed essentially from those of their public buildings.

37. *It must be admitted as a principle of sound taste* that every building should have a form and character suited to, and expressive of, its use and destination. But this rule does not appear by many of our modern architects to be very essential; for the same kind of portico that was employed by the ancients in their most magnificent temples, the same pediment and dome, are frequently made to form prominent features in a mansion, notwithstanding their unfitness for such a purpose. In some cases even the sculls, pateræ, and sacrificial instruments, have been sculptured upon the fronts of private houses, in defiance of all historical association; and it is unfortunate for the art that great absurdities have become so common, and the public is so familiarized with them, that it would require no little courage to point them out as errors. Some have no other idea of Grecian or Roman architecture than the modern mansions of England a century ago, as represented in *figs.* 18 and 19, or the still more recent ones of Portland Place and the Regent's Park; but we wish to state, that these were merely the attempts to adapt some portion of this style to modern English habits and customs—attempts often very unsuccessful, and sometimes grossly erroneous, or even puerile. Grecian architecture, in which we may, according to custom, include Roman, as having been in some degree borrowed from it, was eminently beautiful in the hands of the ancients; and instead of the monotony and sameness which are justly complained of in its modern dress, among them possessed considerable variety.

38. *What is termed modern Grecian architecture,* though not strictly Greek, is admirably suited to our present domestic habits, and is considered, by the greater number of well-educated architects and amateurs, as excelling every other style in the most important points; it is likewise more easily connected with the arts of painting and sculpture than any other. But it can be treated with great success only by the skilful and even learned artist, by whom the very perfection of antique architecture, and the paucity of standard examples, are felt as a source of difficulty that may cause many to shrink from it, while they fearlessly attempt the Elizabethan style, in which a certain coarseness of idea may pass. But the frequent failure of those who attempt to design in the classic manner is

no proof of its inferiority; and were this the place to point them out, it would not be difficult to mention several of the causes of frequent failure.

39. *Gothic architecture*, in its various stages, has for some time been a rival to Grecian, even for domestic purposes. Observing how admirably it is adapted to ecclesiastical edifices, it has been supposed that it must be equally well suited for mansions to dwell in. But this, according to the principle we have laid down, respecting the form and character agreeing with the destination, does not necessarily follow. Accordingly, there are a great many difficulties in adapting this style to ordinary dwelling-houses under our present circumstances. It is but of late that it has been so well studied that a marked difference has been perceived between the style employed formerly in buildings for ecclesiastical and for domestic purposes; indeed, there are few remains of the latter, except what belong to monastic, collegiate, or military structures; the private houses of our ancestors, even as low down as the reign of Queen Elizabeth, being chiefly wood and plaster; and the ancient timber houses, with their carved gables, high and often thatched roofs, casements, &c., though much admired as picturesque by some persons, have been imitated chiefly in small houses affectedly styled "cottages." It became, therefore, requisite, in designing a large modern house in the Gothic style, to look to more considerable examples. Some borrowed their ideas from ancient ecclesiastical architecture; and among the first attempts the parts were taken from churches, and even cathedrals; pinnacles, buttresses, ornamented battlements, pointed windows with stained glass, &c., were the sort of decorations that, it was imagined, would mark a Gothic mansion. It was soon found, however, that what was beautiful on a great scale, became only ridiculous when imitated in miniature; and when the architecture of our ancestors was studied with more care, it was likewise discovered that a profound knowledge of it was necessary, and even that it was essential that architects should be acquainted, not only with the difference between ecclesiastical and civil architecture, but with the styles of different periods; that, in short, they should be antiquaries as well as architects. It may not be necessary here to examine what association of ideas has originated the wish in some persons to inhabit a "castle" or an "abbey;" but certain it is that such imitations have seldom succeeded, and are not to be recommended in modern domestic dwellings. The situation best suited for a castle is seldom so for a domestic residence; nor is the low site, which will do well for an ordinary dwelling, characteristic of a place for defence; while most of those characters which render such remains of antiquity interesting are not attainable in a private house. The imitation of an abbey has not been more fortunate; and although the monastic character may appear more easy to preserve, still there are numerous circumstances that render the style of religious buildings, however excellent in the originals, unfit to be imitated in modern houses. The rich and florid style of ornament, so much admired in ancient Gothic edifices of the latest period, is generally too expensive for private individuals; and a plain Gothic style demands a certain magnitude to give it importance. Even when the rich kind of Gothic architecture is well understood, it is found extremely difficult, and almost impracticable, to preserve its true character in a modern house, except by a considerable sacrifice of simplicity in the interior distribution, and the introduction of much that adds nothing to convenience or use, but often materially interferes with them, besides causing much expenditure. If pointed arches are employed in the apertures, they create considerable embarrassment in the finishing of the interior; and even if the windows are rectangular, which they may be consistently with the style, yet these can scarcely admit of all the modern improvements in glass without destroying the ancient character which is wished to be kept up. If the house is to be Gothic, the furniture, or great part of it, should be in the same style, and generally must be made expressly for the place; hence another considerable source of useless expense, added to the giving up numerous modern improvements in so important a point of comfort. To this it may be added, that the designing all the details throughout of a Gothic mansion ought to be intrusted only to architects who have made this style their particular study, otherwise the incongruities produced may be numerous. But, notwithstanding what we have said, we are free to admit that, under the most favourable circumstances, Gothic architecture has a charm quite its own, but which it depends upon the architect to develop. Where expense is not an object of consideration, and where certain associations of ideas give rise to its preference, it is far from being impossible for the skilful artist to unite much domestic convenience with agreeable and tasteful forms. Our arguments militate against its general, rather than its occasional introduction; but we consider it as a "sine qua non," that if the style is to be Gothic, it should be so strictly, otherwise disgust and ridicule may be the result, which may be illustrated by the effect produced when ignorant persons attempt to imitate ancient costume.

40. *The Tudor Style.*—It has been often regretted that we have not among us a style of architecture that might be considered as peculiarly national. The high-pointed Gothic is common to Central Europe, and no country can claim it generally as its own. Although scarcely any remains exist of private domestic architecture of this style prior to the reign of Henry VIII., yet we have, as before mentioned, many manorial residences still

tolerably perfect, and other examples of civil architecture of the time of the royal race of the Tudors. Although some peculiarities may be perceived in the Gothic of each country, this is, perhaps, more strikingly the case with respect to what has been termed Tudor architecture, which is, upon the whole, much better suited for domestic buildings than the high-pointed and earlier Gothic; and for those whose associations of ideas incline them to wish for a style that may be considered as purely English, perhaps this has higher claims than any other, for it does not appear that it has been observed in other countries precisely the same as with us. But we must confess that our own taste does not lead us to recommend it, either as peculiarly beautiful, or as being well adapted to convenience and comfort; in short, as having all those qualities of the first importance which we should desire in a private residence; and we think that the loss of, or any great deficiency in these, is too great a sacrifice in favour of any associations, or the mere revival of a style not in itself of a superior kind. But as this is only individual opinion, we, of course, leave every one to adopt or reject it; and we must likewise state that our objections are limited to erecting an entirely new house in that style, for in the case of repairs of, or additions to, old mansions of Tudor times, the style should be strictly preserved; admitting, at the same time, that there are certain parts, as the oriel windows, which have great merit in every respect.

Fig. 21 represents part of a mansion in the Tudor style, from an excellent work on the subject, "Hunt's Tudor Architecture."

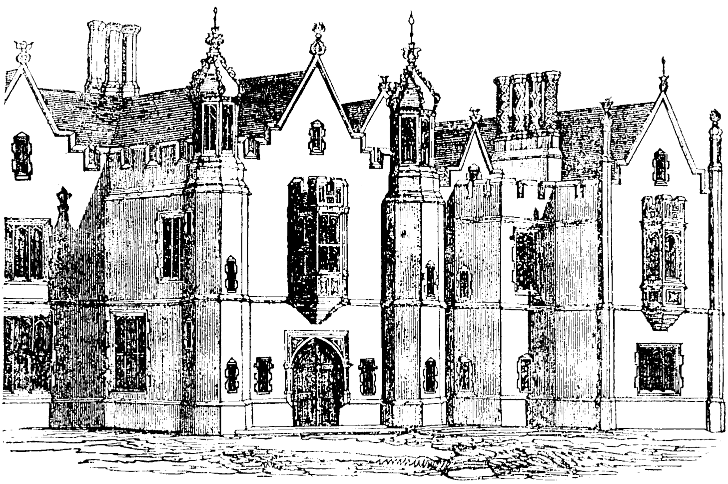


Fig. 21.

41. *Elizabethan Architecture.*—When we consider what was the origin of the style of architecture which has received this appellation, and examine several mansions that still exist in this country, which have had full justice done to them in late publications, it is difficult to imagine what could have given rise to opinions in its favour so strongly expressed of late. It is quite evident that it was, in great part, imported from Italy, and that, by the artists from thence, some of the monstrous absurdities of the Cinque Cento have been united to a few features of the early Tudor architecture. No doubt can exist of its partial Italian origin, even had we no historical evidence, when we compare the various grotesque carvings and other ornaments, and perceive their exact correspondence with what were common in Italy at that time, where, as we have stated, good architectural sculpture survived general design. The great beauty of some of the parts in the oldest Cinque Cento architecture is obvious, having been borrowed by the Italians from the antique, though in a great measure disguised by ridiculous conceits. With these are mingled an infinity of faults arising from imagination run wild, and a misconception of Greek and Roman feeling, though they were sanctioned by many celebrated artists of the Italian school. It is impossible to look over a few considerable mansions raised here in the time of Queen Elizabeth, and the two succeeding reigns, without recognising numerous absurdities in the details, notwithstanding we may feel the conviction that even these must have come from the hands of skilful designers, such as this country could not boast of possessing at that time among its natives; a truth, however, which perhaps can only be felt by those who are familiar with the details of antique and modern architecture.

Fig. 22, the front of Wollaton Hall, is a characteristic specimen of what is termed the Elizabethan style. This style, which begins to be considered as an "old English" manner,

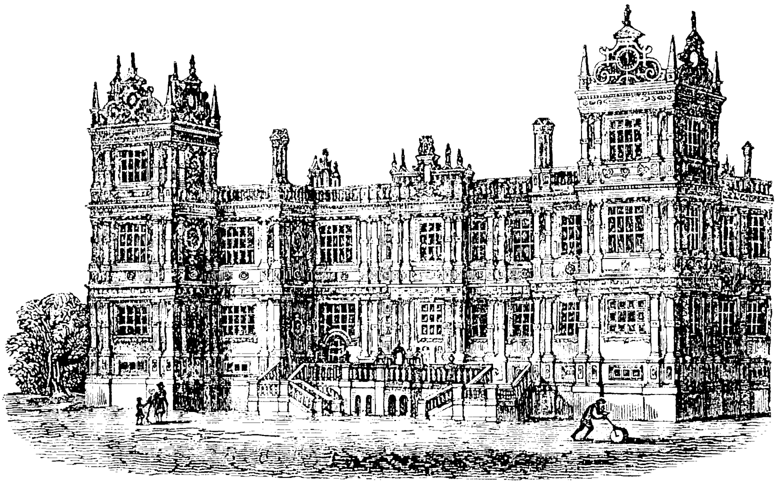


Fig. 22.

has excited much interest of late, and has frequently been employed in the erection of country seats. In the present day, a strong feeling seems to exist of respect for what is merely ancient; and some who are enthusiastic add, likewise, a fancied perception of beauty in a style which to others exhibits much deformity. There is frequently no arguing where tastes differ materially, and where they depend chiefly upon feeling. One advantage which has been derived from the present rage (shall we call it?) for the Gothic and Elizabethan styles is, that both have been studied, and are much better understood than formerly; and this, we must admit, is a certain step in the progress of architectural science. Besides, we are willing to grant that Elizabethan architecture has some legitimate claims to attention. It has a certain interest from associations; it has likewise some intrinsic merit, and possesses some good points. It can be more easily adapted to our present habits than Gothic; and we have some examples tolerably perfect in mansions of our ancestors, which may be sufficient to enable us to revive the style, should it be deserving of revival. Hence, those who are solicitous to avoid what may be termed antiquarian errors in design may possess in these models for imitation, parts of which are by no means devoid of merit. Although the grotesque ornaments with which the Elizabethan style is usually accompanied cannot be reckoned very fine, they are at least curious and amusing, and are calculated to display some taste, though not of a highly refined nature. Many of the forms are not a little uncouth; yet there is in the whole an air of richness and costliness, and the spectator is often so captivated with the general magnificence, as to be little disposed to criticise the individual parts. Considering its history and origin, and that it was the produce of a period when the arts were at a low ebb, it would be in vain to look for more. It harmonizes with the costume of the period when it took its rise.

42. *Doubtless, if any one acknowledged style is to be aimed at*, it will be a particular merit in the designer to exhibit a technical acquaintance with it, and to give its true character; but it may be a question whether it be necessary, at the present day, that our domestic architecture should be strictly either Grecian, Gothic, or Elizabethan. Should this question be resolved in the affirmative, the business of the architect will be brought within certain limits; he would then be, in a great measure, confined to the study of the models before him, and his powers of invention less called upon. In comparing the various styles, and in endeavouring to fix their comparative values from designs, it should be kept in mind as a well-known fact, that an artist of skill, possessed of the principles of composition, may make excellent designs in any given style; and therefore his success will be no proof of the merit of a style, which may appear better or worse according to the talent of the designer. Much will depend likewise upon the particular bias of the architect: one may have studied Gothic architecture much, but may have paid less attention to any other; he will, of course, be most likely to succeed in what he is best acquainted with. Those architects who first introduced Grecian architecture into this country, as Inigo Jones and Sir Christopher Wren, though men of great talent, have left us only miserable attempts at Gothic, which they had not studied sufficiently; and we find, on looking over the compositions of living artists, a great inequality in the merit of their designs, according to the particular bent of their studies. It is therefore easy to see how we may be misled by confining ourselves to particular examples, and

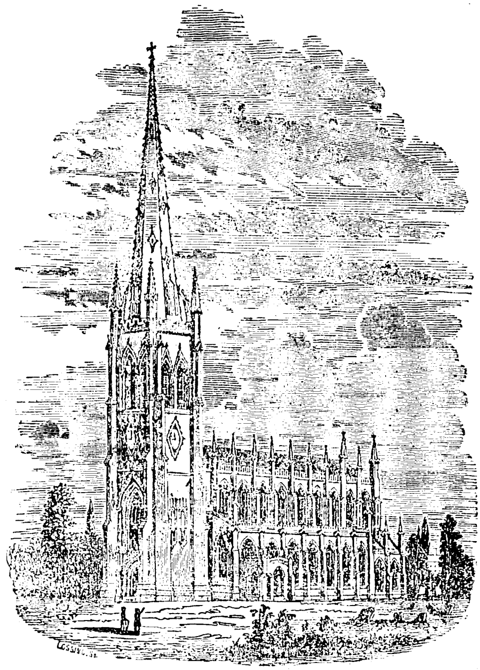
how necessary it is to take into our consideration an almost infinite variety of circumstances in criticising architecture.

43. *It must be obvious, from what we have already stated, that we are not inclined to give our full approbation to either the Gothic or Elizabethan styles of architecture for general adoption*, notwithstanding the argument of their nationality; nor do we see any good reason why a modern house should look as if it had been erected centuries ago, and why it should not rather exhibit the result of every recent discovery and improvement in the arts of building and domestic economy; nor why any of these should be sacrificed to feelings merely of association. Why should we look backward, instead of forward, in the history of society, and content ourselves with copying or reviving obsolete forms which have no particular merit, instead of exercising invention in producing something of greater excellence? In fine, why should architecture be so fettered, any more than other branches of the fine arts? In painting, the artist of the present day is not the most esteemed who can produce only a good imitation of a Poussin, a Claude, a Cuyp, or a Berghem. So far has the art of landscape advanced, that though the artist has availed himself of the works of these masters, he must likewise give proofs of his deep study of nature, the source of their excellence, and combine this with original thinking. Indeed, so far must he be from appearing a servile copyist of any one's manner, that he will be the less thought of should he strongly remind us of his predecessors. It is very true, that originality in architecture is far more difficult than in any other branch of the fine arts; because, as we have already observed, in the latter there is the wide range of nature to refer to. But would it not be possible for the architect to employ the works of his predecessors in the same way that landscape painters have done? selecting whatever is excellent, but also combining this with his own inventions, suggested, in a great measure, by the ever-varying habits of society, in so skilful a manner that his compositions may appear so far original as to render it impossible to discover whence they were derived.

44. *In the mean time, there is a style admirably suited for the villa*, both from its picturesque effect, and from the facility with which it might be adapted to domestic purposes. This style is known among architects under the designation of the *Irregular Italian*, and of which a tolerable idea may be formed from examples to be seen in the buildings introduced with the landscapes of the Italian school, as Claude, Poussin, &c. It was founded upon the villas of Italy of a few centuries back, which were composed from partial antique remains in the Roman character, with additions in a style somewhat different, and derived, in some cases, from the castellated manner which had become necessary for defence, together with forms suggested by climate, the whole being highly picturesque; a quality, however, derived more from accident than from any studied intention as to effect. In proof of its picturesque beauty, it is sufficient to observe, that it is always to this day chosen by landscape painters of the highest class in their principal compositions. We do not mean to say that perfect examples of this style can be pointed out fit for actual imitation, but enough has been done to suggest ideas to a skilful designer.

Regularity in the exterior, though essential in public buildings, does not appear to be equally desirable in a villa; on the contrary, the picturesque, as well as utility and convenience, demand more variety. Perfect regularity—that is, one half of the front corresponding to the other half, as in *figs.* 18 and 19—appeared to our architects of fifty or sixty years ago indispensable in every considerable mansion, and any deficiency in such symmetry was looked upon as an egregious error in a design; yet that this is not picturesque, is demonstrated by such formality being shunned by all painters. Nothing is more embarrassing to the architect than the necessity of preserving this perfect uniformity in the principal fronts, at the same time with the most useful and convenient distribution of the interior: many plans, that might otherwise have been made excellent, have been cramped and injured by endeavouring to attain the qualities of perfect regularity with that of great convenience. It would seem to have been forgotten, that the principal use of a house is to live in with comfort; and that, consequently, the interior should be planned first, the elevation, or exterior, arising out of it as circumstances admit. This practice, if followed, would introduce many improvements into our domestic distributions, would free the architect from his present trammels, and would lead naturally to that picturesque irregularity which is so beautiful in the hands of a tasteful designer. The formal symmetrical manner, so much esteemed some years ago in every architectural design, does not appear to have been considered so desirable by our ancestors; for in ancient works we often see a departure from it not easily accounted for, except by supposing some view to the picturesque. It must be observed, however, that when mere reduction of cost is considered, or how much space can be enclosed by a certain quantity of walling, that the perfectly symmetrical form has the advantage; indeed, it is easy to demonstrate that a cube will enclose more space than any other figure with plane surfaces, even more than one the plan of which is a rectangle; and hence it is, probably, that we have seen of late so many English houses erected in the form nearly of cubical boxes, or Chinese tea-chests, every idea of picturesque beauty being entirely out of the question.

The species of architectural design we are now advocating as peculiarly suited to the English villa embraces equally every class of building, from the humblest cottage to the largest mansion, and is consistent with the greatest economy or the highest luxury and expenditure. It admits of vast variety of forms, with every sort of decoration from painting and sculpture; and affords room for the exercise of endless invention, even bordering upon the capricious. Although, being founded upon Roman architecture, it does not admit of an evident mixture of any other positive style, yet it is not so exclusive but it may borrow from other styles various details, even of the Lombard style, if so modified that their origin is not recognisable. But in selecting parts not strictly Grecian or Roman, to give a wider range and more variety than if confined to the antique, we do not recommend introducing many of the gross productions of the old Italian school, which have, to a certain degree, vitiated modern architecture throughout Europe. On this subject it is unnecessary to enter more into detail: those who have made architecture their study will understand the points to which we allude; and to teach those absolutely unacquainted with the science, a work expressly intended for that purpose is necessary. Meanwhile, the above hints may afford some assistance, and therefore will not be misplaced.



[Every variety of architecture may be found to have been adopted in different parts of America, both for public and private edifices, and these are often complicated most barbarously, to suit conflicting tastes, even in the same building. The Grecian and the Gothic may be regarded, however, as the predominant styles of architecture in this country, especially for churches and other public buildings. That there is an increasing taste for excellence in this department would appear, from the preference given to architects who have cultivated the science in the best schools abroad, for recent structures in the United States. One specimen only is here inserted, by way of comparison with foreign edifices. viz., Trinity Church, now erecting in New-York.]

CHAPTER IV.

ARRANGEMENT AND DESCRIPTION OF THE VARIOUS APARTMENTS.

Much of the comfort of a house depends upon the judicious arrangement of the several apartments, and this is the first thing that usually occupies the study of the designer. The ground-plan of a house in every country must vary with its habits and customs, and what is excellent in one may be extremely unsuitable in another. This subject has been much studied by English architects, and various collections of plans have been published, which may assist in designing a new one. We may here observe, that it is not our intention, in this work, to give a collection of plans for domestic dwellings, since that would demand more space than would be consistent with our numerous subjects. When we consider the great variety of plans to be adapted to the various classes of society, and the wants and tastes of individuals, it must be obvious that this can be exhibited only in works devoted expressly to that object. The specimens of architecture given above in the woodcuts are not intended as examples to be followed, or as designs for imitation, but only to illustrate what has been said on the subject of style. The plan of the interior of a mansion to be built may be good, yet the interior may not be approved of; but in that case it is very possible to design another elevation to the same plan, or some judicious alterations may be made. It is too often the case, that, in order to produce an agreeable elevation, or exterior, the architect sacrifices the convenience of the interior. Alterations of a plan may be easily made upon paper; and if every person could be taught to draw plans—a thing of very easy accomplishment—we might expect considerable architectural improvements, as far, at least, as convenience is concerned.

The following hints respecting the qualities or requisites of various apartments are intended to assist those who may make the attempt of designing plans of domestic buildings. It is by no means supposed that even a very extensive establishment must contain all the apartments here enumerated: a selection from them will, in most cases, be sufficient.

45. *Porch or Portico.*—Some contrivance for shelter should mark the entrance to a private dwelling; and this is usually affected by a porch or portico, the former consisting of a recess, and the latter of projecting columns supporting an entablature. The style of these must be regulated by that of the rest of the building and the taste of the architect; but the porticoes before the entrance, which have been often adopted in modern English mansions, as well as in those of other countries, consisting of lofty columns of the height of two stories, appear inconsistent with the obvious purposes of utility, and are too ostentatious to be sanctioned by good taste; it is also an objection to them, that, besides being uselessly expensive, they unavoidably darken the windows of the upper story. This kind of portico is evidently an injudicious attempt to apply the front of an antique temple to a domestic residence, without considering the different destinations and characters of the two edifices.

The original use of a portico of lofty columns among those ancient nations from whom it was borrowed, was to promenade beneath; and they were accordingly attached to and surrounded temples, into the interior of which the mass of the people were not admitted; or they consisted of colonnades in various places for walking in: but four or six columns placed in front of private dwellings cannot even be supposed to have the same object, and it is evidently raised as ornament only, though misapplied.

46. *Entrance Hall.*—If the mansion be large, a spacious entrance hall, or, as it is sometimes called, the *Vestibule*, has a good effect; but in a small house, the hall and staircase are usually thrown into one, which, besides occupying less room where space can ill be spared, has the advantage that both may be warmed together. The floor is frequently laid with stone or marble, and mosaic would be elegant.

47. *Staircases.*—The size of the principal staircase, and the part of the building where it is placed, affect considerably the convenience of the residence. Sometimes it is too large for the rooms; and, in other instances, its smallness gives an air of meanness. In large houses, the staircase is usually placed near the middle of the plan, and is lighted by a skylight; but in small houses it is on one side, that it may have the benefit of windows. Access to the staircase should be easy and obvious to all, and it should likewise afford free communication to all the rooms to which it leads. The back staircase, on the contrary, should be more concealed, being chiefly intended for the servants. The principal staircase should always, if possible, be of stone; and it were well if the other staircase were made of the same material, in case of fire, and to lessen the noise from feet.

48. *Breakfast-room.*—Except in large houses, there is seldom a separate breakfast room, the dining-room being generally used for this purpose. But if there be space, a breakfast-room, looking to the east, will be found agreeable; and it should, if possible, communicate by glass doors with the garden, conservatory, or lawn.

49. *Dining-room.*—This should be placed so that the way to it from the kitchen is easy, and yet so that it is not in the least annoyed by noise or odour from the latter. If possible, there should be an adjoining room for servants, and to collect dishes and dining apparatus in, that time may not be lost in bringing them in; and it will be useful to have there a steam table to keep dishes hot. A good deal of ingenuity is requisite in contriving a comfortable dining-room, in arranging the approaches to it, and connecting it with the drawing-room. Steam or hot water has the great advantage of warming it equally in every part; and the situation of the sideboard should be judiciously fixed.

A method first practised at the *Café Mechanique* in Paris, of raising the dishes up by machinery, and now frequently used in coffee-houses and taverns in London, might be adopted with advantage in some private houses. An instance is known in London where the dinner is brought up from the kitchen upon an inclined plane.

50. *Drawing-room.*—This apartment is usually that which is fitted up with greater elegance than any other in the building. The windows are generally made to come down to the floor, with French sashes, and the walls are ornamented in a tasteful manner with painting or rich ornamental papering. The style of the whole should be lively and cheerful; and a well-designed chimney fireplace is most congenial with English habits and feelings. Few drawing-rooms are without some ornaments of sculpture or painting; and good taste is evinced in their selection: much of the trumpery toys often seen there would be better omitted. Two drawing-rooms opening into each other are found convenient either in town or country.

51. *Saloon.*—The name of *Salon*, on the Continent, is equivalent to our drawing-room: with us the saloon is rather a room of communication between others, or one to be used

occasionally for music, dancing, &c. It may be fitted up with ottomans round the walls, and may sometimes serve also as a picture gallery.

52. *Library.*—The size of this apartment must depend much upon the taste of the owner, and whether his collection of books is considerable. The style of the room and furniture should be rather plain; the walls stuccoed and painted in oil; the light good, but quiet: a skylight is best, to give more room for bookcases. If it can be conveniently warmed by steam or hot water, with good ventilation at the same time, it will, perhaps, be preferable to having an open fire, as it will be free from the trouble and dust of a chimney fireplace. Besides the books, it should be furnished with maps, globes, &c., and, perhaps, with microscopes and other philosophical instruments.

53. *Gentleman's Study, or Business-room.*—This may adjoin the library, being intended for greater privacy and quiet.

54. *Billiard-room.*—This in the country is found a useful resource for exercise in bad weather. The best billiard tables are made of cast iron, slate, or some substance not liable to warp.

55. *Hunting and Fishing Tackle* require a separate room, or convenient closets, according to the taste and amusements of the proprietor and his friends.

56. *Gallery.*—By this term is designated an apartment for a particular purpose, such as for music, for pictures, for sculpture, &c. It is generally of longer proportions than usual. If for pictures or sculpture, the light should be from above, either by skylight or windows placed very high up, and only on one side. Very few architectural ornaments should be introduced, as they tend to draw attention from the subjects for which the gallery is erected. It should be provided with long seats or ottomans, as well as chairs, and should be warmed by steam, hot water, or warm air. Pictures and sculptures are seen to more advantage in a gallery contrived for their reception than when disposed over the walls of a house, where many must be placed in unfavourable lights and situations. The gallery may, though attached to the house, be under a separate roof, which, indeed, will sometimes be found necessary on account of the light.

57. *Lady's Sitting-room.*—This should adjoin her bedroom or dressing-room. In France, the *boudoir* is often the most highly ornamented part of the house, which English habits and taste do not require.

58. *Bedchambers.*—It is of great importance to health that the apartments in which we pass so many hours should be lofty, and, if possible, spacious, as a change of air during the night is not easily effected. Nothing can be more injudicious than the too frequent practice of making bedchambers low, to suit what is thought to be the picturesque appearance of a domestic edifice, where persons often submit to the serious inconvenience of low rooms in the upper story, and even of a thatched roof, as if it were desirable to copy the imperfections of our ancestors. We will not contend against the supposed principle of taste in diminishing the height of each story as we ascend, but remind our readers that the air expelled during respiration, though it rises at first to the top of the apartment, yet, if it has no outlet, descends as it cools, and mixes with what we breathe, a circumstance which was not known formerly, when bedrooms were constructed scarcely loftier than seven or eight feet. By referring the reader to Book III., "On Ventilation," the manner in which we consume the air of an apartment will be understood, and the value of the above remarks comprehended. The apertures in the bedroom story should be so placed that a thorough draught can be obtained in the daytime, for the purpose of changing the air completely. Every bedroom, even the least, should have a chimney fireplace, however small. An eastern aspect is the most agreeable for a bedchamber, because it receives the first rays of the sun; an evening sun, on the contrary, heats it, and renders the air oppressive. Small closets, and beds in recesses, are extremely injurious to health, as they can seldom be well ventilated. The style of furnishing in bedrooms should be neat, but plain, and everything capable of collecting dust should be avoided as much as possible. See Book V., "On Furniture."

59. *Dressing-rooms and Baths* should be attached to the bedchambers as much as is consistent with the size and style of the house: the addition of the latter is more than a mere luxury.

60. *Nursery.*—For directions respecting this place, we refer the reader to that part near the end of the work, where the nursery is treated of expressly; observing, that wherever it is placed, attention should be paid to its security from fire, and the ready means of escape. There should likewise be an easy communication between it and the lady's bed or dressing room.

61. *Schoolroom.*—This is frequently a necessary apartment, particularly in the country, where the young people are educated at home. It should be fitted up with a library of the most useful books, maps, globes, and the various apparatus required in education; and here might be kept the little cabinet of natural history, philosophical apparatus, &c. It can scarcely be necessary to observe that the warming and ventilation of it should be perfect.

A small chemical Laboratory for experiments might be attached, or be easily accessible, which should be perfectly fire proof; and a little *workshop* will likewise be an addition that may afford both amusement and instruction.

62. *Museum.*—This is not a usual addition to a mansion, yet well deserves to be one. It need not be large to contain a very entertaining and instructive collection of such objects of natural history as must interest the occupants, or would be useful to the junior part of the family. The various objects placed in it should be arranged and displayed with the greatest possible neatness and taste, yet without gaudy ornaments; and there should be connected with it a place for unpacking and for keeping unarranged specimens, not to encumber the museum itself. The light should be good, and convenient cabinets and tables provided.

63. *Observatory.*—Those who are fond of astronomy may have a room at the top of the house, perhaps in a tower, which forms a picturesque part of a villa in the Italian style. In this may be kept a good telescope, and other instruments, which may be a source of frequent amusement: such a room, if not used for astronomical purposes, may be found agreeable and convenient for viewing the surrounding country, or for studying the clouds, &c.

64. *Conservatory.*—This is a building constructed for the growth and preservation of trees, shrubs, and plants, chiefly exotic, and is often attached to the mansion, and so placed that some of the principal apartments communicate immediately with it. It is a modern improvement, and it is an agreeable luxury to enter from a library or breakfast-room suddenly into the midst of odoriferous plants. A conservatory should, if possible, be so large as to afford walks in it, which ought to be paved, the plants growing either in the earth, or in pots sunk to a level with the surface. It is warmed by flues, or by steam or hot water; the sides and roof should be of glass, and the latter should be strong enough to resist hail. When the roof is opaque, the plants do not flourish. The style of architecture should be extremely light, without large piers, which obstruct the sun's rays. Some splendid conservatories have been executed of late, for which see "Loudon's Encyclopedia of Gardening."

65. *Domestic Offices.*—In arranging the plan of a house, the situation and distribution of the offices demand much consideration; yet they are frequently the most defective part of the mansion. The present fashion of placing many of them in a sunk story, though economical with regard to expense and space, is often injurious to health and cleanliness. In towns this is, in a great measure, unavoidable, according to present custom, but in the country a superior arrangement is generally practicable. To the architect must be left the distribution of the several places according to the plan of the rest of the house and the particular locality; and we can do little more at present than enumerate the various apartments that are included under this head, with such few remarks as may appear the most essential; observing, that a proper arrangement of the several offices cannot be made, nor their fittings-up completed in the best manner, except by those who will take the trouble of making themselves intimately acquainted with the business to be done there.

66. *The various offices* usually connected immediately with the house itself are, the kitchen, scullery, pantry; the several larders, as the wet, dry, fish, game, and vegetable larders; salting and smoking-rooms. There are also the servants' hall, the steward's room, butler's room, plate closet, men's washing and dressing room, knife and shoe cleaning place. Then the housekeeper's room, storeroom, stillroom, china closet, maid-servants' sitting-room; lastly, the various cellars for wine and beer, iceroom, coal cellars. Forming a group by themselves, and detached from the house, may be the brewhouse, bakehouse, washhouse, and laundry. The dairy, dairy scullery, and cowhouse may be situated in another part. Also, composing a separate group, may be the coachhouse, harness and saddle room, stables, dog-kennels, stable-yard, and lodging-houses for the servants employed in them. In the approach to a villa or country mansion the offices should, as much as possible, be kept out of sight.

The principal requisites of a good kitchen are stated in a separate part of this work, where the processes of cookery are described. A good chimney fireplace should never be omitted; for whatever improvements are made in the apparatus for cooking, yet it is not prudent to dispense with the open fire, which may or may not be used continually. Good ventilation to the kitchen should be provided for in building; for if this be neglected, it will, perhaps, be impossible to effect it afterward. If the ventilation be sufficient, it will not only keep the kitchen cool, but prevent the smell of the cooking operations from spreading over the house. The place for coal and other fuel, to supply the kitchen and offices adjoining, should be very near; and it will be convenient, and save much labour, if the coals can be passed from it into the kitchen by an opening in the wall. If the kitchen is detached, it may be lighted by a skylight, which will give the best light and allow most space on the walls.

The scullery should adjoin the kitchen, and be fitted up with a boiler, plate racks, shelves, plate drainers, cistern and sinks, a chopping block, and other conveniences well known. Where steam is much employed, this is generally the place where the steam boiler, with its necessary apparatus, is placed, from which pipes conduct the steam to the kitchen and the various parts of the house. It should be paved with flag-stones rubbed, and some recommend giving them one coat of oil to prevent grease from marking.

The qualities of a good larder are described under "Preservation of Food," Book X.

The other offices necessary to be connected with the house depend so much upon the whole establishment, that no rules can be laid down which can be generally applied. The requisites for a brewhouse are mentioned in Book VIII., "On Brewing;" and those of the washhouse and laundry in Book XX. The same may be observed of the dairy, cowhouse, and stables, which are treated of under their several heads. Some information respecting a good distribution of offices may be obtained from published plans, but better from inspection of such as receive a character of convenience from intelligent servants, who are often able to appreciate their merits, and who should therefore be consulted respecting them.

GROUNDS IMMEDIATELY ROUND THE MANSION.

Although our object in the present work is to confine our chief attention to the domestic edifice itself, without treating in detail on the manner of laying out the grounds, which is the proper business of the landscape gardener, and is seldom attempted by the architect, yet a few remarks upon that part which is in the immediate vicinity of the mansion would appear necessary.

In England, instead of having the cultivated land come up almost to the door of the dwelling, as is frequently the case in other countries, a certain space round the house is kept as pleasure ground, lawn, or park, and ornamented with trees, shrubs, and flowers; and this space is usually enclosed by a sunk fence instead of a wall, not to shut out the view of the country beyond.

67. *The approach to the mansion* in the old style was often directly in front, sometimes by a straight avenue. At present it is thought to be more agreeable and picturesque to avoid such formality, and to have the first view of the house on an angle so as to see two of its sides; the road being made winding, that it may present greater variety than when perfectly straight.

But admitting numerous defects in the ancient artificial and formal style of gardening, and the more just appreciation at present of the beauties of nature, it has been objected by the late Mr. Hope, that the modern custom of "launching from the threshold of the symmetric mansion, in the most abrupt manner, into a scene wholly composed of the most unsymmetric and desultory forms of mere nature, totally out of character with those of the mansion, is a deviation from propriety and good taste." In this respect, modern reform (which swept away the avenue, the terrace with its steps, balustrades, statues, vases, and other embellishments of old times, together with the more objectionable cut yews, trellises, and other unnaturally formal objects, and substituted mere wild, though picturesque, nature) has been carried to an extreme. The change, however, we must observe, gave rise to what is so deservedly admired under the title of the *English Garden;* but as this can be executed with success only on a scale of considerable magnitude, it is better, perhaps, when the space is more limited, to imitate something of the old style still to be seen in some parts of the Continent, as in France and Italy, where the regular forms of architectural and sculptural embellishments are mixed with natural objects in the immediate vicinity of the dwelling, to preserve a gradation from the regular forms of art to those of rural scenery more remote. The style of architecture to which we have alluded above, denominated the irregular Italian, admits of this variety much better than any other, and that consistently with utility, affording, by its terraces, colonnades and arcades, dry and sheltered walks, together with greater facility in preserving that neatness and cleanness near the house which is so desirable; while the beautiful ornaments of statues, garden buildings, and seats of various kinds, with parterres of flowers, fountains, bridges, and other decorations, can be introduced with propriety, although they might seem incongruous and misplaced in ordinary pleasure-grounds, which represent merely a selected portion of natural scenery.

But on this subject it is not desirable that we should dictate; and we throw out this hint rather to awaken attention to ideas perhaps too much neglected, notwithstanding they have been alluded to by persons of great taste and talents; and the existing desire for neatness and finish round our dwellings has become so general in England, that probably it is, upon the whole, best to leave this to the gradual improvement which is going on.

It should not be supposed, from what we have said, that we recommend any of the absurdities of the Dutch taste of former times, nor that we overlook the merit of numerous improvements of the present day: we only propose that a mixture of the artificial with the natural should be introduced, such as is sanctioned by the works of the greatest masters in landscape painting, who, having studied profoundly the principles of picturesque beauty, are, undoubtedly, the best acquainted with it. And at the same time that we express our opinion on the "capabilities" of the style we have advocated (to use the expression of an eminent landscape gardener), we must not conceal that it cannot be treated successfully except by artists of the highest class; and that attempts by those not well versed in the true principles of art are in great danger of being puerile, and even disgusting. It has been justly remarked that our mansions or villas are seldom well connected with the surrounding grounds, owing to the architect and landscape gardener being distinct persons, or not acting in concert. There can be no doubt but that many of the fine compositions to be seen in Italian villas have been produced by the great artists of former times, when it was more the custom to unite the three professions of architect, sculptor, and painter.

As we recede from the mansion, the appearance of art may diminish, till at last it is no longer desirable, and we may trust to those characters which nature alone presents in perfection.

Water somewhere in the grounds is an agreeable feature; where it does not exist naturally, it may be sometimes introduced artificially, but so as if it seemed to belong to the place. Stagnant water, however, should by all means be avoided, since it is productive of noxious exhalations.

As we do not propose to treat here of modern landscape gardening as a science, we can only refer those of our readers who wish to acquire some knowledge of it to study the writings of Shenstone, Gilpin, Uvedale Price, Knight, Repton, Meason, the late Thomas Hope, most of whose principles have been collected together by Loudon.

68. *The entrance to the grounds* from the public road is usually marked by a large gate and lodge for the porter, which is sometimes an ornamented building. Perhaps it is good taste not to aim at ornamenting it much.

69. *The situation of the flower and kitchen gardens* must be regulated by the soil, aspect, and other circumstances depending upon the locality. It is convenient that the latter should be near to the stable court, and not far from the kitchen. For the management of the gardens, we refer the reader to "Loudon's Encyclopædia of Gardening."

CHAPTER V.

DUTIES OF THE ARCHITECT.

Since it is not always possible to meet with a house newly built with all the requisite conveniences, and in the desired situation, the only resource may be to build a new one, which can be exactly suited to the wants of the proprietor, and which may be constructed with all the modern improvements.

70. *Having resolved on building, the first step to be taken* is to engage an architect or surveyor, terms which are nearly synonymous, the chief difference being, that the former title is supposed to mark a higher grade in the profession. Having put the architect in possession of all the necessary information to enable him to design the intended mansion, such as the extent of the family and establishment, the limits of expense, &c., the first thing proper to be done is to make such rough drawings as shall convey a general idea of the plan and distribution of the apartments, together with the appearance of the exterior, accompanied by an approximation to the cost. This being approved of, it will then be necessary to prepare plans more detailed, and to make out an accurate estimate, the labour of which being very considerable, it is not advisable to go through it in the first instance, until the proprietor and architect thoroughly understand each other as to the convenience and style to be aimed at. This first step is too often omitted; and at once highly-finished drawings are made, the effect of which is to bias the judgment and inexperienced eye, or to give rise to unnecessary expense before the design is actually determined upon. There should, however, ultimately be plans of each story, carefully drawn, with elevations of the principal fronts; and it would be desirable if some kind of model could be got up at a small expense, for this would be much better understood by many persons than drawings alone. It must be evident how useful it is to bestow much care in considering the plans upon paper, as these can be easily altered, whereas alterations during the execution of a building are not only difficult and expensive, but often render the original estimate useless, and, indeed, lead to setting it aside. It ought to be known that it is quite possible to make an estimate for a new house that shall be very near the actual cost, but that this cannot be done where many alterations and repairs are introduced. In the former case, the estimate is produced by the same process on paper as is employed in measuring the building when finished; but, in the latter case, the estimate cannot be much more than conjecture. It should be a rule, therefore, to alter as little as possible after a building is once begun.

Together with plans and estimates, there is made out what is termed a *specification*, or *particular*, which is an accurate technical description of the manner in which the several works are to be executed.

71. *There are various ways in which building may be carried on; the best, and what may be termed the legitimate, mode*, is for the architect to select and engage all the master tradesmen, who should work entirely under his direction and superintendence, they being furnished with accurate *working drawings*, and copies of the specifications, which describe the kind of materials to be used, and all the necessary details respecting the work; and it is the business of the architect to see that these are most strictly adhered to

When the whole is completed to the satisfaction of the architect, and partly while it is going on, the several works are measured and valued by two persons. One is the architect himself, or some one appointed by him, and who acts for the interest of the proprietor; the other is employed by the tradesman to take care of his interest. These persons belong to a class of minor surveyors, who, being solely employed in measuring, valuing, and estimating, have more experience than any others in these operations, which are extremely laborious. The measurements being made out, are cast up into what are termed *quantities;* to each of which is attached the price usually agreed upon, and allowed by the general consent of the surveyors and tradesmen of the day, and which are founded upon the prime cost of the materials, and the time generally employed by the workmen, according to the observations and experience of the master tradesmen, together with a certain usual per centage for profit. These prices are severely criticised in case of any difficulty by the two surveyors, who have opposite interests to attend to, and they are at last adjusted as nearly as possible to what they ought to be.

The prices allowed for all the different kind of work in building are published every year or two in what are entitled "Builders' Price Books;" and although these are not sanctioned by the profession, nor considered as authority, being the work of experienced individuals only, yet they are very near the truth, and may serve to give a general idea of what is allowed by surveyors. Should any part of the work not be well done, or the materials employed be of an inferior kind, the employer's surveyor will not allow the price demanded. In short, the measurement and prices made out by the two surveyors employed in this business constitute the bill to be delivered to the employer, and it is signed by both the surveyors. Nothing can be fairer than this mode of doing business; anything like collusion is almost impossible, and we may safely say is never practised. In certain cases, indeed (but this is generally where the bill has been made out by one surveyor only), when the employer considers himself to have been overcharged, the bill is put into the hands of another surveyor to be examined, and deductions are made in prices, but more rarely in the quantities, from the great difficulties of their examination. If these deductions, marked in red ink, are not submitted to by the tradesman, a lawsuit may be the consequence; but as lawyers are unable to enter into such an affair as the examination of charges of which they have little experience, the case is generally at last referred to arbitration, two experienced surveyors being appointed arbitrators. This disagreeable conclusion may almost always be avoided by care and precision in the original estimates, by firmness on the part of the architect during the execution of the work, and by the proprietor not giving occasion to alterations. The architect receives so much per cent. upon the amount of the bills (generally five, or less, if the work is very considerable). Some persons imagine that this mode of remuneration offers a temptation to run the employer to greater expense than is necessary; but whatever may be the case in works on a very large scale, this can scarcely happen in ordinary business. If the most conscientious architect use every means in his power to make his estimates correct, and employ all his precautions during the carrying on of the work, it will almost always happen that the cost will somewhat exceed the estimate from unforeseen circumstances; on which account it is prudent to add something to the estimate for contingencies and extras: and should these turn out to be considerable, the architect will suffer in the estimation of his employer, while the trifling increase in his commission will by no means be an equivalent for his loss of reputation. It is therefore so much his interest to keep within his estimate; and such is the general desire of architects to do so, that the motives sometimes apprehended are scarcely possible.

The honourable architect, however, has a double duty to perform: he is not to consider himself as acting for the interest of his employer only, but he is likewise to do justice to the tradesmen under him, by allowing them reasonable and customary prices, provided the work is properly executed. The tradesman thus has the least possible temptation to slight his work, and the employer has the satisfaction of having the best chance that his house will be well built, and of paying no more for it than its just value.

72. *A deviation from this mode is sometimes practised.* Some master tradesmen being content with less profit than others, an agreement for *prices only* is made in the first instance, instead of having them to be arranged by the two surveyors above mentioned. This may reduce the bills somewhat; but there is some risk that the work will be executed in an inferior manner, yet so that the architect will not have it in his power altogether to prevent it.

A third mode is to have the work performed by contract.* Here the plans and estimates are made as before, and either each tradesman contracts for his portion, or some individual, called a *builder*, undertakes to execute the whole for a sum, he employing the several tradesmen, and perhaps doing part of the work himself. In this case, the architect or designer may or may not superintend the work; but if he should do so, he has

* [This is the course most generally adopted in America, contracts being entered into by "*builders*," who estimate the amount for which they will erect the house and complete it, according to a plan and specifications previously agreed upon. In this case, an architect may or may not be employed to superintend the materials and workmanship; though, in most cases, the builder, if a responsible and capable man, is himself employed as the superintendent, for which he receives a compensation per diem, or sometimes by a given sum for the job.]

much less the power of checking its bad performance than if the tradesmen had been employed by himself; and if the builder has engaged to do the whole at a low estimate, there is a great chance but both the materials and workmanship will be of an inferior description, particularly when there is no surveyor to superintend the execution. Many persons have the erroneous idea that by employing a builder only, they will save the architect's commission, and have the work executed as well and at less expense. This view, however, is fallacious. The mere builder, without any check, has it in his power to put in materials of an inferior kind, and to execute the work in a worse manner than he would be permitted to do by a respectable architect; and the employer, instead of saving five per cent., may actually pay 10 or 20 per cent. more than he ought, without the possibility of a remedy, and have the mortification that his house, after all, may be ill built. It is likewise to be observed, that it seldom happens the mere builder is much of an architect; he has usually been a tradesman, generally a carpenter or a bricklayer, and he is probably but imperfectly acquainted with the other branches of the building business, and deficient in that general knowledge which the well-educated architect ought to possess. Much evil to architecture has arisen from too little care having been bestowed on making estimates before work is begun, through which the actual expense has much exceeded them; and some blame may be attached to those who, not to alarm their employers, give in the lowest calculation, omitting to state any addition for expenses, which, though unforeseen, always occur. Numerous instances which have happened, of the cost of buildings executed under architects exceeding their estimates, have led to the employment of builders, who, together with upholsterers, have been too often intrusted with the duties of the architect. The remedy is, that young architects should apply themselves more than they usually do to the details in the practice of their art, and that they use every means practicable to keep within the limits of carefully made estimates. This is not the place for pointing out what should be the education and acquirements of an architect: it is sufficient at present to state that he should not only possess in an eminent degree the arts of design, but that he should be intimately acquainted with the execution of all the details of work in every part of the building business; and, therefore, that no profession can be cited where greater industry and application, together with good natural talents, are required, than in that of architecture.

There are some gentlemen who have an ambition to become their own architects; but such persons are never aware, until it is too late, of the difficulties they will have to encounter, nor of the vast variety of knowledge necessary, and which, for several reasons, can be acquired only in a professional way. They generally pay dearly for their amusement, and very seldom gain any credit by it.

73. *In the metropolis and its environs*, besides the architect or surveyor under whose direction a house is built, every new building is subject to the examination of a district surveyor, whose duty it is to take care that the conditions of the "Building Act" have been complied with.

74. *Twenty-four hours' notice must be given to the district surveyor* before any building or wall on a new or old foundation is erected within the limits of this act. The notice must be given by the first master tradesman who is to begin the work; and he is liable to a penalty of £20 should he neglect to give such notice, besides having all work condemned to be demolished that should be built contrary to the act. The surveyor receives a fee for his trouble, as arranged by the act, in proportion to the rate of the building. Anything built or altered contrary to the Building Act is to be condemned as a nuisance, and removed; and it is also the business of the district surveyors to examine all houses and walls in a state of decay, and to condemn them if their condition is considered ruinous and dangerous.

75. *The Building Act having passed* for the improvement of building, for security and health, and the prevention of fires, it is the interest of the public to see that it is not infringed. The district surveyors are accordingly very strict; and it is proper that every one who thinks of building or altering buildings should be aware of the principal regulations, and see that the district surveyor is properly informed of his intention to build. Neglect of this has sometimes led to serious inconveniences.

76. *Taking a house on lease, or purchasing it.* Every person about to take a house on lease, or to purchase it, should, previous to his doing so, have it well examined by an experienced surveyor, as to its actual condition, and the repairs that may be necessary. This is a matter that can only be properly understood by professional persons, for whatever may be known of the subject by others, it is scarcely possible that they can be aware of all the circumstances to be attended to; and the neglect of sufficient examination may subject the tenant at the end of the lease to make good delapidations, which being only in an incipient state when he took possession, required a practised eye to detect them. Badly-constructed drains or roofs, commencement of dry rot, settlements in walls, decaying or bad sashes, the strength and stiffness of floors, and many other circumstances are only well understood by professional persons.

CHAPTER VI.

HINTS ON THE PRACTICE OF BUILDING.

77. *General Observations.*—It is not our object to introduce into this work a regular treatise on building. What we propose is, to give those general ideas with respect to the construction of domestic residences which it may be useful for the employer to be acquainted with. When we are about to build, we cannot, as has been already observed, with propriety dispense with the assistance of an architect or surveyor; for the numerous details of actual work or execution in a building are too complicated, and require too much experience, for any one to direct, except those who have made building their profession. But it may, in many cases, be convenient to have such a general acquaintance with the subject as may give an insight into the principles of construction, and of the processes of the various trades employed, as well as in the modes of charging and checking expense, which not unfrequently far exceeds the intention, and even ability to pay, of those who venture on building.

Sect. I.—Constructing the Carcass or Skeleton of a House.

The operations of the builder are divided into two parts, the formation of what is technically called the *carcass*, or skeleton of the house, and the *finishing*. The carcass comprehends the foundation, walls, beams, and joists of the floors and roof, covering of the latter, and woodwork of the partitions. What remains to complete the interior constitutes the finishing. We shall commence by a description of some of the principal materials, as bricks, stone, and mortar.

Subsect. 1.—*Bricks.*

78. *Bricks are the materials most generally employed* for the walls of private dwellings in this country; and when they are well made, and properly burned, no substance is superior in durability, as may be perceived in the remains of ancient Roman buildings, where the bricks are now as perfect as when they were laid, a circumstance owing to the skill and care which were used in their manufacture; but modern bricks are often so carelessly made, that they crumble to pieces in a very short time. Much judgment is, therefore, required in the selection and purchase of this material, which is best procured by visiting the several brick-fields before buying any. Where good brick earth exists upon an estate, some may venture to make their own bricks; but, to succeed, it will be necessary to engage persons who are experienced in digging and tempering the clay, and burning the bricks.

All clays, even the purest, consist of two kinds of earth, alumina and silica. When kneaded with water, clay forms a paste that is plastic, or capable of being moulded into any form. This may be dried in the air, or burned in the fire. In the former case, it acquires a certain degree of hardness; but if this dried clay be again ground up with water, it recovers its former plastic state. Sun-dried bricks, though not durable, were formerly used in many places, as Babylon, Egypt, &c., and are still employed in the East, but never in this country. If dried clay be subjected to a red heat, its hardness is much increased; and when broken into fragments, these are no longer capable of being softened by water, and uniting into a paste. Bricks well burned by fire form one of the most durable of building materials.

Pure clays may be made into extremely hard bricks; but, in the ordinary practice of brick-making, there are several circumstances taken into consideration. When the clay is of a very tough or adhesive kind, or "fat," as it is called, owing to the abundance of argillaceous matter, much labour is required in kneading and tempering it, and the bricks made from it are apt to shrink too much, and crack in the drying and burning. A mixture of sand prevents this; but if there be too much sand, the clay will not be sufficiently ductile, and the bricks will be too brittle.

In many parts of the country natural clay is found, consisting of the just proportions of clay and sand; and where there is a slight deficiency of either, this may often be supplied by artificial means. It is very rarely, however, that natural clays are found consisting only of alumina and silica. They usually contain also more or less of carbonate or sulphate of lime, magnesia, oxyde of iron, &c.; and these ingredients, though small in quantity, modify the nature of the bricks. The iron, if neither lime nor magnesia are present, gives to the bricks a red colour; but if lime be likewise an ingredient in the clay, the iron causes the colour to be some shade of a cream or yellowish brown. The Roman bricks, many specimens of which exist in this country, and which are of an admirable kind, are of a deep red, as were likewise all the bricks made here about a century ago; but as this colour is not thought so agreeable as that of yellowish or whitish stone, great pains have been taken of late to obtain bricks of as light a colour as possible—one circumstance, among others, which has led to their deterioration, though it has improved their appearance. Instead of using the strongest and toughest clays, such clays are now preferred as have a considerable quantity of calcareous matter, and called *marle*, or technically *malm* earths. From this bricks are made of a light yellowish colour; and when natural clays of this kind cannot be had, it has become a practice to grind a quantity of chalk with the clay to produce the mixture necessary for light-coloured bricks.

79. *The common process of brick-making* is as follows: Brick earth, consisting of a clayey loam, of just proportions in the ingredients, is usually dug in September, and exposed in heaps of a few feet in height to the action of the frost of winter, which pulverizes and mellows it. The small stones are then separated, by grinding it in water, and passing it through a grating. The clay thus reduced to mud is now mixed with chalk ground with water to the consistence of cream, if any calcareous ingredient is required. After remaining until it has acquired sufficient consistency, it is finally tempered by working it in a pug-mill, when it is ready to be moulded. Formerly, before the pug-mill was invented, the clay was thrown into a shallow pit, in which it was trodden by the feet of men or oxen. When the clay has been properly tempered, it is taken to the moulder's bench, and separated into small pieces. The mould is a box of a size fixed by act of parliament, but with the bottom loose. It is placed on the bench sprinkled over with sand, to prevent the clay from sticking to it; a lump of the prepared clay is dashed in, and the top scraped off with a flat stick. The newly-moulded bricks are carried on a wheelbarrow to a place where, arranged on each other diagonally, with spaces between, they are dried in the air sufficiently to bear removal, and are then fit to be burned. Should the weather be fine, a few days will be sufficient for the drying. The burning is performed either in a kiln for the purpose, or in clamps, which are large square piles of them skilfully built up, with small coal cinders, called *breeze*, between the layers, and openings sufficient to allow of the admission of air necessary for combustion. Kilns are generally used in the country for burning bricks, which is a more perfect mode; but for all the ordinary ones used in London, clamps are employed.

80. *Bricks burned in clamps*, and even in kilns, are not all of the same quality. Those in the middle, and the most perfectly burned, are called *stocks*, while those on the outside are more imperfect, and are denominated *place bricks*, and sometimes *samel* or sandel bricks: the latter are never employed in good work, or where durability is an object. *Common stocks* are both red and gray; they are used for ordinary walls. The burning of a clamp generally occupies twenty or thirty days, and requires great experience. If the bricks are too much burned, particularly where there is much lime present in the clay, they are apt to vitrify, and run together; and, if not sufficiently burned, they will have no durability. Bricks vitrified or too much burned are termed *burrs;* and though they cannot be used in walls, are useful in some situations. Bricks made with great care of a natural marly earth, or of an artificial mixture to resemble it, are extremely white and uniform, and are called *marle* or *malm stocks*. These are employed in facing the fronts of the best houses in London. A sort, called *cutters*, are made so soft as to bear being cut or rubbed into any form, as for the arches of windows. Some soft bricks are red, and are called *red rubbers*.

Paving bricks are made smooth, and a little thinner than common bricks.

Dutch clinkers are a small kind of bricks, imported from Holland. They are superior in hardness to any other, and were formerly much used, being highly esteemed for paving stables, where they were laid on edge; but now that some of equal quality are made at Cheshunt in Hertfordshire, and other places, the Dutch are no longer brought over.

An extremely white brick, used in the fronts of several churches near the metropolis, and some of the best houses, is made at Ipswich. Highgate Church presents a specimen of them.

Fire bricks, for furnaces and fireplaces, are of a different composition from ordinary bricks, as it is necessary that they should be infusible in high degrees of heat. In their manufacture pure clays are necessary, without iron or lime. The white clay dug at Stourbridge is the best for the purpose; and instead of sand, the clay is mixed with pounded old glass pots, crucibles, or fine bricks, which are not liable to vitrify. They are sometimes called *Welsh lumps*.

A soft and thin red brick, capable of resisting the fire, is likewise made at Hedgerley, near Windsor, and hence called *Windsor bricks:* they are used sometimes for lining portable furnaces and similar purposes, because they can be cut to any form, which the Welsh lumps cannot; but they are not so durable in strong heat as the latter, which are the only ones fit for lining grates.

Hiort's bricks may be mentioned as being valuable, on account of their forms for building circular flues for chimneys, which are more easily cleaned than square ones; but they are too expensive for common use. Another kind for the same purpose, but cheaper, has been invented by Chadley.

81. *Tiles* are made of clay, finer, tougher, and better prepared than that of bricks, and they are burned in a kiln. They are of different kinds, according to the use to which they are applied. They are for roofs, *plain* and *pan* tiles, also *hip* and *ridge tiles*. *Foot tiles* are used for paving; sometimes tiles are glazed, to render them more durable.

82. *The manufacture of bricks is placed under the control of the Excise*; and all bricks made in England for sale must be 8½ inches long, 2½ inches thick, and 4 wide. Makers of bricks and tiles must give notice of their intention to begin the manufacture, under a penalty of £100.

The mode in which the duty on bricks is levied is complained of as a great check to their improvement. The present duty on common bricks is 5*s.* 10*d.* per thousand. To render the tax easy of collection, the brickmaker is restricted to the above-mentioned size. If he deviates in the least from these dimensions, or forms upon them any moulding, he renders himself liable to such an increase of duty as amounts to a prohibition of the article. Were it not for this, an infinity of forms of bricks might be contrived, suited to various purposes; and when we consider the durability of the material, and the facility with which it may be moulded into any required form, it is much to be regretted that means are not found for preserving the revenue without depriving the public of the advantages which might be derived from the inventions of architects.

It is remarkable that during many ages of the architectural history of this country, from the period of the Roman occupation to about the time of Queen Elizabeth, the use of bricks was unknown; and it is likewise remarkable that formerly they were made of much better quality than at present. Even so late as a century ago, the art of moulding a fine brick into various forms to suit the purposes of architecture was carried to a high degree of perfection, as may be seen in the beautiful red brickwork in the chimney shafts of many manor-houses, and in many other old houses, one of which remains in St. Martin's Lane, London. Excellent brickwork may likewise be seen in the conservatory in Kensington Gardens, and in many parts of the kingdom.

The general use of stucco on the fronts of houses, though it has much improved their appearance, has contributed in many cases, where they have been built upon speculation for sale, to deteriorate the soundness of the brickwork, by enabling builders to conceal their bad bricks through covering the exterior with a coat of cement.

Subsect. 2.—*Stone.*

83. *The selection of stone for building* requires considerable skill. Even the kinds usually mentioned as the most durable, as granite, porphyry, and basalt, are not always fit to be employed. Before using any kind of stone, the durability of which is not known, it is proper to observe what effect exposure to the weather for some years, and the frost of winter, have had upon it. No chemical analysis alone can give the required information on this point.

Granite, when of the best kind, is extremely durable, though difficult to work to a good face. It is, nevertheless, much employed in public works, and in some places, as Aberdeen, where it is very plentiful, all the private houses are constructed with it. Much of the granite used in London is brought from Cornwall and Devon, but the most durable granite comes from Aberdeenshire. This is of two kinds, gray and red, the latter being the hardest. Both these take a very fine polish, and splendid examples of polished granite are produced in Aberdeen, of which specimens are occasionally brought to London, both of columns and vases, which approach closely to Egyptian granite. *Porphyry* and *basalt* are too hard to be used for ordinary purposes. Other stones used among us for building are hard limestones, and such stones as are generally known by the name of freestone. The name of *freestone* is applied to such stones as can be cut readily, and as well in one direction as another, not being fissile or splitting into thin layers like slate.

When limestones admit of a polish, they are called marbles. All our fine white marbles are imported, for we have none in Britain of equal quality with foreign, except what is quarried in too small blocks, or is situated inconveniently for transportation. Though most of the veined and coloured marbles to be seen in use are also foreign, we have abundance of coloured marbles in Devonshire and Derbyshire, some of which are of considerable beauty; but they are not extensively employed. Gray compact limestone is durable, but cannot easily be worked into a smooth face. and therefore is not calculated to make an elegant front. Magnesian limestone is an exception; it is of a light yellow colour, extremely durable, and much employed in Yorkshire, and those parts of England where the quarries are situated, and is now used in the new Houses of Parliament.

The most usual stones for the fronts of houses in England are the freestones. *Oolite* is a calcareous freestone, composed of small rounded grains resembling fish roe, whence the name. It is abundant in many of the counties of England.

84. *Bath stone* is an oolitic limestone, so soft that, when fresh from the quarry, it can be cut by a toothed saw like wood, yet it hardens considerably in the air. All the city of Bath is constructed with it, and it is likewise now brought in considerable quantities to London, being less expensive than Portland stone, from the facility with which it is cut and carved; but it is not durable.

85. *Portland stone* is another variety of oolite, which has been used in the most important public buildings in London, and formerly for the paving of many of the private edi-

fices, till the use of stucco in a great measure superseded it. It is now employed chiefly in sills, coping, stone staircases, landings, and other subordinate parts of a building for which Bath stone is too soft.

86. *Sandstones* are freestones composed of grains of sand cemented together naturally: they are infinitely various in hardness, durability, and colour, some being excellent for the fronts of houses, while other kinds are so soft as to be totally unfit, or require being protected by stucco. Though sandstones are the best that consist chiefly of silicious particles, yet when the cement that unites the grains of sand is of calcareous or argillaceous matter, the durability is extremely variable, and only experience can determine whether they should be employed: it is the cementing matter that suffers disintegration by various causes, as the rain and frost; and when this is destroyed, the stone of course falls to pieces. The commencement of this destruction may be frequently observed by lichens growing on the stones, the decayed cement affording a proper soil for these minute plants.

Some kinds of stone lie in the quarry in vast masses, scarcely, if at all, in beds, and consequently they can be raised in very large blocks: of this nature are most granites, porphyries, serpentines, and many marbles, particularly statuary. Extraordinary instances of large blocks of these stones may be seen in the columns and obelisks of the ancients, as also in the walls of ancient cities; and very large blocks of granite are brought from Devon, Cornwall, and Aberdeenshire. Portland also furnishes large blocks of oolite. Sandstones are always in layers more or less thick; some layers furnishing good sandstone of considerable scantling, while others are only fit for flags and paving. This is owing to the manner in which the sand forming the stone has been originally deposited, and many sandstones are farther deteriorated by their containing fossil shells and other organic bodies. When these are numerous, the stone is seldom fit for facings.

Much valuable information respecting the building stones of this country may be obtained by consulting the Report made to the Commissioners of Woods and Forests on the occasion of selecting the best stone for the new Houses of Parliament.

87. *Of marbles* we have few that are the produce of this country; all our best marbles are imported from the Continent. Our white statuary marble comes from Carrara, in Italy. It is beautiful and fine grained, and is used not only for statues, busts, &c., but for the best chimney-pieces. We have no white marbles in Britain that can be procured in blocks so large, nor so fit for the sculptor. Of veined and coloured marbles we have many in Britain very good, but they are not much in use, few of them being of such richness as the Continental marbles. An interesting marble is found in Derbyshire, filled with fragments of the fossils called Encrinites, which is occasionally employed for chimney-pieces; and there is a great variety of coloured marbles in Devonshire, which deserve to be more employed. Black marble, as well as several others, are brought from Ireland. The Petworth and Purbeck marbles were formerly much used in Gothic churches, but they are now little known.

We may here observe, that English builders are in the habit of calling almost all stones that take a polish by the name of marbles; but the term should be confined to *calcareous stones only;* leaving serpentines, porphyries, &c., to be designated by the names proper to the species. Thus the serpentine of Anglesea is called, improperly, Mona marble: it is a beautiful stone, and was in considerable request some years ago; but the quarries are not worked at present.

Subsect 3.—*Mortar and Cement.*

88. *Where walls have been constructed with very large and heavy blocks of stone*, as was the case with some in ancient Greece and Italy, the remains of which, called Cyclopian, are seen to this day, no cement was necessary, the weight of the masses being sufficient to keep them from being displaced; but with bricks or stones of the ordinary size, some cement is required to make a firm wall. In countries where bitumen is plentiful, this substance has been employed, as was the case in the buildings of ancient Babylon, existing remains of which have been described by recent travellers. But cements derived from calcareous substances are by far the most general, and are the only ones used in this country for the ordinary purposes of architecture.

Our common mortar is composed of lime made into a paste with water and sand, which, when completely dried, becomes of a stony hardness; and, the strength of walls depending much upon the excellence of this material, it is proper that the principles upon which its good quality depends should be understood.

89. *Lime*, or calcareous earth, familiar by sight to every one, is never found pure in nature, but is always combined with some other substance. Before it can be employed for mortar, it is necessary to detach it from its combinations; and all of what is so employed is obtained by exposing certain limestones to a strong heat, or burning them, as it is termed, in a kiln. Limestones consist of lime combined with carbonic acid, the properties of which as a gas will be particularly detailed in our section on Fermentation. In the limestone it is, however, in a solid state, combined with lime; and the stone is what chemists term *carbonate of lime.* When a red heat is applied to limestones, the

carbonic acid separates from the calcareous earth in a gaseous state, and flies off, leaving the lime pure, which is then called *quicklime.* This quicklime differs essentially from powdered limestone, and from chalk, which is also a carbonate of lime, in being caustic and soluble in water, which the carbonate is not. The newly-burned caustic lime is next to be slacked by pouring water upon it; the lumps immediately crack, fall to pieces, and soon become a fine white powder, at the same time giving out much heat, which occasions abundance of steam. But the greater part of the water is absorbed, enters into combination with the quicklime, and passes into a solid state; for instead of a moist paste being the result, as might be expected, the lime remains quite dry in the state of white powder. The union of the water with the lime forms a *hydrate* of lime, and is termed by builders *slacked lime.*

90. *Limestones are easily distinguished from other rocks*, by pouring upon them a little diluted acid of any kind, such as the nitric or muriatic: if an effervescence ensues, or the rapid formation of minute bubbles, the substance is limestone, the bubbles consisting of the carbonic acid gas which has been liberated from its combination, on account of the lime having a stronger attraction for the new acid than for the carbonic acid. A few other minerals besides limestone will afford the same appearance of effervescence; but as these are not in sufficient quantity to form large rocks, this test may be considered as practically sufficient to ascertain limestones.

Although all limestones consist essentially of lime and carbonic acid, and though lime may be obtained from them all by chemical means, yet, practically, all are not equally fit for burning into lime: for instance, white or statuary marble is a very pure carbonate of lime; but, when heated in a kiln, it is sometimes liable to fall into a coarse powder before the carbonic acid gas can be driven off, which prevents quicklime being obtained from it. Nor is it necessary that the limestones should always be of the purest kind for this purpose; for many limestones that contain a smaller quantity of other substances make better lime for mortar than the purest carbonate of lime. Limestones, indeed, may be divided into two kinds, as far as relates to their affording lime for mortar. Those which consist of pure, or very nearly pure, carbonate of lime; and those which, besides lime and carbonic acid, contain likewise a portion of clay, iron, magnesia, and sometimes a minute quantity of other matters. The lime procured from the first is capable of making a mortar that dries hard in the air, and which, when well made and become thoroughly hard, will not afterward soften in water; but if water be kept in contact with it before it has dried, it will never set or become hard: hence it is totally unfit for hydraulic purposes, or building under water. On the contrary, all those limestones that contain a considerable proportion of clay, and particularly if that be ferruginous, afford, when burned, what is called *hydraulic* or *water* lime, because, when made into mortar by the addition of sand and water, such mortar sets hard even under water; on which account it is extremely valuable for building piers, docks, and similar works.

An opinion is very generally entertained among builders, that the harder the limestone, the better must be the lime obtained from it by burning. But this is not strictly true: chalk, when burned in the best manner, as it was by the late Lord Stanhope, makes lime as fit for mortar as the hardest pure limestone, provided it be used for this purpose immediately; but it is a fact of practical importance, that lime made from soft porous stones like chalk absorb from the atmosphere the carbonic acid which they have lost in burning, sooner than lime made from more compact stone; and as chalk lime is seldom secured from the access of air before it is worked into mortar, it has sometimes returned so far to the state of chalk as nearly to have lost its binding quality. Every description of lime should be used as fresh as possible.

The lime used for common mortar in and about London is made from white chalk, often imperfectly burned; but a superior kind is procured from employing the gray chalk of Dorking, which contains some clay, yet not enough to form the best hydraulic lime.

91. *The sand for mortar* should consist of clean, angular, silicious grains, not too fine, and as free as possible from any admixture of earthy substances. River sand is usually the best, or pit sand if it be of the proper size, and not dirty, which it is apt to be, clay or earth of any kind weakening the mortar. Sea sand is improper, except it is well washed to deprive it of the salt that adheres to it, as that would prevent the walls from ever being dry, causing them to attract the humidity of the atmosphere. The sand is passed through a screen or sieve, to reduce it to the proper degree of coarseness; and what consists of very small rounded grains is not so proper as what is rather coarse and sharp. Old and bruised mortar screened, and rubbish scraped off the roads, which some bricklayers are apt to use, are improper.

92. *To form mortar*, fresh-slacked lime is mixed up with a sufficient quantity of proper sand, water enough being added to make it into a tough paste. In mixing the lime and sand together, considerable labour should be used; as it is found that the beating the mortar well, so as to incorporate the materials thoroughly, is essential to make it of good quality, and fit for the mason or bricklayer. The inferiority of modern to ancient mortar has been a subject of frequent remark and regret; and the chief cause is, no doubt, owing to the less care now taken in the selection of the materials, and the less labour bestowed

upon them. The lime employed for London houses is sometimes imperfectly burned; and having been conveyed from a distance of from ten to twenty miles, without any precaution to keep it from the air, it has often lost much of its cementing properties before it is used. This is too frequently mixed with dirty sand, except a surveyor superintends the work; and the whole is merely incorporated with a spade, in a slovenly manner, with too great a quantity of water, to save trouble in beating it.

93. *Hydraulic mortars*, or *water cements*, are, as we have stated, made by using lime from limestones containing clay, generally ferruginous, or from other materials not calcareous, which we shall describe.

Limestones of this kind are found in various countries, though less commonly than pure limestones. In England, the most abundant material of this kind is the *Lias limestone*, which is found in a belt stretching across England from Whitby to Lyme Regis, in Dorsetshire; and it is likewise plentiful round Bath, and in several parts of Gloucestershire. It has long been extensively worked at Watchet, Aberthaw, and Barrow in Leicestershire. The Lias stone, which is found in thin beds alternating with slaty clay, is of a dull gray colour and earthy fracture, containing about 11 per cent. of clay and iron. The lime made from it was employed successfully by Smeaton *in constructing the Eddystone lighthouse, mixed with Pozzolana*. In Bath and other places this, with sand, forms the common mortar, which is excellent. In London it is little used, from its price being 25 per cent. more than that of Dorking lime; but it is employed in a cheap and good stucco. There are a few other substances, not calcareous, that are still superior to those we have mentioned, for their property of causing mortar to harden under water.

Pozzolana is brought from Pozzuoli, near Naples, and consists of volcanic ashes that have concreted into a cellular mass of a baked appearance and rusty colour. It was this material that enabled the Romans to construct those remarkable moles and summer retreats in the bay of Baiæ, the ruins of which may yet be traced in the sea. When mixed in proper proportion with mortar made with common lime and sand, it causes it speedily to set under water, and become as hard as stone, affording the strongest water-cement known.

Dutch tarras or *trass* is another substance nearly similar, which used formerly to be imported from Holland, where it is extensively employed in hydraulic works. This is made from a porous lava found near Andernach and other places on the banks of the Rhine: it is ground to powder, for the purpose of using instead of Pozzolana. Its use here is now superseded by Parker's cement, which will be described among *stuccoes*.

Grout, or liquid mortar, is common mortar made so fluid with water, that when poured on a course of brickwork when just laid, it will run into the joints, and cement the whole together very firmly: this practice is employed occasionally where great strength of walls is required.

94. *Asphalte* is a material lately introduced into building, and which has some valuable properties. It is a bituminous substance, found in various places; but perhaps the best known to us is that brought from the south of France, where it is found near the town of Seyssel, on the east of the Jura. It is there dug as a calcareous stone impregnated with bitumen: this is pounded and exposed to a strong heat, by which the whole is fused or rendered soft; when cooled, it is made to form a hard cement. The asphalte is used in various ways, mixed with sand, gravel, pebbles, &c., according to the various uses to which it is applied. It has been largely employed, instead of stone, in the *trottoirs* or side pavements in Paris and other places; and examples of this kind may be seen in various places in London, which appear to answer very well. This would, no doubt, be imitated oftener, but that our abundance of good stone renders it less necessary to use this resource. It is very useful as floors in offices of buildings of various kinds, being perfectly tight, warm, and impervious to vermin. It is said likewise to form excellent walks in gardens, and succeeds in terraces where damp prevails. It is said to be little inflammable; but it is not used here on roofs, though occasionally employed in this manner on the Continent. There are some other varieties of the asphalte, but it is difficult yet to speak of their comparative merits

SUBSECT. 4.—*Drains.*

When the plan of a house is completed, one of the first things to be done is to insert that of the *drains*, and to determine in what way the water from the roof and other parts should arrive at the sewers, cesspools, or other places for its reception.

95. *The drains of a building demand great attention* from the architect who plans them in the first instance, and they also require to be kept in the most perfect order, to ensure the safety of the building, and the comfort, and even health, of the inhabitants. It is to be observed, that in the metropolis and its environs it is necessary to comply with the regulations in the Building Act in the construction of the drains, and it is the business of the district surveyor to see that nothing is done contrary to that act. There should be kept in every house (though it is seldom or never done) an accurate plan of all the drains, which ought to be preserved from the time the building was erected; but if that has been neglected, then the first time they have to be repaired or opened, a plan should

be made to refer to at any time. In this not only the course of the drains should be accurately marked, but likewise all the cesspools, stench traps, and sink stones; also the general sewer. It would be still farther useful if sections were made, showing the quantity of slope or current of the drains, their depth below the floor, pavement, &c. For want of such a plan, it is difficult to conceive the trouble which occurs when drains get out of order; and sometimes much unnecessary expense is incurred, and even serious mistakes are made from the bricklayer who may be employed not knowing their true course. Pavements and floors must be taken up and deranged, in order to discover them, or work is carried on erroneously, and fails of its object.

All small drains that it is necessary to open occasionally when they require cleaning out, should be of the form of *a*, *fig.* 23, with concave or arched bottoms, and the tops flat and covered with flag stones or paving tiles set in cement. The concave bottom enables the water to collect better together, and to move more freely than when the bottoms are flat. Barrel drains *b*, *fig.* 23, are the strongest, but as they cannot be opened without breaking them up, they are only used where there is a considerable fall, and where they are not required to be frequently opened. The fall in a drain should not be less than a quarter of an inch in a foot. *Sewers* are generally built of the form represented at *c*, *fig.* 23.

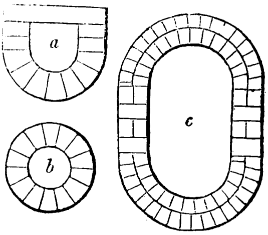


Fig. 23.

96. *It is of great importance that the drains should be executed in a workmanlike manner*, and a proper currect given to carry off the water. If they are built in a careless and insufficient manner, the house is very likely to prove forever damp and unhealthy. They should be constructed of sound bricks with Roman cement, and every precaution should be taken to make them perform their office with as little looking at as possible.

97. *When nothing prevents the foul air of drains from coming out* through the apertures by which the water goes down, the consequence is extremely disagreeable, and even injurious to health; and to obviate this effect, the contrivance called a *bell stench trap* is made at every sink. *Fig.* 24, *a*, *b*, *c*, represents the section of a portion of a hollow cone of metal, having a short pipe in the middle *b*, *d*; and water is put into this cone up to the level *a*, *c*. A loose perforated cover, *e*, *f* (see section, and also the *fig.* below) is made to rest on a shoulder on the top of the cone, and this cover is perforated with two circles of holes; on the lower side of this cover a hemispherical cup is fixed, the edges of which dip under the surface of the water. When water of any kind is thrown on the cover, it passes down through the holes and finds its way under the edges of the inverted cup, down through the tube *d*, and so into the drain; but if any foul air should come back the same way, before it gets out it would have to pass through the water; but from its levity it lodges in the top of the hemispherical cup, and cannot descend through the water, except more pressure was exerted than is usually the case; hence the cup dipping into the water is a complete trap or stop for the air, and effectually hinders any bad smell or other noxious effluviæ from coming up from drains, which, indeed, should never be without this simple but useful contrivance. These traps likewise prevent the intrusion of rats, &c. This apparatus, however, is sometimes liable to be deranged by neglect or bad usage; and it is proper to construct another kind, of brickwork. Somewhere in the course of the drain let there be sunk a small square well, *fig.* 25, *g*, *g*, built round with bricks laid in cement, and plastered on the inside with the same, so as to be completely watertight and remain always filled with water. Across this well let there be a piece of paving stone so fixed that its top may touch the cover of the drain, and its lower edge dip below the surface of the water in this trap or well. On the same principle as the bell trap, no air can pass along the drain, it being stopped by the water below the stone.

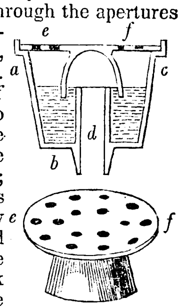


Fig. 2

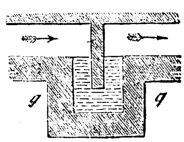


Fig 25.

A cheap trap may be constructed of common red earthenware, to be used in places where any waste water goes down to a drain. In *fig.* 26, *a*, *b*, *c* represents a piece of coarse pottery, of which the horizontal part, *a*, *b*, is about nine inches square, perforated with holes; from the under side of this the piece *c* projects, and dips into the water that will always remain in the square receptacle *d*, and which will overflow and fall down by *e* into the drain.

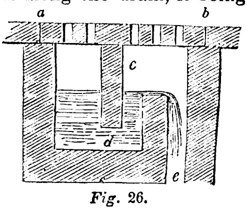


Fig. 26.

In cities and large towns the drains are carried into the common sewers; but in places where there are no sewers, it is necessary to carry the drains to some place where the water can be discharged without causing a nuisance. Cesspools or tanks bricked round are sometimes sunk to receive what is brought by the drains; but these should be avoided as much as possible, as they sometimes generate foul air that renders the place unhealthy. If used, their situations should be well covered and marked, and they should never be placed near the foundation of a building, but sunk at some distance from it. If the situation admits of it, the drains should empty themselves into some running stream, whence the foul matter may be carried away, or be discharged into some place so far removed as not to injure the air of the dwelling by its noxious effluvia.

98. *The sewers of London*, in modern times, stand unrivalled for extent and excellent construction, and to this must be attributed much of the increased salubrity of the metropolis, although a good deal remains to be done to render them adequate to the wants of so immense a population. The great sewers are placed at such a depth as to drain even the lowest parts of the basement stories, a circumstance which struck with astonishment some engineers who were lately sent from Paris to collect information on this subject. In most cities and towns all that is attempted, in the way of drainage, is to get rid of the mere surface water, and where this is neglected dangerous fevers are the frequent result.

Subsect. 5.—*Foundation.*

99. *To secure the strength and stability of an edifice*, the *foundation must be laid in a sound and substantial manner;* and yet this is too often executed very negligently, from which result settlements and cracks in the walls, defects generally incurable, except at a vast expense, and endangering the safety of the buildings. A house built upon a rock is proverbially safe, but all rocks are not good to build upon, only such as are of a firm texture. Some knowledge of the geological structure of the country would be useful, in enabling the architect to judge well of the nature of the ground; sometimes boring to some depth will be prudent, and every precaution should be employed to avoid errors and failures in the foundation. It is a good rule never to trust to "made ground," that is, such as has been disturbed by man, but to dig the trench for the foundation down to the original stratum; because no earth that has been once disturbed ever becomes so firm as at first. No ground where there are natural springs should be built upon, except great care be taken that they are well determined and arched over. Clay, gravel, or even sand, may make a very solid foundation, provided their original beds are reached, and there be no springs to affect them. All London is built upon sandy gravel, and the foundations are sufficiently durable when they have been built properly.

100. *No general rule for the depth of foundations can apply to every case*, such as that given by Palladio, that they should be one sixth of the height of the building; but this must be regulated by local circumstances. To ascertain the nature of the bottom, the ground should be struck hard with the hammer; if it shakes, it is loose; if small parts only are soft, they may be removed, though it is best to have all the foundation level. When, notwithstanding, the ground is not thought sufficiently firm, recourse must be had to some precautions. Piles may be driven, and over them oak planks may be laid; or planks alone may be put in the bottom of the trench: charring the outside of these will make them endure longer. Large blocks of stone may likewise be laid down, particularly at the corners.

101. *If parts only of the foundation are soft*, arches may be turned from one hard spot to another. But the best method of securing the foundation is that which is now very generally practised, namely, to fill up a certain depth of the trench with what is termed *concrete*, or pebble mortar, which is composed of thin mortar made with lime newly slacked, and clean pebbles or stone chippings; when this becomes hard, which it does in a short time, the whole foundation seems as if composed of a rock, which may be built upon without fear of any cracks or settlements. This kind of mortar is by no means a new invention, though its use has been of late revived; for it may be seen in our old castles and other buildings of great antiquity.

Subsect. 6.—*Walls of Brick and of Stone.*

102. *The choice of materials for walls* must, in some degree, be determined by the locality, the comparative price, the style of the structure, the objects in building as far as duration is concerned, and many other points which may vary with different individuals.

The materials in general use are brick, stone, and earth or Pisé. The Building Act requires that the materials of walls should be of brick, stone, or artificial stone, and no timber to be used in them, except such as is necessary for planking, bridging, or piling the foundation; and for templets, chains, and bonds, and also the ends of girders, beams, purlins, binding and trimming joists, or other principal timbers, observing always to leave 8½ inches of solid brickwork between the ends and sides of such timbers and the timbers of adjoining buildings.

103. *The thickness of walls* must, of course, be regulated by the height and number of stories in the mansion, and the materials, whether of stone or bricks. It is to be observed that in brick walls the thickness is, in some degree, regulated by the size of the bricks: thus a wall may be 1, 2, or 3 bricks, or 1½, 2½, 3½, &c., but it cannot be 1¾, 2¾, &c., since the bricks cannot be cut properly. In stone walls there is no such limitation.

104. *The lowest part of the walls is technically called the footing*, which should be considerably thicker than the wall above, diminishing to that of the walls by a set-off in each course as it rises. This, as well as the thickness of the wall, is regulated by the Building Act, and there can be no better rule than to attend to its instructions, even when the building is out of its limits. In the first, second, and third rates, the footing must have a width at least nine inches more than the thickness of the wall above, and the top of it shall be at least six inches below the surface of the lowest ground or adjoining area, and at least 12 inches below the surface of the lowest floor in the house.

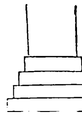


Fig. 27.

105. *Party walls* are those which divide one house from another; they must be built with good bricks, and the Building Act is very particular in requiring them to be of a certain thickness, according to the several rates. No external wall can be converted into a party wall.

106. *When stone is employed*, the architect must be guided partly by the strength of his materials. The operation of preparing the scaffolding, and raising the wall with strict adherence to the dimensions marked in the working drawings, are subjects of too technical a nature to be entered into here, and must be left, in a great measure, to the skill of the tradesmen, superintended by the surveyor. A few general hints may be mentioned as things to be attended to. Care being taken to provide the best bricks and mortar, and that the bricklayer uses what is technically called the proper bond in building, the wall should not be run up too hastily, although most persons are desirous of expedition; in particular, one part should never be worked up higher than another above a few feet at a time, since all walls settle or shrink a little when newly built, on account of the softness of the mortar, and if the work be carried up too rapidly, cracks are apt to occur from unequal settling.

107. *In dry weather it is useful to wet the bricks* before they are laid down, in order that the mortar may adhere to them better; and care should be taken that the bricklayer fill in properly the cavities that may happen in the centre of the wall, which they are apt to neglect. Walls should not be built in frosty weather, since, if the mortar should happen to freeze while it is wet or new, it will, on thawing, crumble, and its adhesive property be totally destroyed; therefore such wall will have no strength or durability. In stormy and rainy weather, the top of the new wall should, if possible, be covered with straw or boards.

108. *Sound materials should be used in the lowest part of the wall*, although, from this part being concealed, it is too often the practice to introduce materials of inferior quality. Place bricks should never be permitted, and only the hardest stocks employed: if they should be somewhat overburned, so as to be in some degree vitrified, and unfit for the upper part of the wall, they may do well in the foundation. When there are piers in the wall which have to support great weights, it may be proper to turn reversed arches, as in *fig.* 28, to distribute the pressure properly and prevent settlements.

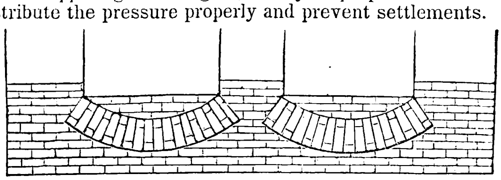


Fig. 28.

109. *When walls are required to be very strong*, it is a good practice to pour some liquid mortar, or *grout*, on the brickwork at every five or six courses which will fill the joints, and set very firm. Also to prevent any damp from rising in the basement story, which, in some situations, is apt to be the case, it is well to lay a couple of courses of bricks in Roman cement, or asphalte, a little above the foundation, as this will prove impenetrable to the wet; or a row or two of strong slates imbedded in cement may be laid in the same place. It should be a rule never to be broken, that the earth should not be suffered to lie against any part of the wall of the basement story; since, if it does, that part of the wall is sure to be always damp within: an area, more or less wide, should be dug out quite round the building. Kitchens are sometimes rendered unhealthy and scarcely habitable, and the whole house affected by damp and bad air, from neglect of this precaution.

110. *The wall over all openings*, such as doors and windows, is supported on the inside by lintels of timber; but on the outside by brick arches. These are of various kinds; *a*, *fig.* 29, is a semicircular arch, the strongest of any. *b*, is a flag segment arch, executed over windows in houses of the most ordinary kind of brickwork. *c*, is an arch used where great strength is required; a wooden lintel is put over the open-

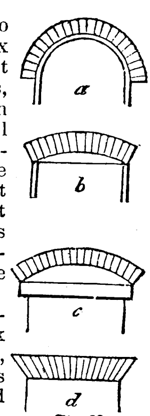


Fig. 29

ing, and a segment arch placed thus to relieve the lintel from the superincumbent weight. *d* is the mode of forming the brick arches in houses of the best class: here the lower part of the bricks forms a straight line instead of a curve, and the bricks are cut and rubbed so as to be all of the wedge form: these last are termed *gauged* arches, and require to be very well set with a small joint, otherwise the bricks give way and fall down.

111. *The stone sills of windows* are those pieces at the bottom (*a*, *fig.* 30) which project from the wall about two inches to turn off the rain, and prevent it from running down on the wall. These are always left out until the brickwork has had time to settle completely; for, as the piers on each side of the window press, by their weight, more than the brickwork immediately under the opening of the window, if the stone sill were to be put in while the brickwork was in the act of settling, the two ends of the stone would receive more pressure than the middle, and would consequently break. After the wall has completely settled, or, as it is called, "come to its bearing," the stone sills are put into their places.

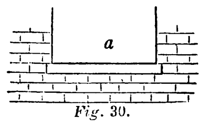


Fig. 30.

112. *The coping* of walls is the course of stone that is put on the top, and it is very important that this should be of a good material. Portland is the best of what is used in London. Yorkshire stone is put in inferior houses.

113. *With respect to the manner of building walls*, in the best houses where the facing is of stone, the latter is squared, hewn, or rubbed, and laid with regular joints. The inside of the wall is sometimes of brick, or rough stone, and the outside casing of smoothed stone, termed *ashlar*; in this case the ashlar should be well bonded with the backing. Even when the walls are of brick, stone is required for certain parts, as kerbs, steps, landings, columns, string courses, cornices, coping, balustrades, and paving of halls, &c., though some of these are now executed in Parker's cement.

114. *Walls built with stones not hewn*, and brought to a smooth face, are called *rubble walls*; and they may be uncoursed or coursed, and be laid dry, or with mortar. When uncoursed, the stones are used of all sizes as they come out of the quarry, the interstices of the large being filled up with smaller ones (see *a*, *fig.* 31), and sometimes they are hammer dressed on the face. When the wall is coursed, the stones for each course being selected of the proper size, and rough dressed, they are laid as at *b*. This mode of building is much used in country places, where stone is plentiful; and the mason's work may be covered with stucco or rough-cast.

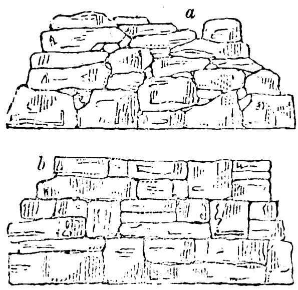


Fig. 31

115. *Pisé*, or earth compressed in mould, is a material very common in some parts of France, and houses built in this way are both warm and comfortable; but it is little employed in this country. Walls of mud and straw are confined to cottages, and are not to be recommended.

Subsect. 7.—*Chimneys.*

116. *The situation of all the chimney fireplaces having been determined in the ground-plan*, the bricklayer proceeds to set them out with care, and the carpenter to lay his joists accordingly.

117. *The Building Act requires* that there shall be no timber over the opening of any chimney for supporting the breast, but that there shall be an arch of brick or stone, or an iron bar; and no timber shall be laid in the wall under the hearth of any chimney nearer than eighteen inches from the surface of the hearth. The hearth of every chimney shall be laid on brick or stone; and the chimney shall have a slab of stone, marble, iron, or tile, at least eighteen inches broad, and one foot longer than the opening of the chimney; such slab shall be laid upon brick or stone trimmers. In party walls there is to be thirteen inches of brickwork between the backs of chimneys on each side of the wall.

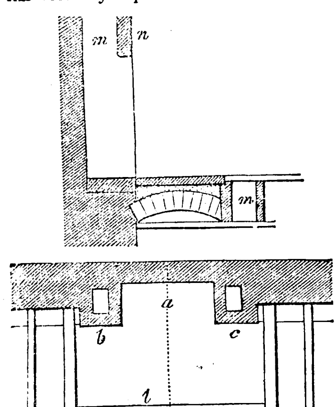


Fig. 32.

118. *a*, *b*, *c* (*fig.* 32) *represents the plan of a chimney*; *d*, *g*, *h*, *i* are the joists, and *l* is a short joist called a trimmer, let into the trimming joists *g* and *h*, at the same distance from the wall as the marble slab is to come into the room. This trimmer is shown at *m*, in the section above, supposed to be taken through the dotted line in the plan. The

use of this trimmer is to support the end of a very flat brick arch, seen in the section, extending from the wall; this arch must be so flat as to be wholly included, together with the thickness of the hearth, in that of the floor. The breadth of the brickwork of the chimney at *b* and *c* is obliged, by act of Parliament, to be such that no woodwork may lie nearer to the flues than nine inches. The whole of the hearth and slab thus rests upon bricks as a security from fire. The depth of the chimney in the wall is left to the architect; but it is generally from two feet six inches to eighteen inches. The thickness of the brickwork of the chimney breast, *n*, has been usually four inches; and it is supported upon a slightly curved iron bar. No flue is now permitted to be built with an angle less than 135 degrees, unless the same shall be provided with proper openings, not less than nine inches square, and proper close iron doors, and frames inserted in such openings, whereby such flue may be swept by machinery; and every salient or projecting angle within such place shall be rounded off four inches at least, and shall be protected by a rounded iron bar. See Sect. 10, Book II.

119. *Perhaps no parts in building, requiring great care, have been constructed with less care* than chimneys, fireplaces, and flues. The inside of the latter has been daubed over with a kind of mortar, having in it a mixture of cow-dung to prevent its peeling off, but which is liable to come off in sweeping. Were the form of flues circular in the plan, instead of being rectangular, as they almost always are, they would be more easily cleaned, there being then no angles for the soot to lodge in, and they would likewise draw better; but, in that case, a particular form of bricks must be employed, except the bricklayer could manage with the ordinary brick and Parker's cement, with which the inside should be made perfectly smooth. But since the practice of sweeping chimneys by climbing boys is abolished, many improvements will, no doubt, be made in the construction of flues. For the construction of chimney fireplaces, see Book II., "On Warming Domestic Edifices."

120. *Chimney tops.*—These are often neglected by the architect, and left to the bricklayer. Nothing can be more unsightly than the appearance of a plain stack of chimneys carrying a row of common red chimney pots, as *a*, *fig.* 33. Much more taste was displayed by our ancestors, who, in old English mansions, designed the chimney shafts in an ornamental manner, that is now imitated in Elizabethan or Gothic houses; but the style of a Grecian edifice demands different designs. The architect, however, should avoid the usual absurdity of a finishing cornice supported by modillions of any kind, as at *a*, since these represent the ends of joists, an idea entirely inconsistent with the nature of a chimney shaft. Chimney pots are frequently made square, as at *b*, and have a better effect than the usual round ones, which, independently of their form, have a character of meanness, derived, perhaps, from association of ideas, which condemns them to the poorest class of houses. The cowls to prevent smoke, too often disfiguring them, are proofs of ill-constructed chimneys, except, indeed, there are local circumstances that may excuse the builder.

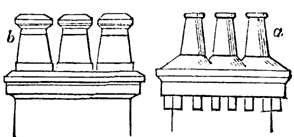


Fig. 33.

SUBSECT. 8.—*Pointing Brickwork.*

121. *Pointing* is filling in the joints of the brickwork with mortar, or restoring this when it has been attacked by frost while the building has been going on, or where it has become decayed through time. The old mortar is first raked out by the labourer; the bricklayer then wets the joints with a brush, and fills them up with mortar containing a proportion of black scales from the smith's forge, which makes a very hard, dark *blue mortar;* or Parker's cement may be used: this is called *flat* pointing. If great neatness is required, the whole wall is well washed and coloured before the pointing is done, and a very neat straight line is also added by white putty, and cut very smooth, which is termed *tuck pointing.*

SUBSECT. 9.—*Stuccoes and Rough-cast*

122. *Stuccoes.*—These are compositions with which walls are coated, to produce an imitation of stone; but it had long been found very difficult to form a durable stucco for the external parts of houses in this country.

123. *The excellent stucco now familiarly known in London by the name of Roman cement,* is improperly so called, because it is not the cement used by the Romans. Its original name of *Parker's cement* should be retained, because it was a discovery made by Mr. Parker about forty years ago, who still manufactures it. Certain nodules, consisting of indurated clay with some lime and iron, known long to geologists by the name of the Ludus Helmontii, or Septaria, were found by him to possess the property of setting very hard when burned and ground to powder, and made into a mortar mixed up with lime and sand: this mixture becomes hard in a few minutes; so quickly, indeed, that no more of the cement can be used at a time than can be worked up with the trowel or other tool immediately, as it sets almost under the workman's hands. When properly executed, it does not appear ever to fail, or scale off the walls, as almost all former stuccoes were found

to do, sooner or later. And not only is it used for the surface of the walls, but it is worked into cornices, mouldings of all kinds, and, in short, into all the ornaments and enrichments, even of Gothic architecture, where stone alone could formerly be employed. It is the most perfect water cement in common use in this country, and is used in all cases where a superior material of this kind for building is required. The nodules from which it is made are found chiefly in the London clay at the Isle of Shepey; but they occur likewise at Harwich, and at Whitby in Yorkshire. It is to be observed that this stucco will not stand the fire, and therefore should not be employed in setting grates, or in any places to which the fire has access. All limestones having a considerable proportion of clay and iron will afford a somewhat similar material: accordingly, a pretty good stucco is made from the lias limestone; but, though cheaper, it is inferior to Parker's.

124. *Hamlin's mastic* is another cement having valuable properties. It is an invention of Loriat of France, a century ago, though patented here. Linseed oil is used in it, and being extremely beautiful, it is sometimes used to cover Parker's or other cement in a thin coat. It is very durable, but expensive. It has one advantage, that when applied to the walls of apartments, they may be papered immediately.

125. *Martin's patent cement* is a new composition which is described as having some good properties. It can be made to imitate Portland stone or coloured tesseræ, as well as marble. It is perfectly hard, and extremely durable. Mouldings can likewise be easily formed with it, and, consequently, walls may be paneled. It is of moderate expense.

126. *Keene's patent marble cement* is a late invention, and appears to be approved of. It is of various kinds. The coarse qualities form a paving not distinguishable from stone in colour and hardness, but at less price; one variety is a close imitation of marble. Our limits will not permit us to describe various other stuccoes that have been invented and tried, which is the less to be regretted, since most of them have failed, and are of little use.

127. *Rough-casting* is a cheap and durable method of finishing walls instead of stucco, and is well calculated to protect them from the effects of the weather, but is chiefly employed in small houses and cottages in the country built of rough stone or rubble. There are two kinds of rough-cast. In the first, the wall receives a coat of lime and hair laid on smooth; and as fast as a certain portion of it is covered, the rough-cast is thrown or splashed against the wet mortar with a large trowel. This rough-cast is made by reducing very fine gravel or coarse sand to a uniform size by sifting or screening, and washing the earth away from it. This is mixed with newly-slacked lime and water to the consistence of thick cream. When the plasterer has covered a part of the wall in the manner mentioned, he brushes it over with a whitewash brush dipped into the pail with the rough-cast, so as to lay the whole smooth and even. The intense white of the lime is unpleasant to a person of taste, although, in some parts of the country, many delight in it; but this white glare may be easily softened, and a stone colour produced, by putting into the mixture a sufficient quantity of yellow or stone ochre, or Spanish brown, or ochre with brown or black, to produce the desired tint. It will be necessary to try the colour on a board or a part of the wall, and to let it dry to determine the exact tint, and to put more colour or more lime and sand till the tint be adjusted. Either a sufficient quantity should be made for the whole building, or very great care must be taken to get the same tint in every quantity that is used, or the colouring will look patchy; and it is to be observed that the tint given must be very light, otherwise it may be worse than pure white.

Another method of rough-casting is also used. Upon the first coat of lime and hair there is thrown, while it is yet in a soft state, a quantity of very small angular fragments of stone, as limestone, granite, &c. These fragments being pressed, stick in the mortar, and are firmly fixed there when the latter is dry and hard. This mode is much practised in Bristol, where broken spar from the quarries gives a rich glittering appearance to the houses done with it.

128. *A colouring for outside walls* may be made of fresh-slacked lime, to which a little sulphate of iron added will give a warm tint. This colouring is useful for a brick house that has become black and dirty: it should be done before the wall is fresh pointed, and if the tint be well chosen, the house will look nearly as if just built.

Painting stone or stuccoed walls with oil colours has been found sometimes a good practice, and preserves them very much.

129. *Limewhiting* is a wash made by mixing quick-lime with water alone, and laying it on with a large flat brush: it is used for areas and similar places. If required not to be capable of being rubbed off, some coarse size may be added.

An excellent lime-wash for walls or boarding of out-houses or cottages may be made as follows: Half fill with water a tub of six or eight gallons, and add to it as much of clean, sharp, and rather coarse sand, and of Dorking lime fresh burned, in about equal quantities, as will make, when it is well stirred up and mixed, a wash of about the thickness of cream. Lay this on the walls with a large brush, taking care to stir up the mixture every time the brush is dipped into it, so as to take up as much sand as possible. The more fresh the lime the better, which, if good and proper for the purpose, will make the water hot.

Subsect. 10.—*Carpenters' Work.*

130. Though the bricklayer is the first artificer who begins, yet the carpenter very soon comes into action. In the building business a distinction is made between the artificers in wood who assist in forming the carcass, and those who execute the finishing in the same material. The first are termed *carpenters*, the latter *joiners*.

131. *Timber.* The only kinds of timber in common use for building in this country are oak, and fir or wood of the pine tribe; the former is by far the strongest and most durable, but likewise most expensive.

132. *By far the best oak is of English growth.* There are two varieties of it, the *Quercus robur*, or common oak, the most abundant; and another much more rare and less known, *Quercus sessiflora*, distinguished from the former by having long foot-stalks to its leaves. It is said that the latter had been employed in some of the oldest wooden roofs in England, which are usually supposed to be of chestnut. English oak is chiefly employed in ship-building, but it is likewise used in domestic buildings whenever great strength or durability is required. It is the only timber that can be depended upon for ground joists, except the soil is particularly dry; and it is not liable to be attacked by worms, from the gallic and tannic acids which it contains. It is also used in window and door sills, and in all such parts as are very liable to be decayed by the weather or damp. It was formerly much more extensively used here before *fir* was introduced, and may be seen in the internal finishings and carvings of ancient houses. The varieties of foreign oak are very considerable, and some of them are imported. An American species brought from Canada is much inferior to English oak, being light, spongy, and not durable. Oak is likewise brought from Norway. A kind of oak called *wainscot* is now much employed in finishing and furniture; this is of a lighter colour, and comes down the Rhine, being imported from Riga. Oak flourishes best in clayey soils; and it is remarked, that the slower the growth the more durable is the wood.

133. *The terms fir and deal* are applied to the wood of the pine tribe, which is particularly the "builder's timber," as oak is that of the ship-carpenter. The name of *fir* is applied to logs which are only squared with the axe, and to the various scantlings sawed out of them for girders, joists, roofing timbers, &c. When the wood is sawed into the form of planks, these are called *deals*; whence this name, which properly belongs only to the form, is often applied to the material itself. Vast forests of pine exist in the north of Europe, on both sides of the Baltic, in Norway, Sweden, Russia, Prussia, Poland, and Germany, from whence the timber is shipped for us in the ports of the Baltic and Norway. The best fir is known to us by the name of Dantzic, Memel, Riga, &c., from the ports where it is shipped under the name of spars and masts; and the best deals are brought in vast quantities from Christiana in Norway, as well as other places in Scandinavia.

134. *There are two kinds of pine wood principally in common use;* the red or yellow, and the white. The first is the wood of the *Pinus sylvestris*, or common Scotch fir, which, containing a great deal of turpentine, is the most durable; this, when sawn into deals, is used in work where strength and durability are particularly required; for instance, the best deal floors are laid with yellow deal. *Battens* are a narrow kind of flooring boards. *Planks* are very wide and thick deals, used for various purposes. White deal is the wood of the *Pinus Abies*, or spruce fir, and contains less turpentine than the yellow; hence it is not so durable; but being easier to work, and less liable to warp, it is particularly useful to the joiner, and is also the cheapest. A great deal of Scotch fir grows in the north of Scotland, where it is sawed up for use in that country, but this does not come into the English market. A few other varieties of fir are grown in various parts of Britain, and are employed in agricultural erections, but as they are not common in the building branch, we need not enumerate them. We may, however, except the larch, *Pinus larix*, which is now extensively planted in Scotland, and proves an extremely durable, as well as beautiful wood.

135. *The American pine* (*Pinus Strobus*) brought here from Canada is light, soft, and of a clean grain, belonging to the white pines; hence it is very useful as deals in many parts of joiners' work, particularly as it may be had of extraordinary widths; but it is not strong when used as timber.

136. *Other kinds of wood* occasionally used in building will be described under "Materials for Furniture."

137. *Preservation of wood.* It is not only necessary that timber of the proper kind should be employed, but that it should be well seasoned, by drying, before it is put into the building, and no part containing sap should be admitted. Neglect of this frequently is the occasion of the disease called the *dry rot*, which is a decay of the wood, connected with the growth of a minute plant belonging to the tribe of fungi, which, finding there a favourable situation, spreads with wonderful rapidity, and, feeding upon the juice of the wood, reduces the fibres to an extremely brittle state, so as to be useless as a support;

and if this be not stopped, the rot will in time seize upon great part of the woodwork through the building, and cause its destruction. As the growth of these plants is promoted by confined air, a free circulation of air prevents it; it is proper, therefore, in buildings of considerable magnitude, to provide for this by having small openings in the wall to allow the air to circulate freely round the principal timbers: these apertures are closed on the outside by iron gratings. When the dry rot has commenced its ravages, these can only be put a stop to by cutting out every part in the least affected, and replacing them by new and sound materials. It is also useful to char all wood so introduced, and to wash it and all the neighbouring places with a solution of sulphate of iron. Timber to be used for building is, in some cases, impregnated with a solution of corrosive sublimate, according to Kyan's patent, which is said to prevent this disease; but as this is expensive, it is best not to trust to this or any other preventive.

138. *It is desirable for durability* that there should be as little woodwork as possible in walls; since, if any of the strength is made to depend upon wood, should this decay, the failure of the wall must be the consequence.

139. *In all modern brick houses, a quantity of timber called bond timber* is let into the walls, to equalize the pressure, and tie the whole together; for brickwork alone, as it is executed in modern days, would not be sufficient. A good deal of the strength of the walls depends upon the bond timber being in sufficient quantity, and properly placed. In cheap houses, built on speculation, the builder is too apt to be scanty in this part of the work; and sometimes the timber is not of the best quality; when it decays, the safety of the brickwork is endangered. Bond timber is seldom requisite, and is not desirable, in the basement story: in the parlour story there are generally two or three tiers of it; and the timber is cut so as to agree with the thickness of the bricks. Pieces of this bond timber, or of oak, called *wood bricks*, are also sawed into short lengths, or that of a brick, and inserted in various parts of the walls, for the purpose of nailing parts of the joiner's work to; where that is neglected, it is frequently necessary to drive strong wooden plugs into the wall to supply the want; but this is apt to shake and loosen the wall. Besides the regular bond timber, timbers of larger size or scantling are laid at the top of each story, to receive the joists of the story above it. These are termed *wall plates*; and care should be taken that each tier is united together so as form an entire chain round the building, except where the chimney flues come; and that they are properly secured at the corners. The bond timbers are carried across the windows at first, and are not cut out until the carcass is thoroughly dry, and the walls come to their proper bearing.

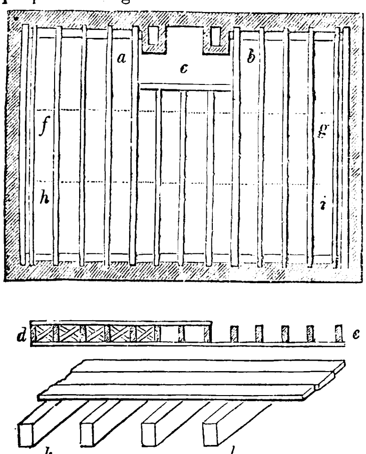


Fig. 34.

140. *Floor timbers.*—In England floors are almost always made of wood, and are supported by beams called *joists*. At the completion of each story by the bricklayer, the carpenter puts down the various timbers of the floor, technically called the *naked flooring*. These consist of various arrangements, according to the degree of strength required, and the size of the apartments. When the apartments are small, *single flooring* may be sufficient. This consists of joists usually twelve inches apart, simply laid from one wall to another (*fig.* 34), or to a partition, their ends resting on the wall plates; the flooring boards being nailed upon the upper edges of the joists, and the ceiling on the lower. The depth of the joists is made several times their thickness, for greater strength, but the latter should never be less than two inches. *a* and *b* are the *trimming joists*, a little stouter than the rest, to receive the trimmer *c*, that supports one end of the brick arch called the brick trimmer, as has been already explained under chimneys. This kind of floor may be made considerably stiffer and stronger, if required, by putting *struts* between the joists in the manner shown in the section *d e*. These struts are short pieces of wood, about an inch thick and three inches wide, nailed on to the joists, and ranged in straight lines across the floor, as at *f g* and *h i*, the distances between the rows being about five or six feet. In this kind of flooring the ceiling is apt to crack. *k l* is a perspective view of a portion of this floor.

141. *Double flooring* is superior to single, in not letting the sound pass through so easily, and being better for the ceilings. They are formed by first laying down beams across, from wall to wall, called *binders*, *a b* and *c d*, which carry the joists, then termed *bridging joists*, see *fig.* 35, plan, section *e f*, and perspective view *g h*. The binders are usually placed about six feet apart: the ceiling joists on which the laths for the plastered ceiling are nailed, are let into these.

142. *Double framed flooring.—Fig.* 36, plan, section, and perspective view, is where a

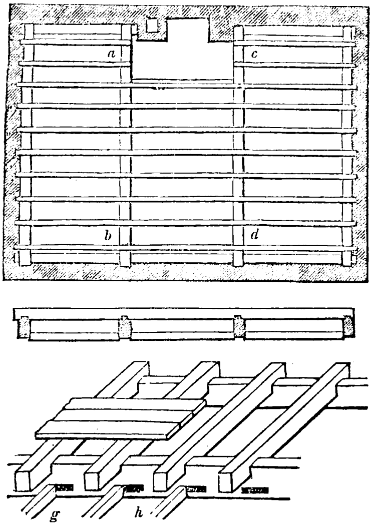


Fig. 35.

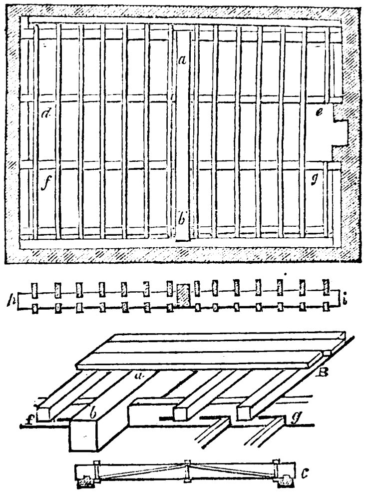


Fig. 36.

very strong beam, *a b*, called a *girder*, is used to shorten the bearing, when the size of the room is too large for binding joists alone.

In very large rooms, where a girder, consisting of a single piece of timber, would not sustain the weight without being somewhat bent, it is stiffened by what is termed being *trussed.* The usual truss consists of two pieces of oak, placed at an angle, on the same principle as the rafters of a roof, and inserted between the two halves of the girder, sawn down through the middle, and afterward bolted together with the truss between, as at *c.* The whole is then put down upon the walls, as at *a b* in the plan, and acts as a single very stiff piece. Other modes of trussing are in use.

Into this girder the binding joists *d e* and *f g* are framed, and upon them are placed the bridging joists, the ceiling joists being beneath, as in the section *h i*, and perspective view *B.*

143. *The scantlings, or thickness of the floor timbers, are regulated by the Building Act.* No joists of any floor, or rafters of any roof, or quarters of any partition, are permitted to be framed more than twelve inches apart; and no joists of any floor shall have a bearing of more than fifteen feet, and no beams or girders of any floor shall be laid so that the joists bearing thereon shall have a longer bearing than twelve feet. The scantlings of floor timbers are to be as follows:

Joists with a bearing of					
6 feet to	8 feet shall be at least	$6\frac{1}{2}$	inches deep, and	2	inches thick.
8 "	10 "	8	"	2	"
10 "	12 "	9	"	$2\frac{1}{4}$	"
12 "	15 "	10	"	$2\frac{1}{2}$	"
Beams and girders with a bearing of					
9 feet to	12 feet shall be at least	9	"	6	"
12 "	15 "	10	"	7	"
15 "	18 "	11	"	8	"
18 "	21 "	12	"	9	"
21 "	24 { shall be cut, reversed, and bolted, and at least }	13	"	10	"

144. *The floors of many kitchens and other offices* in the basement story are paved with stone, for which Yorkshire slabs are generally used; but where greater comfort is required in a small house, the floors are laid with boards nailed on joists, called *ground joists* or *sleepers*, which, however, should never lie on the ground, but should always be supported hollow upon brick walls a foot in height, to prevent the floors from being damp, which they are sure to be when the joists are laid upon the earth, the consequence of which is their decay in a short time. Ground joists are best of oak. Wood should be avoided as much as possible in the basement story: the skirtings are sometimes made of slate, cut and ground smooth for the purpose: this material is capable of being

advantageously applied in many parts instead of wood ; or some kind of hard stucco may be used.

145. *What is termed pugging the floors* is very useful as a security against fire, and to prevent sound being heard through them. Slips of wood of an inch square are nailed on the inside of all the joists, two inches from the bottom, and other similar slips, three inches from the top ; a layer of short pieces of laths is laid between each pair of joists upon these slips, and is covered by a coat of lime and hair : by these means hollow spaces are left between the flooring boards and the ceiling below, which confines the air sufficiently to deaden the sound, and, in a great measure, to prevent the spreading of combustion.

146. *Partitions.*—Some partitions are entirely of brick, where strength requires it, or where a short bearing for the timbers of floors is necessary ; but as these take up much room and are expensive, the most usual kind in ordinary houses consists of upright pieces of wood sawn into small scantlings, technically called *quartering*, placed about a foot apart, and covered with lath and plaster. The spaces between the quarters are sometimes filled up with bricks laid flat, which is termed *brick-nogging*. In other cases, the bricks are omitted. When the partitions are required to be very ong to carry weights, they are trussed or stiffened by braces, *fig.* 37. Partitions in houses of an inferior kind are formed only of wainscotting, which has the great inconvenience that the voice is easily heard through it. The same thing happens in some cases where the quarter partitions are left hollow : and to prevent sound, as well as to check the rapid spread of fire, if they are not brick-nogged, it is best to treat them nearly in the same way as we described in the pugging of floors, only one layer of laths and mortar may be sufficient.

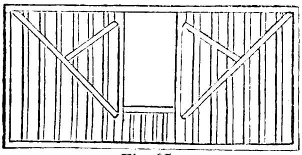


Fig. 37.

147. *Roof.* The design of the roof comes from the office of the architect, but its execution rests with the carpenter.

When the domestic edifices of this kingdom were constructed chiefly of timber, about two hundred years ago, the carpenters were not so well skilled in the art of cutting out and placing their beams, with a view to economy and strength, as those of the present day ; and the walls were often unnecessarily loaded with a profusion of this material in the floors and roofs. The science of carpentry is now better understood, and strength is made to depend upon judicious framing, combined with lightness, using as little as possible of so perishable and expensive a material as wood. Proportioning the scantlings or thicknesses of the timber just to the strength required, demands the exercise of considerable skill and experience ; an inch more or less in the scantlings materially affects the cost and the strength of the edifice ; but we need scarcely observe that any excess is best on the side of safety. These scantlings are now regulated by the Building Act.

In many countries where there is little rain, as in Egypt and Asia Minor, the roofs are made quite flat ; but in Europe, in general, they slope from one side to the other, or form a raised central ridge between the side walls. The angle in which the two opposite sides of the roof are thus raised is technically called the *pitch* of the roof. In the northern parts of Europe the pitch has always been more acute, and consequently the height of the roof more considerable than was the custom among the Greeks and Romans, heavy falls of snow demanding a high pitch. From this cause, the roofs of ancient buildings among us were higher than they have been made since our taste has been influenced by Italian and Grecian architecture. At present it is thought to look best to make the pitch very low ; but if this is carried to excess, it is difficult to prevent the wet from insinuating itself between the joints of the slates and tiles, except they are filled witn cement.

148. *Construction of the roof.* If the rafters *a*, *b*, in A, *fig.* 38, abutted simply against the walls without any *tie beam*, *c*, it is evident that any weight laid upon them would have a tendency to cause them to open and thrust out the walls, which, in ordinary buildings, have not sufficient strength to resist ; it becomes necessary, therefore, to prevent this effect by having a beam *c* connecting the ends of the rafters, which then can, by their thrust, only stretch this beam like a cord ; and the latter is, on that account, called the *tie beam*. In that case, the whole triangle seems like one piece, and the weight of the roof acts only perpendicularly on the walls without any lateral thrust. This is the first simple principle in forming a trussed roof. When the building is very small, and height in the interior is wanted, instead of such a tie beam, the lateral thrust may be, in a great measure, prevented by a horizontal tie kept up higher, as at B, *fig.* 39, called a *collar beam ;* but this will answer only in small roofs.

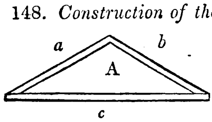


Fig. 38.

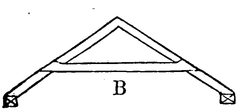


Fig. 39.

In larger roofs a more complicated structure is required, which is represented in *fig.* 40. At certain distances, generally every six or seven feet, the rafters and tie beams are made stout, and connected together by trussing; these are called *principal rafters*. Perpendicular pieces, *a*, called *king posts*, rise from the centre of the tie beams, *b c*, and struts, *e d*, extend from the foot of the king posts to the principal rafters framed into the top of the king posts and tie beams. On the back of these principal rafters, and extending horizontally from one set of them to the other, is a piece, *f g*, named a *purlin*, which supports the common rafters, *h i*, *h i*, the upper ends of which are nailed to the *ridge piece*, *k*, and the lower ends secured to the horizontal *poll plate*, *l*. The end of each tie beam, *b c*, rests upon the *wall plate*, *m*.

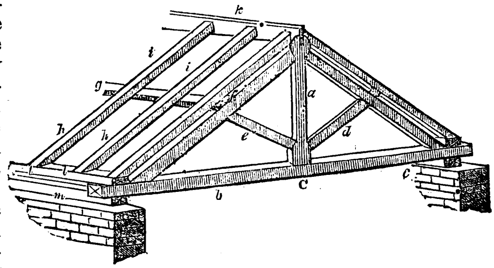


Fig. 40.

149. *By the Building Act, no water is suffered to drip* next any public way from the roof of any building, except from the roofs of porticoes or other entrances; but to be conveyed by metal pipes, or wooden trunks, or brick or stone funnels, into drains or reservoirs.

Subsect. 11.—*Smith's Work.*

150. *There is a certain quantity of iron in every house*, and to execute this there is the blacksmith and the whitesmith. The first makes such articles only as do not require filing, grinding, or any process that renders his work bright; but finishes everything off on the anvil, as in the making of cramps, iron ties, bars, railing, chains, &c. The whitesmith makes and finishes articles of iron and steel, that are to have a bright surface by means of the file and turning lathe; to him, also, belongs the making and repairing of locks, bell-hanging, &c. The carpenter has occasion for the blacksmith to make a great variety of iron ties, straps, bolts, nuts, and screws for his work, which are always of wrought iron, and for all of which he gives him the necessary directions. The joiner also requires various articles of iron for his work, as well as bars and other fastenings for doors and windows. Most of the articles made by the whitesmith are purchased from the ironmonger. Iron has, of late, come much into use in many parts of buildings that were formerly constructed of wood, as in roofs, floors, &c., with the view of rendering them fire-proof; and many ornamental parts are found to be made economically of cast iron. For the manufacture of iron, see "Materials for Furniture."

Subsect. 12.—*Coverings for Roofs.*

151. *Various materials are employed to cover the roofs* in different parts of the world, according to climate and the natural materials; but in this country they are limited to the metals, slates, tiles, and thatch. Of metals, lead is the best, requiring no repairs for a long series of years; but it is heavy and expensive, and therefore entire roofs of lead are used only in churches and other public or valuable buildings, or where the roof is required to be flat. Lead is, however, partially employed in the roofs of all private houses. Sheet lead for this purpose is of two kinds, *cast* and *milled* lead. Cast lead is made by suffering the melted metal to run out of a box through a long horizontal slit upon a table prepared for the purpose. The thickness of cast sheet-lead varies from six to ten pounds in the superficial foot; seven pounds to the superficial foot is the most common. Milled lead is produced by passing the solid metal between steel rollers, and is made of various thicknesses, from three to five pounds to the foot; this thickness is not proper for flats nor gutters, but is used for hips, ridges, flashings, &c. Some, however, prefer stout milled lead to cast, as not being so liable to have the defects called *pinholes*, which cause leakages difficult to discover.

Zinc is of late occasionally used to cover roofs, being lighter and cheaper than lead; but it is not so much to be depended upon, oxidating in many cases, to which lead is scarcely at all liable.

Copper is likewise employed as roofing (see farther, "Materials for Furniture"), where the want of pliability hinders the use of the other metals, or where great lightness is an object; but this metal is now almost superseded by the use of zinc.

Slate is by far the most general covering for the roofs of good houses in Britain. When of the best kind, it is light and durable. The slates employed are chiefly of two kinds; one large and rather heavy, quarried chiefly in Westmoreland, and used only in large edifices where the walls are sufficiently strong to support the weight, and where durability, and not cheapness, is the principal object. The other kind, smaller and thinner, come principally from North Wales. The first is of a light greenish gray colour, the other a dark or bluish gray. Of Welsh slates there are different sizes, called *Welsh rags, imperials, duchesses*, and *ladies*. Excellent slates are found in the western isles of Scotland, as the Eisedale slates, used in Edinburgh.

152. *To try the goodness of slates*, lay one in an oven till perfectly dry; weigh it, and then immerse it in water for some time. When taken out, wipe it carefully with a dry cloth, and weigh it again. Those slates which have acquired the least additional weight, and consequently have absorbed least water from being the least porous, are the fittest for roofing. Good slates should be thin, dense, and of a smooth surface. Balance one on the finger, and strike it with a hammer; if the sound is clear, the slate may be considered as firm; if dull, the slate is less dense, and should be rejected.

153. *Before the slates are put on*, the rafters are covered with boarding, and on this the slates are fastened with nails, being laid over each other, so that the water falling on any joint, instead of reaching the boarding, falls on another slate beneath, there being, in fact, a double thickness of slates.

Slating should be pointed on the inside, or plastered with a coat of lime and hair, to keep out the wind and snow effectually: this keeps the ceilings dry and the house warm.

154. *Patent slating* is done by laying large slates side by side on the rafters, without boarding, and cementing, and screwing fillets of slates over the joints. This kind of slating may be laid with a pitch of only ten degrees; whereas ordinary slating requires at least twenty-five degrees. It is little used, the cement being apt to decay.

155. *The rain water is carried away from the roof* in several modes. The simplest and most ancient mode, which is still practised, is by *dripping eaves;* but these, in the old manner, had the great inconvenience of keeping the wall wet, besides the annoyance to persons walking near. When the eaves project considerably, in the manner of Italian buildings (a mode that is frequently imitated here in small houses), the appearance is picturesque from the deep shadow thrown on the wall; and the disagreeable effect of the water dropping is obviated by placing a small leaden trough, as at *a*, *fig.* 41, at the extremity, to catch the water before it drops; from this the water is led into a perpendicular pipe; or, for very small roofs, a semicircular lead trough may be placed, as at *b*. But for large houses, and for all those in the streets, the construction of gutters and parapets is used, by which the rain and snow water is let down by a pipe into the street drain. Great attention must be paid to these gutters on the roof, not only with regard to their first construction, but that they are always kept in proper repair; otherwise, if they are improperly formed or neglected, the water will penetrate into the houses, and injure the apartments, an accident to which eaves are not so liable. It may be proper to notice a few circumstances on this subject. All lead gutters must have a small degree of slope to give the water a current, which, particularly in those of considerable length, increases the width of the gutter at one end, and therefore demands a greater quantity of lead. Speculators, to avoid expense, are apt to make this slope too small. The sheets ought never to be joined by solder, because, if confined, the expansion in warm weather would cause the lead to crack; but they are connected by drips, a kind of step of two inches, made in laying the boards for the lead. The lead over this is only hammered close, as in the black line, *a*, *fig.* 42, and not soldered. For the same reason of saving lead, builders sometimes make this step too little; and when this is the case, the snow, in thawing, is liable to rise up in this joint, and to damage the ceilings. The lead of the gutter is also made to pass for seven or eight inches up under the slates *d d*, to keep out the wet, as is shown by the dark line at *b c;* and when the lead is not cut wide enough to admit of this, the snow water, in heavy falls, will also gain entrance under the slates. At the other edge the lead of the gutter turns up against the parapet, as at *b;* and a slip of lead called a *flashing*, as *f*, is let into the brickwork, and turns down over the lead of the gutter, to prevent the rain insinuating itself between it and the brickwork. When wet appears in the ceiling of the upper story, it is frequently owing to some of these circumstances having been neglected; or, perhaps, from some crack in the lead. The whole should therefore be carefully examined by the plumber; but if the defect arises from the lead of the gutter having been originally cut too narrow, there is no effectual remedy but taking it up and putting down wider lead—an operation both tedious and expensive. It

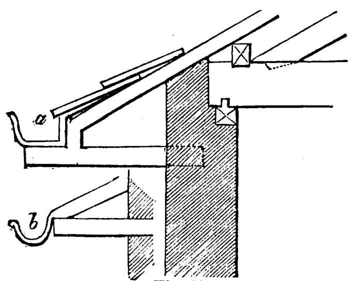


Fig. 41.

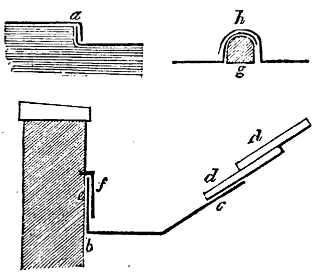


Fig. 42.

must be evident, therefore, that, in a new building, these points demand particular attention. We may here observe that, in very heavy falls of snow, the wet will sometimes rise under the slates, even when the lead is of the proper width, if the precaution be neglected of throwing off the snow before it thaws. The *ridge* of the slates is likewise covered with a slip of lead, as also the angles of the roofs, called *hips* and *valleys.*

When the whole of the roof is covered with lead, or in flats, as the sheets must not be soldered together, they are joined by the edges being hammered round a semicircular piece of wood, *b, fig.* 42, in the manner shown by the dark lines, *a.*

156. *Tiles* form a heavier covering for a roof than slates, and are now only employed for offices and houses of an inferior class. There are two kinds of tiles in common use, *plain tiles* and *pantiles.* Plain tiles are of the same form as slates, but are laid on laths of oak or fir, and bedded and pointed with mortar. The pitch of the roof requires to be 45 degrees, and the tiles require frequent pointing. Pantiles are curved, as in *fig.* 43, and are laid on each other dry: they are seldom used except in cowhouses, sheds, and other out-buildings. They do not form so warm a roof as plain tiles, and are more liable to be deranged.

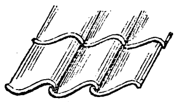


Fig. 43.

157. *Tiles, in the form of antique tiles, fig.* 44, are employed at present by the Italians. They are picturesque, and are suited to low-pitched roofs. *a* represents one of the tiles, having the edge turned up: two of these, being laid together, the turned-up edges are covered by a semi-cylindrical tile, *b*, bedded in cement. These last are made a little tapering upward, to fit on each other. *c* represents the appearance of the tiles when put together. Tiles of this form are also made occasionally in some parts of England.

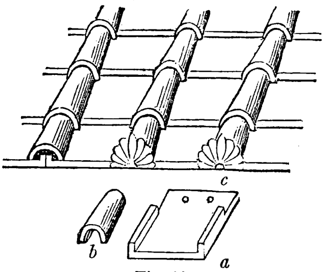


Fig. 44

Common tiles are not nearly so durable as slates, being much affected by the frost: but when glazed, as they sometimes are, with a dark glaze, they are very durable.

When the red colour of tiles is objectionable, they may be covered with a coat of anticorrosive paint.

In ornamental cottages, a thatched roof often forms part of their character. Thatch is cool in summer and warm in winter; but the objections to it are, danger from fire, and want of durability: it is also liable to harbour insects when it grows old. For temporary constructions, painted canvass may be used, or even paper pitched and sanded. Boards or shingles may likewise be employed.

SECT. II.—DETAILS OF FINISHING THE INTERIOR.

158. *Having now completed the skeleton or carcass of the house,* it is necessary that it should remain some time after it is built, before proceeding to finish it, not only that it may become thoroughly dry, but that the walls should settle in every part. There are few ordinary buildings where some slight settlements do not occur in the foundations from the unequal pressure of the parts; sometimes these may not be of the smallest consequence, as they soon stop entirely: but should the finishing be proceeded with in too great haste, and before the carcass is completely settled and dry, the various internal works, if ever so well executed, may be injured, and appear as if they had been badly executed. Gentlemen are often impatient to have their house finished; but it is proper they should be acquainted with the risk that they run by insisting on too rapid a completion.

159. *The finishing comprehends all the details of work, both within and without,* independent of the bare walls, and timbers of the floor, partitions, and roof: it is executed by the joiner, plasterer, painter, glazier, paper-hanger, plumber, smith, and ironmonger. Of these the principal is the joiner, who lays down the flooring-boards, puts up the staircase, makes the doors, sashes, window-shutters, and, in short, all the mouldings and finishings of wood throughout the house, together with such parts of the furniture as are called fixtures; he also sometimes supplies verandas and window-blinds: the greatest part of the joiner's work is prepared in the shop, ready to put up. The plasterer coats the walls with plaster and stucco, and puts up the ceilings, cornices, and other plaster ornaments. The house-painter paints the outside and inside work; the glazier fills the sashes with glass; the paper-hanger covers the walls of apartments with paper; and the plumber supplies the water-closets, and puts up the necessary lead pipes and cisterns.

The style of finishing must, like that of the exterior, depend upon various circumstan ces, such as the expense to be incurred, and the condition and rank of the proprietor. With regard to the expense, much care should be bestowed upon choosing the mode in which the various works are to be executed, and the decorations to be introduced; in

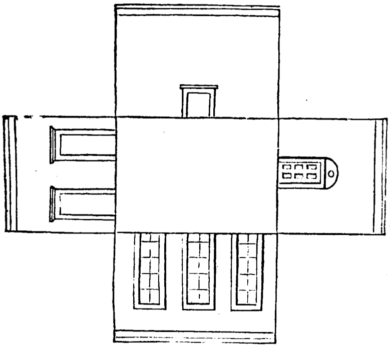


Fig. 45.

these, not unfrequently, much useless expenditure is occasioned, without corresponding advantage. In the modern style of finishing our apartments it must be admitted that vast improvements have been made of late. The use of oil paint, and the invention of paper-hanging, have given a lightness and airiness to our apartments, strongly contrasted with the heavy effect of the dark-coloured wainscot and dust-collecting tapestry of former times; while the abundant introduction of light, by means of large panes of glass, adds a cheerfulness formerly unknown.

160. *The finishing of all the apartments may be designed and exhibited* previously to execution, by drawings made in the manner shown in *fig.* 45, where the four sides are laid down round the plan. On each of these the several details may be inserted; and even the window-curtains and furniture may be shown.

Subsect. 1.—*Plastering the Walls and Ceilings.*

161. *The business of the plasterer* commences as soon as the brickwork is thoroughly dry, and not before, otherwise there will be danger of the drying and finishing of the house being protracted, as we have stated. The name of this trade is derived from *plaster of Paris*, the substance of which all plaster ornaments and cornices are made, and which is sometimes employed, likewise, to mix with mortar for the plastering on walls to cause it to set sooner. It is produced from a stone or mineral, called gypsum, in the following manner: The gypsum is broken into small lumps, and submitted to the action of a heated oven. When cold, it is ground to a fine powder in a mill, and is then fit for use. A paste made of plaster of Paris and water, of the consistence of thick cream, has the peculiar property of setting, or becoming solid, in a few minutes; and upon this property depends the method of making plaster-casts. The moulds for these casts having been previously oiled, the liquid mixture is poured into them, and when it is hard the casts are taken out. This material is so called from its having been originally imported from Paris, where it is made plentifully from the gypsum of Montmartre; but what we now have is prepared from gypsum found in Derbyshire and other places; this is brought to London, where it is calcined, ground, and sold in brown paper bags. But the business of the plasterer is not confined to plaster-casts; he likewise lays on the coatings of mortar to walls, partitions, and other places; and he also does the stucco, whitewashing, and some kinds of colouring.

162. *Brick walls to be plastered* ought first to be perfectly dry; and the process of covering them with plaster is termed *rendering*. The first coat laid on consists of good common mortar, having hair from the tanyards mixed with it, to prevent its cracking. The second coat, called *setting*, is done by a finer mortar, made with lime and fine sand. The lime used in this case is called *fine stuff*, and is prepared by slacking quicklime with very little water, and afterward saturating it with water to excess, putting it into tubs to settle and cause the water to evaporate; by this means a fine material is procured: a nicer kind of it is called *putty*. The use of the second coat of plaster is to give a perfectly smooth surface for colouring or papering. Sometimes, if the work is required to dry or set very soon, a little plaster of Paris is mixed with it, and it is then called *gauged stuff*.

163. *In order to secure the perfect dryness of plastering or stucco in good apartments*, the brick walls are generally *battened*. This is fixing on them long upright slips of wood called battens, on which laths are nailed close together horizontally, thus leaving a cavity between the laths and the walls. The plastering being laid upon these laths, no wet that may penetrate the wall can reach the plaster: this kind of work is termed *lath and plaster*. The first coat laid on consists of lime, sand, and hair, which is termed by the plasterer *pricking up*. The next coat is of a finer material, and being laid on and smoothed with a flat tool of wood called a float, is termed *floating*. The setting, or third coat, is done with fine stuff, to which is sometimes added a little plaster of Paris, to make it dry quicker and be firmer for the paper. The lath and plaster for partitions of quartering, likewise for ceilings, is done in the same manner. It is to be observed that, previously to the plasterer beginning to lay his several coats of plaster on walls, the joiner must fix his *grounds*, which are pieces of wood nailed to the bond timber and wood bricks, projecting as far from the wall as the finishing of the plastering; and to these grounds he afterward nails his skirtings, architrave mouldings of doors, windows, &c.

164. *Stucco for inside walls or partitions* is composed of fine stuff with fine washed sand,

in the proportion of one part of the latter to three of the former; and sometimes, if it is required to dry in a short time, it is *gauged*, by mixing a little plaster of Paris. The best stucco for apartments and staircases is laid on a floated ground, and is worked very even with a large trowel, till it is as smooth as glass; if the stucco is not perfectly flat, the irregularities will appear where it is painted in oil: this is called *trowelled stucco*, and is the fittest for painting upon.

165. *Cornices, if they are large*, are first begun by fixing wooden brackets in the angles, and covering those with laths, which receive a coat of common plastering; afterward the mouldings are run in a fine mortar by a mould made of a piece of wood cut out to the profile of the drawing given; and they are finished by fine stuff. When there are ornaments in the cornices, they are cast in plaster of Paris, in short lengths, and fixed up by the plasterer in the places allotted for them. The modelling of these ornaments in the first instance, from drawings made by the architect, requires to be done by persons of great skill and practice, who have devoted themselves to this branch of art.

166. *Ceilings were, some years ago, very much enriched with paintings and ornaments in plaster;* but much labour appears to have been thrown away in this practice, as it is painful to look up at such ceilings. There is now seldom more done than to put a large flower in the centre to hang the lustre or lamps from; and this flower is best made of papier-machée: between the leaves of this ornament there may be apertures for ventilation. Cornices are likewise much reduced from what they were in old houses; and friezes below them are, in general, totally omitted: all which adds much to the apparent height and lightness of the apartment.

167. *Whitewashing, or colouring, is the last operation on ceilings*, and this is sometimes used in other places. Whitewashing is done with whiting made from chalk. Balls of whiting are broken in water; and this is best done over night. To take off from the glare of the white, a little blue-black is sometimes added for ceilings. A quantity of warm dissolved size is put to this, and the whole is well stirred in a pail. The whitewashing is laid on with a large flat brush. When old ceilings are whitewashed, it is difficult sometimes to hide the stains; the best way is first to wash and scrape off with a trowel the old whiting and dirt, the surface being wetted with a flat brush, and to stop up all the cracks and defective places in the old work. In cornices, some pains is necessary in scraping out the leaves and ornaments. The ceiling must dry thoroughly after this operation before the whiting is attempted. If no size can be had, a little carpenter's glue, boiled to the consistence of size, will serve as a substitute; or potato starch will answer.

Subsect. 2.—*Floors.*

168. *The flooring boards* are never put down till the carcass and roof are quite finished, and the temporary windows put up to keep out the weather; but the boards are sawn, rough-planed, and set up to dry and season thoroughly, which generally requires a year. Oak was formerly used for the best floors, and was often laid in curious patterns, called *marquetry;* but this is now out of fashion in this country, the universal use of carpets having superseded it, and, indeed, rendered the appearance only of the boards of less consequence, regard being had chiefly to the floor being perfectly level and tight, on which account it is essential that the boards do not warp or shrink after they are put down, either of which circumstances proves injurious to the carpets. The best wood in general use is yellow deal; white deal is softer, and does not wear so well. It is also required in the best floors that they shall be of clean deal, that is, without knots, sap, or other blemishes. The boards are laid down and put together in various ways, according to the kind of apartments and the expense to be incurred. In the commonest rooms they are simply nailed to the joists; but in better apartments, to prevent water from passing through to destroy the ceilings of the rooms below, they are *rebated*, that is, the edge of one board is ploughed with a groove, into which the rebate of the next board is inserted. See *fig.* 46. When the boards are not all of one width, and are laid down in a particular manner several at a time, the floor is called *folded:* this is only practised in the cheapest and commonest floors. When the joints of the boards are all continuous, the boards being all of the same width, the floor is *straight joint;* of this kind are all the best floors, in which the boards are secured in such a manner that the heads of the nails are not seen: the boards are then fixed down by means of *dowells* or pegs on one edge of the boards going into holes in the opposite edge, while these edges are fixed to the joists by having the nails driven in slantwise. The whole of the floor can then be planed off together.

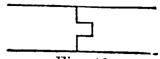


Fig. 46.

169. *In marquetry*, or *parquetry*, an ornamental kind of wood flooring, small pieces of wood of various kinds were cut in certain patterns, and fixed down upon the flooring-boards: the shape of the pieces was seldom more than rectangular, laid in various ways; and the wood was usually oak. It was a kind of mosaic in wood. Specimens of it may still be seen in ancient mansions.

170. *Mosaic, or tesselated pavements*, are not frequently executed among us in ordinary houses, though they were much in fashion among the Romans; beautiful examples of

them have been dug up in the ruins of their villas: tesselated pavements were likewise executed in Gothic buildings in this country some centuries ago. Our custom of covering all our floors with carpets or mats renders these not very necessary. The pavements of halls are sometimes decorated with black and white marble, being laid in squares, or octagons; but, in general, Portland or other stones capable of being worked smooth are sufficient.

171. *Tesseræ for pavements* are now made by several manufacturers, and they appear to be coming into fashion in public buildings and large mansions. Messrs. Chamberlain and Co. of the porcelain works, Worcester, make strong earthenware tiles, either plain red, yellow, or decorated with various coloured patterns in imitation of old English tiles, specimens of which remain in Westminster Abbey and other ancient Gothic buildings Some are now executing for the new Houses of Parliament. They are generally glazed but may be had also unglazed. Tesseræ for mosaic pavements of a variety of patterns, both antique and old English, are likewise manufactured by Wyatt and Parker. Another variety is made by Singer, of Vauxhall, and has been used in the Reform Club-house.

172. *Floors are likewise formed with bricks and tiles.* Brick paving is done either with the bricks flat or on edge, and laid in sand, or in mortar. Brick on edge paving in sand is usually laid in beer and coal cellars, pantries, dairies, or stables, as the open joints allow the fluids to sink through and escape. Bricks laid in mortar make a sound paving; a paving of tiles is neater, but not so durable as one of brick on edge. These kinds of paving are frequently used in farmhouses and cottages: floors in such places are likewise made of various cements.

Subsect. 3.—*Staircase.*

173. *When the staircase is of stone*, Portland stone is the material most commonly used in London: where Bath stone is plentiful, it is sometimes used, but it is too soft. When wood is used, oak is preferable, and was formerly much employed; but in good ordinary houses, yellow deal suffices, as the stairs are generally carpeted. Putting up a staircase well, and particularly the handrail, is one of the most difficult parts of the joiner's business, and the most skilful hands are required for it. The size of the steps is calculated by the architect, who has to consider the height of the stories, and the space in his ground plan; but he cannot depart much from the customary height and tread of steps.

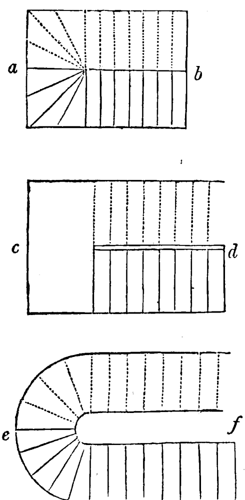


Fig. 47.

174. *A dog-legged staircase* is one where there is no well hole, *a*, *b*, *fig.* 47, and the return of the stair is effected by *winders* fixed to a *newel.* This kind of stair is inconvenient, the width of the steps being diminished to nothing close to the newel: it is, of course, limited to inferior houses, attic stories, &c. In the *better kind of staircases* there are landings at half the height of the story, *c d;* and in plans it is customary to mark the commencement of the flight-steps with lines, while the last half is shown by dotted lines. A *geometrical staircase*, *e f*, is one where the steps wind round an open newel, or, as it is called, a *well* from top to bottom. This is used in cases where the light to the staircase is admitted only from a skylight. These may be circular or elliptical on the plan. The staircase is a very important part of a house; it should be conveniently situated, well lighted, and of easy ascent.

Subsect. 4.—*Doors.*

175. *If the doors are not made of wood well seasoned*, and executed in a workmanlike manner, they will shrink after the painting is finished, and look very ill. The locks, which are of various kinds, and other fastenings, are parts of furniture that demand great attention. To enable doors to rise over the carpets, and yet be tight at the bottom when the door is shut, rising hinges are sometimes used, and are extremely serviceable, cold draughts just over the carpets being very unpleasant and injurious, though frequently unattended to. There are various other inventions for this purpose. In laying the flooring-boards, it is usually the practice to make the floor rise gradually about a quarter of an inch under the door.

The doors of apartments are always framed in two, four, or six panels, which are either plain and square, or ornamented with mouldings. Those of ordinary rooms are of deal; but in the best apartments of large houses they are frequently of mahogany.

Subsect. 5.—*Windows.*

176. *Upon the judicious construction of the windows much of the comfort of a house depends.*

bad sashes are a continual nuisance, letting in draughts of cold air, rattling, or requiring frequent repair. The sashes of the present day, hung with weights and pulleys, are a great improvement on the ancient casements with hinges: when well made, and of good materials, they answer very well; they should always be double hung, that is, top and bottom sash moveable, on account of ventilation. Wainscot is the best kind of wood for sashes, being the most durable, and least liable to shrink. Mahogany is sometimes employed in the best houses. Sash fastenings should never be omitted, for the purpose of binding the sashes together to keep out the cold, as well as for security. Cheap sashes, ill made, are far from being economical. French sashes that come down to the floor, and open with hinges, are pleasant in drawing-rooms, or apartments that communicate directly with a lawn or garden, but they are apt to be cold in winter. *Double* sashes, or two sashes a little way apart, little used here, but universal in Russia, are extremely warm, and have the good quality of excluding noise, properties which render them very suitable for certain situations. It is to be observed that more light comes from the upper than from the lower part of a window, and therefore, where much light is required, the sashes should reach as high as possible; in low apartments the light is often obstructed by useless drapery of window curtains.

177. *By the Building Act*, all door and window frames are to be set in newels or recesses, at least four inches from the front of the building, as a security against the spreading of fires.

No bow-window or other projection shall be built next to any public street, so as to extend beyond the general line of the fronts of the houses in the said street, except such projections as are necessary for copings, cornices, facias, door and window dressings, or for open porticoes, steps, or iron pallisades; and also, except shop windows, which are allowed, in streets thirty feet wide or more, to project ten inches from the line of the building, and five inches in streets of less width.

178. When the sashes have been completely finished by the joiner, and painted by the painter, they are filled in with glass by the glazier, who secures the panes by means of putty made of whiting and linseed oil.

179. *Window shutters* are framed in the manner of doors, and are made to fold in several widths by means of hinges to go back into a recess at the sides of the windows. When the walls are too thin to receive the necessary width of the front shutters, the architrave is brought forward in the room, or the shutters are made to slide up and down.

180. *For the manufacture of glass*, see the article "Glass," in Book V., "Furniture."

181. *There are several kinds of glass in common use for windows.*—plate glass, crown glass, and common glass. Plate glass is by far the best, though most expensive, not at all distorting the objects viewed through it, which is more or less the case with all other kinds of glass. It is often introduced into the windows of the best kind, as also in those of shop fronts. Crown glass is always used in the best windows in ordinary houses. There were formerly two kinds of glass made in London, Ratcliffe crown and Lambeth crown, but from the greater price of fuel in the metropolis, the glasshouses are now removed to Newcastle and Bristol. Window glass being all blown in circular plates, not exceeding five feet in diameter, these are cut by the glazier's diamond into panes of various sizes, from the part surrounding the knot in the centre of the plate. Panes may be procured 33 inches by 25. Glaziers describe panes of glass as firsts, seconds, and thirds. The *firsts* are crown glass, the *seconds* and *thirds* are common and inferior glass; the thirds being of a greenish tint, and used only in very ordinary situations. Panes of glass are charged more per foot as they increase in size, because there is more waste when large panes are cut from the circular tables than where the panes are small.

182. *When light alone is required for offices* where it is not convenient to see through the glass, ground glass, or wavy or granulous glass, is used: to imitate the former economically, the effect may be produced very nearly by dexterously applying a lump of glazier's putty, or even thin size and whiting, or boiled starch.

SUBSECT. 6.—*Chimney-pieces.*

183. *Chimney-pieces are decorations surrounding the openings of chimney fireplaces.* In the principal apartments they are usually ornamented more or less with sculpture, and they form a principal feature in English houses. Rules have been sometimes given by writers on architecture for proportioning the size of the openings of chimneys to the size of the apartments; but such rules are not founded upon any principle that can be admitted. The use of the fireplace is to warm the apartment, and as the mode of accomplishing this effect has varied through improvements in the nature of the fuel, and the way of using it, so the size of the chimney opening has been subject to change, and the decorations surrounding this opening have been modified accordingly.

In the time of Queen Elizabeth, when wood was the fuel, the chimney-opening was large, and the chimney-piece reached nearly to the top of the room. In after times, when coal became the fuel, and Grecian architecture came into fashion, the size of the chimney opening was reduced, and the chimney-piece partook of the general style of the apartment; but for a long time the mouldings and ornaments were of a massive kind.

About fifty years ago the modern French taste began to be imitated here, and great elegance has been attempted in the design and execution of chimney-pieces suited to our improved fire-grates. In consequence of Count Rumford's principle of lowering the fire itself, the cornice of the chim ey-pieces have descended to a convenient height for placing ornaments upon them. In the best apartments chimney-pieces are always of marble, either white or coloured, the first being the most usual in the drawing-room, and the latter in libraries and dining-rooms. Those in inferior apartments and offices are of various materials, as Portland stone, slate, or even wood, which may be painted and sanded: cast iron is likewise sometimes employed. Chimney-pieces of all kinds may be economically purchased, ready made, at the show-rooms of stone masons and sculptors, but in the best houses they are generally designed by the architects.

Subsect. 7.—*House Painting.*

House painting is practised, not only for decoration, but likewise for the preservation of the woodwork.

184. *The application of oil painting to our houses* is a very great improvement upon the practice of our ancestors, and has come into general use only since about the beginning of the last century. Before that time the woodwork, both within and without, was uncovered with paint; and we still see the effect of this in very old houses. Oak acquired a very dark sombre colour; and when deal was first introduced, it not being the practice to paint it, the effect was worse, as it contracted dirt, without admitting of being so easily cleaned by polishing and brushing as oak. Oil paint not only preserves woodwork from decay, but has the advantage of being easily cleaned by soap and water; and when at last that fails, the painting may be renewed at a small expense, thus preserving a perpetual freshness in our apartments, conducive at once to health and cheerfulness. The practice of house painting has given rise to a taste for cleanliness and elegance in our dwellings that could not otherwise have been so well attained.

185. *There are various kinds of painting*, according to the nature of the vehicles employed for the colours: as oil painting, distemper, and fresco.

186. *Oil painting* being the most important as applied to our domestic buildings, we shall commence by describing it; and first of its materials.

187. *White-lead* forms the basis of this kind of paint, to which are added a certain quantity of various pigments when different tints of colour are required.

188. *White-lead is made in the following manner.* Sheets of lead are rolled up spirally, so as to leave the space of about an inch between each coil, and then are placed vertically in earthen pots, with a ledge in them to support the lead. In the bottom of each pot is some good malt vinegar, or pyroligneous acid. The pots are then covered, and placed in a bed of horse dung, or of tanner's bark. The vapour of the vinegar oxydizes the surface of the lead, and converts the oxyde into the diacetate of lead; while the carbonic acid, which is extricated in consequence of the fermentation of the dung, rapidly decomposes this diacetate, and converts it into a *carbonate* of lead, which appears as a white crust upon the surface of the sheets of lead. The finest part of this comes off in flakes, forming what is called *flake white*, which is the best of the lead, and is employed only in painting oil pictures: this is collected, ground in water, made into lumps, and dried by stoves. The plates are thus treated repeatedly, till they are corroded quite through, and all reduced to the state of carbonate.

It is necessary to observe, that in the method just mentioned, of placing the lead in pots, the white-lead causes the sheets to adhere so firmly to the pots, that the workmen are obliged, in order to detach them, to knock, which occasions a great deal of dirt, extremely prejudicial to their health. By an improved mode, the rolls of lead are placed on a floor of boards pierced full of holes, and below this floor the pots full of vinegar are placed, sunk in dung, the vapour of the vinegar and the carbonic acid ascending to the lead through the holes: this method is not only more productive of white-lead, but there is no breakage of the pots, and the rolls being well sprinkled with water, the dust is avoided.

The white-lead, after the flake white has been separated, is scraped off, and then ground in water, and afterward saturated with linseed oil. It is then put into firkins, each containing about three hundred weight, in which state it is dispensed at the colour shops.

White-lead, when sold by retail, is frequently found adulterated with powdered chalk and various white mineral bodies, that very much injure its quality, causing it to have less body, and likewise to turn yellow when made into paint. As much of the durability and beauty of the paint depends upon the goodness of the white employed as the basis, especial care should be taken to have this genuine. When a large quantity is wanted, it is safest to purchase it at the white-lead works where it is made; but even there it is sometimes not free from adulteration. It is improved by keeping.

Adulteration with chalk may be detected by dissolving a little diluted hydrochloric acid, filtering it, and adding a little oxalate of ammonia. If chalk be in the white-lead, a cloudy white precipitate of oxalate of lime will appear, which is owing to the affinity of the oxalic acid for lime, the basis of chalk.

Nottingham white is a superior kind of white-lead, used in the best work in the finishing called *Flatting.*

189. *The oils employed* are those varieties which have a drying quality, which is increased by art: such as linseed oil, nut oil, poppy oil, lamp oil, and walnut oil. They are all obtained by pressure from the seeds of the plants after which they are named, and from the manner in which they are procured, they at first always contain mucilage.

190. *Linseed oil* is the only one that is employed in the large way in house painting: it is obtained by pressure from the seed of flax; and it is afterward filtered, to clear it of any of the husks of the seed, and then suffered to remain in tubs to precipitate and clarify. The freer from colour the oil is, the better; and its clearness is greatly improved by keeping: if kept for a year or two, it will deposite all its colouring particles, and be nearly as transparent as water. In this state the oil is called *raw linseed oil;* and though it has of itself a drying property, yet paint made with it would be very long in drying, and therefore means are employed to increase this property.

191. *Oils are rendered drying* by boiling them either alone, or with metallic oxydes; as litharge, ceruse, red-lead, &c. The mucilage is supposed to unite with the oxygen of the oxyde, and the oil itself is then ready to attract oxygen from the atmosphere, and to become solid. There are various methods of preparing drying oil. Add to half a gallon of raw linseed oil six ounces of litharge, and an ounce and a half of white vitriol. Boil the oil on these over a gentle fire, taking care to skim it from time to time: the matter which rises to the top, and which is skimmed off, is called by the painters *smudge*, or *dryer;* it is of a lead colour, and is used for outside work, and sometimes mixed in the dark colours, to make them dry quicker. When no more scum rises, the fire is stopped, the oil, being left at rest, gradually settles and clarifies. Linseed oil so prepared is sold at all colour-shops under the name of *boiled oil.* Instead of litharge, red-lead or white-lead may be used, or linseed oil may be rendered drying without boiling by mixing one pound of white-lead with a gallon of oil, and letting it stand a week or two, till the lead and the feculent parts of the oil have subsided. Some consider that the best way is to boil the oil simply for a considerable time, without any addition.

In boiling oil it is necessary to be extremely careful to prevent any water from coming into it while boiling; for a single drop would be instantly converted into steam by the excessive heat of the boiling oil (600 degrees), which, by its expansive power, would force part of the oil over the sides of the boiler; and this, taking fire, might occasion serious accidents.

192. Oil of turpentine, generally called *turps* by house painters, and improperly termed "spirits" of turpentine, is much in use as an ingredient in paint; and as its history is connected with several other substances employed, we will give them all together.

193. *Common turpentine* is the natural resinous juice which exists in trees of the fir tribe, and may be often observed exuding from a deal board which is exposed to the sun, particularly in places where there are knots, which abound in it. It is about the consistence of honey, of a yellowish colour, and is obtained in large quantities from the wild pine or Scotch fir (*Pinus Sylvestris*), but is brought to us chiefly from the northern countries of Europe. To procure the turpentine, the trees are stripped of their outer bark in the month of May for about six inches, so as to expose the inner smooth bark, near the foot of the tree, where an incision is made three inches square, and an inch deep. The resinous juice soon begins to exude in transparent drops, which fall into a proper receptacle. The turpentine continues to flow till September; and a healthy tree may yield from six to twelve pounds annually, and that for a century. This turpentine consists of common resin and essential oil of turpentine, which may be separated from each other by distillation.

194. *Oil of turpentine* is the essential oil, obtained by distilling with water the common turpentine just mentioned. This is put into a still with water, and, when heat is applied, the oil of turpentine comes over with the steam, being found in the receiver swimming upon the condensed water, from which it is easily separated. About 60 lbs. of the oil is procured from 250 lbs. of good turpentine. This process is carried on both abroad and at home; but the oil drawn in this country is always preferred. The oil of turpentine is used by the painter to mix with his oil colour to assist in drying; and it has an advantage over drying oil, that it is perfectly transparent and colourless. It has also another useful property, that of destroying the shining or gloss of common oil paint, as we shall describe.

195. *Common brown resin*, or rosin, called also colophony, is the solid substance that remains in the retort after the distillation of the oil of turpentine.

196. *Turpentine varnish.*—As the common turpentine drawn from the tree consists of essential oil of turpentine, having resin dissolved in it, it is evident that this essential oil is a solvent for resin. If resin be therefore put into oil of turpentine, it will be dissolved and constitute turpentine varnish, which may be made thin at pleasure by adding more of the essential oil. When laid on with the brush, the oil evaporates and leaves the resin as the varnish. Since resin is not soluble in water, turpentine varnish will resist

that fluid ; and as it is soluble in oil of turpentine and in spirits of wine, it may be removed by either of these vehicles.

197. *Tar is an empyreumatic turpentine*, obtained by cutting to pieces trees of the pine or fir tribe, and exposing them to heat in a furnace or in the open air. In the latter mode the wood is cut into billets, piled up in stacks, and covered with turf. Fire is then applied to the wood, and it is suffered to burn with a slow smothered flame, during which process the tar is formed by the partial decomposition of the resinous juice, which flows to the bottom ; the black colour is owing to the smoke and carbon or soot which is mixed with the product. The greater part of the tar used in England comes from the Baltic, and is made in the northern countries adjoining it, which abound in fir. In France and Switzerland tar is produced by a more economical process, and of better quality. It is there distilled from the wood in large brick ovens, and the charcoal which remains is used as fuel.

198. *Pitch* is tar of which the essential oil has been driven off by boiling. Tar differs from common turpentine in having been extracted by heat and blackened by the process, whereas the latter preserves its natural colour ; but both contain the essential oil of turpentine, although this can only be obtained pure from the turpentine. Pitch is prepared in the countries where the tar is procured ; and to convert tar into it, boiling is all that is necessary.

199. *The painter's tools are few.* The brush which they usually employ, called a *pound brush*, made of hogs' bristles, is first used as a duster, until the ends of the hair are so worn as to become soft ; it is then better adapted to lay on the colour and spread it evenly ; and the more it is used the better, till it begins to wear out. Smaller brushes are employed for the bars of sashes, called *sash-tools ;* and a few still smaller are wanted for drawing lines, &c.

200. *Some of the colours are purchased* at the colour-shops in a prepared, and others in a crude, state. Some of the painters grind them themselves on slabs of porphyry or marble, with oil or water. It is of the greatest importance that all their colours, tools, and pots should be kept extremely clean and neat, and their brushes be kept moist and fit for use. When more colour is prepared than can be used immediately, it is prevented from drying by being covered with water.

201. *The first process in painting new work in oil* is to paint or cover by some mode the knots in the wood, to prevent the turpentine with which they are charged from coming through, as it would do after the work is finished. This is called *knotting*, which, in good work, requires to be done very effectually. The common method is to touch each knot with a brush full of paint made with white-lead ground in oil and some red-lead or litharge of lead as a more perfect dryer : some knots may require to be touched twice ; but in the best work the most complete way is to touch the knots with gold size, and to apply gold or silver leaf to the knots, which effectually prevents them from appearing afterward when the painting is finished.

202. *The next process is priming the work*, or giving it the first coat, which generally consists of white-lead, with some red-lead to make it dry soon. The wood in this coat absorbs a good deal of colour ; but it is important for the durability of the paint and the preservation of the wood, that the priming be executed carefully.

203. *The second coat of paint* is put on when this is dry, consisting of white-lead and oil, having an addition of a little oil of turpentine.

204. *Stopping* is the next process ; but previously, the work should be smoothed over with pumice stone, to take down any little prominences or minute chips that become apparent when the paint comes on. Stopping is filling all the nailholes, cracks, and irregularities of any kind, so as to make the surface close and regular. This is done by a putty made of oil and whiting.

205. *The third coat*, which, in common work, is the last, consists of the same materials, if the colour is to be white ; but as a perfect white is not always agreeable, nor likely to be durable, it is generally lowered, either by a little ivory or lamp black, if a silvery white be wished, or a little yellow ochre and burned umber, or some such colours, if a stone colour be required. This finishing coat should be laid on with peculiar care and in a workmanlike manner, not to show streaks or marks of the brush, nor leaving some places uncovered, while others are clogged with paint. In new work of the best kind, it is usual to give four coats of paint, particularly in outside work ; but in this latter the use of turpentine is to be avoided, as rendering the paint more easily affected by water. If any other tint than white be intended, the second and third coats have the proposed colour made up, which demands good judgment, and a practised eye in the person who mixes up the colour.

206. *Oil colour executed in the manner just described will have a gloss* when finished and dry, resembling an imperfect varnish, which is no inconvenience, but rather an advantage, in ordinary places, as this kind of painting will bear to be cleaned with soap and water, without disturbing the paint ; but in the best apartments this gloss has an unpleasant effect, and therefore it is destroyed by mixing a considerable quantity of oil of turpentine in the last or finishing coat, which occasions the paint to dry without gloss,

or be a *dead white*, or "flat," as it is called. This part of the process is accordingly termed *flatting*.

207. *The flatting is more difficult to do than any other coat*, and requires a more dexterous workman; for the turpentine evaporates so quickly that the work dries in a very short time, and the whole side of a room must be executed very quickly not to show marks of joining. More hands are, therefore, required if the work be large, or greater execution and despatch if small. From the quantity of vapour from the turpentine, this part of the process is often both troublesome and unhealthy to the men employed. Flatted painting, though more elegant and ornamental, does not admit of being cleaned or scoured so often as common paint, since the quantity of oil in the paint being small, the colour easily comes off: it will bear cleaning once, and perhaps, with care, twice or thrice; but common paint may be cleaned repeatedly, if done with judgment. Flatting is also much more expensive. Large surfaces sometimes require to be flatted twice, to render them complete. It is scarcely necessary to observe that each coat must be suffered to dry before another is laid on: but it may be too dry; and there is a point of time, which the painter knows, that is best suited to make the several coats adhere together firmly, and prevent scaling off.

It must be observed, that in all the above operations it is necessary to add some sort of dryer. A certain proportion of boiled oil is added to the raw, and sometimes a little sugar of lead ground in oil.

208. *Painting in oil on inside stucco* demands some farther precautions. It is absolutely necessary that not only the surface of the stucco should be quite dry, but likewise the walls upon which it is laid; otherwise, if there be the least dampness in the stucco, it is sure to cause the paint to scale off; and if the walls themselves be not dry before the stucco is put on, this also will frequently separate and come off in flakes. In general, in new houses, two or three years are not too long for the stucco to remain unpainted, though in houses got up on speculation, it is not unfrequent to allow scarcely as many months.

It is said to be best to lay on first a coat of linseed oil with proper dryers, that the stucco may absorb a sufficient quantity, and to follow this by three coats of oil paint, made up as before, allowing two or three days between each coat: at the third coat the ground colour may be laid on to receive the finishing colour, which is usually flatted. If it be necessary to make use of apartments before they are sufficiently dry to receive the oil colour properly, they may have a coat or two of distemper of any colour, which must be removed by washing, when the walls are to be painted in oil.

209. *The process of sanding* is frequently used to outside paint. This is dusting white sand on the last coat of paint to imitate stone; and, when done well, this has an excellent effect, and is durable.

210. *The most usual colours or pigments* employed in house-painting, to mix with the white-lead, are the following:

Reds.

Vermilion, a bright scarlet prepared from sulphur and quicksilver, being a sulphuret of mercury. *Red-lead* is lead calcined till it becomes a red oxyde. *Venetian red* is a native ochre. *Spanish brown*, also a native earth. *Lake* is alumina, the basis of alum, tinged with a dye from cochineal or Brazil wood: it differs much in quality. *Rose pink* is similar to the last, but inferior. *Red ochre* is produced by burning yellow ochre. *Burned Terra di Sienna*, the raw Sienna burned.

Blues.

Prussian blue is a preparation of Prussic acid and iron. *Blue verditure*, a colour from copper precipitated upon chalk. *Indigo*, a colour extracted from plants in India. *Smalt*, a glass coloured by cobalt, and ground to a fine powder.

Yellows.

Yellow ochre, called often stone ochre, a native earth of various qualities. *Dutch pink*, chalk coloured by French berries. *King's yellow*, arsenic combined with sulphur. *Naples yellow*, *Raw Terra di Sienna*, a native earth.

Greens.

Verdigris, a carbonate of copper. *Prussian green*, a composition similar to the blue of that name. *Terre verte*, a native earth.

Orange colour.

Orange lake, the tinging part of anatto or alumina.

Browns.

Burned umber, a native earth. *Asphaltum*, a native bitumen. *Bistre*, a kind of soot from peat smoke. *Cologne earth*, a native pigment dug up.

Blacks.

Lamp black, the soot of oil burned in lamps. *Ivory black*, ivory or bone burned to charcoal. *Blue black*, the charcoal of ivy twigs, or some other plants.

Whites.

Flake white, a superior ceruse. *White-lead*, carbonate of lead.

The above are all the colours usually employed by house-painters. We have omitted those which are only very seldom resorted to, or used in other branches of painting.

211. *Much judgment is required in making up the various tints used in house painting,* and adjusting them harmoniously to each other: our painters have of late years acquired considerable skill and taste in this part of their art; but it is impossible to give any useful verbal directions on this subject: experience and practice with those who are skilled are necessary, together with a good eye for colour. It may be sufficient here to mention the usual pigments employed in making up the tints that are most frequently employed. *Gray* is made with white-lead, Prussian blue, ivory black, and lake, or Venetian red. An inferior one with white, black, or Indigo, and Venetian red. *Pea* and *sea greens*, with white, Prussian blue, and yellow. *Olive green*, with white, Prussian blue, umber, and yellow ochre. *Fawn colour*, with burned terra Sienna, umber, and white.

Formerly it was the practice to finish much of the woodwork in white only; but this is now seldom done: some tint is preferred, as being less painful to the eye, and keeping its colour better.

212. *White paint preserves its colour best in pure air.* It is often remarked how much longer paint will keep white in the country than in town. This is partly owing to the smoke of the latter; but that is not the only cause, for the impurity of the atmosphere will change the colour of paint. Sulphuretted hydrogen is a very deleterious gas, composed of sulphur and hydrogen. (See VENTILATION.) Sulphur united to lead (or sulphuret of lead) is a substance of a blackish colour, with a metallic lustre; and when sulphuretted hydrogen is present where there is white-lead, the sulphur joins to the lead and forms a sulphuret. This deleterious gas, having the smell of rotten eggs, is generated where there are animal matters in a decaying state, and is abundant in the sewers, and places of that kind, where there are putrefying substances; consequently, white paint, in the vicinity of such places, is certain to turn very dark. This change of colour in paint may be more readily perceived in the basement stories of houses, and wherever there is any disengagement of foul air: it may, indeed, in some degree, be considered as a test of the purity of the air.

213. *Graining*, among house-painters, is understood to mean the imitation of the several different species of scarce woods used in articles of furniture; such as mahogany, satinwood, rosewood, kingwood, oak, &c. This kind of painting is now very generally practised, and frequently with great dexterity, some of these woods being so well imitated as scarcely to be distinguished from the originals. Some graining, as the imitations of rare and beautiful woods done in the best manner, is expensive; but graining like oak or wainscot is cheap, costing little more than flatting, and lasting very much longer. It is admirably adapted for doors, architraves, windows, sash bars, and other parts liable to become dirty; and in many rooms the whole of the woodwork is now grained in imitation of some wood or other.

214. *Marbling* is allied to graining, and both are generally performed, when in the best manner, by painters who confine themselves entirely to this branch of the trade. There is much skill and ingenuity shown in imitating the various marbles and porphyries by the study of good slabs of these materials; and when the selection of colours is judicious, the effect is certainly extremely rich, and much preferable to the quantity of cold white once almost universal in ordinary houses. But when the imitations of wood or marble are badly performed, the effect is, on the contrary, particularly disagreeable.

In rooms where there are many pictures hung up, the walls should be painted with a plain colour, as any printed paper injures the effect of pictures; and, in this case, the colour should be that which will suit the pictures best.

215. *The painting of ornaments* is a distinct branch of the business, and is practised only by persons who have learned to draw, and who devote themselves entirely to this art. The name of *Decorator* is now assumed by persons who either paint ornaments, or, more frequently, undertake to get them executed.

216. *When woodwork is to be repainted*, it should be first well dusted down and cleaned, stopping all the cracks and defects with putty; after which it should receive two coats of paint, either white or coloured, as may be required. Should any parts be greasy, the paint will not dry upon it, except the grease be first scoured off with pearlash, or turpentine be mixed with the paint: the first is the safest method.

217. *What is called clear-coat and finish* is a cheaper but less perfect mode of painting. First the cracks in the woodwork are stopped; then it is gone over with a coat of size only, with a little white-lead, which fills up the pores of the wood, and prevents its farther absorption; the next and last coat is of white-lead and oil, constituting the finish. This is a bad method, and altogether unfit for outside work, as the size prevents the perfect adhesion of the paint, causing it often to scale off. Dishonest painters, who undertake work by contract, sometimes practise this instead of painting in a proper manner, when they suppose their employers to be ignorant of the processes of painting; and it is sometimes not easy to detect the fraud when the work is finished. In some cases, however, this coat of size and white-lead is almost necessary, where old work to be repainted is so greasy and dirty as not to take the oil paint.

218. *House painters are liable to be affected by a disease* peculiar to them, called the *painters' colic*, which sometimes becomes fatal; and, if not removed in time, it often terminates in nervous apoplexies or palsy, first of the hands, then of the lower extremities, or depriving them of the use of their limbs. These diseases are owing to the white-lead, or carbonate of lead, of which they use so much. Dr. A. Thomson observes, in his "Materia Medica," that, when colic only is present, castor oil, combined with opium, are the best remedies; but if there is reason to suspect that a portion of the carbonate still is present in the stomach, sulphates of magnesia and soda should be administered: these salts convert the carbonate into a sulphate, which is inert, and is carried off by the remaining part of the salts. This author considers carbonate of lead as the only salt of lead that is directly poisonous, and that, with painters, the disease is frequently induced from want of cleanliness in not sufficiently washing their hands before taking their food. It acts, however, probably also upon the nerves of the skin. Of all the artisans who work in lead, the manufacturers of white-lead are the most in danger from the *colica pictorum;* and, before the present mode was adopted of grinding the white-lead under water, they suffered much from the dust of this material, which filled the air of the grinding-houses; but, since this improvement, very few cases of the disease occur.

219. *Painting in distemper* is mixing the colours up with size instead of oil as a vehicle. Some balls of fine whiting are laid to soak in water over night; and the size, rendered liquid by warming in a pipkin, is poured in, and well stirred up with the whiting. Some colours, finely ground, are added, according to the tints required. This kind of painting is much cheaper than oil-colour, and has no gloss whatever; but, though it looks extremely well if kept clean, it has the inconvenience of being easily stained; and, as it does not bear washing, any foul marks cannot be removed, neither can they be painted over, as the colour cannot be exactly matched again, and any attempt to touch them with paint would only increase the evil. It must be done upon very smooth and dry plastered walls, or upon papered walls. Woodwork is never painted in distemper, as it would not form a good preservative; nor can it be employed in outside work. It demands, like flatting, to be laid on with despatch and dexterity—not to be streaky and uneven. If possible, the whole side of a room should be covered before any one part has quite time to be dry; for this, sufficient colour should be mixed up, and a sufficient number of hands employed.

220. *Various tints in distemper may be made* as follows: *Straw colours*, with whiting, masticot, and Dutch pink; or with whiting, yellow ochre, and a little Venetian red. *Fawn colour*, whiting, Venetian red, and a little black or burned umber; or with white and burned Sienna. *Grass*, white and verditure, with Venetian red;, or with white, Venetian red, and Prussian blue. *Pea green*, with white and Olympian green; or with white, yellow ochre, Prussian blue, and raw umber. *Olive green*, with white, Prussian blue, and burned umber, and yellow ochre.

221. *Those who wish to paint in distemper* must practice mixing up the colours, which is more difficult than in oil, because the tints dry much lighter than they appear when wet. It is necessary, therefore, in order to ascertain what colour a certain mixture will produce, to paint a slip of paper over with it, and to dry it at the fire to see the tint: if this be neglected, the operator will be entirely deceived with respect to the colour of his painting. Nevertheless, it is so easily done, that any one possessed of a little ingenuity may paint over a small room; a circumstance worth knowing, where cleanliness with economy is a great object: and it has the advantage of giving little or no offensive smell during the operation, and for some time afterward, as oil paint does, but may be begun and finished in a day or two. Two coats are generally necessary to cover completely.

222. *When old plastering has become discoloured by stains*, and it is desired to have it painted in distemper, it is advisable to give the surface, when properly cleaned off and prepared, one coat at least of white-lead in oil, with some spirits of turpentine, which will generally fix all old stains that would otherwise come through; and, when quite dry, this will take the water-colours very kindly.

223. When we reflect upon the great importance of cleanliness in our dwellings, the value of painting, both in oil and in distemper, should appear striking. Many servants learn to whitewash very well; and sufficient knowledge of painting, both in oil and in distemper, may be easily acquired by those who are desirous of it: a circumstance which may be of great use to them some time or other in the course of their lives: not a few servants have gained their livelihood by practising painting as a trade.

224. *A very good substitute for size* can be prepared from potatoes. Make starch from the potatoes in the usual manner, mix the whiting and water to the proper consistence, and add the starch. This has the advantage of being wholly without smell, and is also beautifully white. It forms an excellent material for whitening ceilings. It may be observed that, as whiting is only washed chalk, the latter, pounded very fine, may be made shift with, when whiting cannot be procured.

225. *Milk Paint.* A paint has been used on the Continent with success made from *milk* and *lime*, that dries quicker than oil paint, and has no smell. It is made in the

following manner: Take fresh curds, and bruise the lumps on a grinding-stone, or in an earthen pan, or mortar, with a spatula or strong spoon. Then put them into a pot with an equal quantity of lime, well slacked with water, to make it just thick enough to be kneaded. Stir this mixture without adding more water, and a white-coloured fluid will soon be obtained, which will serve as a paint. It may be laid on with a brush with as much ease as varnish, and it dries very speedily. It must, however, be used the same day it is made, for if kept till next day it will be too thick: consequently, no more must be mixed up at one time than can be laid on in a day. If any colour be required, any of the ochres, as yellow ochre, or red ochre, or umber, may be mixed with it in any proportion. Prussian blue would be changed by the lime. Two coats of this paint will be sufficient, and when quite dry it may be polished with a piece of woollen cloth, or similar substance, and it will become as bright as varnish. It will only do for inside work; but it will last longer if varnished over with white of egg after it has been polished.

226. *The following receipt for milk paint* is given in "Smith's Art of House Painting:" Take of skimmed milk nearly two quarts; of fresh-slacked lime about six ounces and a half; of linseed oil four ounces, and of whiting three pounds; put the lime into a stone vessel, and pour upon it a sufficient quantity of milk to form a mixture resembling thin cream; then add the oil, a little at a time, stirring it with a small spatula; the remaining milk is then to be added, and lastly the whiting. The milk must on no account be sour. Slack the lime by dipping the pieces in water, out of which it is to be immediately taken, and left to slack in the air. For fine white paint the oil of caraway is best, because colourless; but with ochres the commonest oils may be used. The oil, when mixed with the milk and lime, entirely disappears, and is totally dissolved by the lime, forming a calcareous soap. The whiting or ochre is to be gently crumbled on the surface of the fluid, which it gradually imbibes, and at last sinks: at this period it must be well stirred in. This paint may be coloured like distemper or size-colour, with levigated charcoal, yellow ochre, &c., and used in the same manner. The quantity here prescribed is sufficient to cover twenty-seven square yards with the first coat, and it will cost about three halfpence a yard. The same paint will do for out-door work by the addition of two ounces of slacked lime, two ounces of linseed oil, and two ounces of white Burgundy pitch: the pitch to be melted in a gentle heat with the oil, and then added to the smooth mixture of the milk and lime. In cold weather it must be mixed warm, to facilitate its incorporation with the milk.

227. *A paint for outside work, called Anticorrosion,* is sold in London. It is made of ground glass bottles, scoria from lead-works, burned oyster-shells, and similar materials, mixed with the usual colouring pigments. It is sold in powder, and when to be used it is worked up with raw linseed oil. It is more difficult to lay on than common paint, and wears out the brushes fast; but it is cheap and extremely durable, never blistering, and, if well done, lasting a lifetime: hence it is much employed in government works: it is particularly good for protecting cast iron, stones, tiles, &c.

228. *The following methods of preserving wood* do not properly come within the usual practice of the painter, but they are useful on particular occasions.

229. *Charring the outside of wood* that is put into the ground, as the ends of piles, posts, and wood laid in the foundations, was practised by the ancient Romans, and is found very effective, as charcoal is perfectly incorruptible.

230. *Coal tar* is much better calculated to preserve outside wood and iron, as well in land as in water, than vegetable tar. It is procured by the distillation of coals in making coke, or coal-gas. Its unpleasant smell and blackish colour are objectionable in many situations, but the former wears off in a few months.

231. *Tar varnish* is made by melting common tar over a slow fire, and stirring in as much coal-dust or powdered charcoal as will make it thick. If required to be brown instead of black, put Spanish brown instead of charcoal.

232. *The tar obtained in the manufacture of pyroligneous acid* has been recommended by the late Mr. Parkes as the best preservative of every kind of wood fence. For this purpose, it should be gently heated in an iron pot, and laid on with a brush. It soaks into the wood, and seems to leave "no body," as the painters express it; but after some days' exposure to the sun, the surface and texture of the wood will be much altered, for it will be so hard and impervious, that it will be very difficult to make any impression on it. If a second or a third coat of the tar be laid on, it will then bear out. When these are dry, if required for ornamental work, it may be painted in oil in the usual manner.

233. *A coating to preserve wood in damp situations* may be made by beating twelve pounds of resin in a mortar, and adding to it three pounds of sulphur and twelve pints of whale oil. This mixture must then be melted over a fire, and stirred well while it is melting. Ochre of any required colour, ground in oil, may be put to it. This composition must be laid on hot, and when the first coat is dry, which will be in two or three days, a second coat may be given; and a third, if necessary.

234. *Gas tar,* with yellow ochre, makes a very cheap and durable green paint for iron rails and coarse woodwork.

235. *Composition to lay on a boarded building, to resist the weather, and likewise fire.* Take one measure of fine sand, two measures of wood ashes well sifted, three of slacked lime ground up with oil, and mix them together; lay this on with a brush, the first coat thin, the second thick. This adheres so strongly to the boards covered with it, that it resists an iron tool, and the action of fire, and is impenetrable by water.

236. *A flexible paint for canvass* is made by stirring into fifty-six pounds of common oil paint a solution of soap lye, made of half a pound of soap and three pounds of water: it must be used while warm.

237. *A black colouring for garden walls* may be made by mixing quicklime, lampblack, a little copperas, and hot water.

238. *A method of rendering fish-oil applicable to the purposes of painting* was communicated by Mr. Vanherman to the Society of Arts; and it appears to be a good and cheap vehicle for paint for out-door work which is much exposed to the weather. "Add to thirty-two gallons of vinegar twelve pounds of litharge and twelve pounds sulphate of zinc, shaking the mixture well twice a day for a week. The mixture is then put into a tun of fish-oil, with which it is well shaken and mixed; and the next day the clearer part, about seven eighths of the whole, is poured off. Twelve gallons of linseed oil and two of oil of turpentine are then added to the clear part, and this, being well shaken together, is left to settle for two or three days, when it will be fit to grind white-lead and all the fine colours in: these, however, are to be thinned for use with linseed oil and oil of turpentine."

Subsect. 8.—*Fresco Painting, and Encaustic.*

239. *Fresco is a kind of painting performed with water colours on a ground of stucco* while it is still wet, and admits of the colours sinking in, and drying with the stucco. It is extremely durable, and bears washing without injury; but it is very difficult to execute, because it must be performed with great rapidity, on account of the necessity of beginning and finishing a part while the stucco is still moist, on which account a picture cannot be sketched in, and carried on gradually, as in oil, since no more ground ought to be laid in one day than the painter can cover in that time; and he must complete immediately the painting on that portion, since the work cannot be retouched, except by distemper, which is imperfect.

It was much in use among the ancients, but their paintings in this way were not highly finished. Several considerable pictures have been executed in fresco by the great masters; but this art is little practised at present, although its durability makes it desirable that it should be employed in certain situations.

240. *Encaustic painting* was a method practised by the ancients, and which, though it has been tried with some success on the Continent, is not used in this country, although a few successful experiments have been made here. It consists in making use of wax as a vehicle for the colours, sometimes mixed with oil to render it more liquid, and then by heating the work with a chafing dish the tints are blended. This kind of painting has durability to recommend it.

Subsect. 9.—*Bronzing.*

241. *Bronzing* is a term applied to a common method of painting wood or iron work, or articles of plaster of Paris, such as busts, statues, &c., so as to imitate bronze. Real bronze acquires in time a coat of a dark green colour, owing to oxydation; but any parts of such bronze that may happen to be exposed to rubbing of any kind will have this crust worn off, and be made to assume a bright metallic colour. In bronzing, this effect is imitated. The first part of the process is to paint the whole over of the dark green just mentioned, which is done by a mixture of Prussian blue, yellow ochre, and verditer ground in oil. When two or three coats of this are nearly dry, but not quite, being still a little sticky, or, as it is technically named, *tacky*, a powder, called bronze powder, is rubbed, by means of a linen pad, on all the edges or places liable to be worn bright had the articles been really of bronze and exposed to friction. Bronze powder is sold in the shops on purpose, and is made by grinding Dutch foil and mosaic gold, or precipitated copper, to powder. When well done, the imitation of ancient bronze is very complete.

Subsect. 10.—*Paper-hanging.*

242. *The most usual mode of finishing the walls of apartments* at present is by covering them with ornamental printed papers, of which there is a great variety, from 1*d.* per yard to several shillings. The art was borrowed originally from the Chinese, by whom it has been practised from time immemorial. The colours employed are of distemper: a ground is first laid, and the patterns are printed by means of blocks and various colours, as in calico printing. The variety in the patterns of printed papers is endless, and is continually changing with fashion; gilding is frequently introduced in rich papers. The French have long excelled us in the designing of papers for this purpose, as they have in almost all architectural ornaments; and it is lamentable to see that the best papers in our shops in the present day are imported from France. Some of these contain

figures and landscapes of great merit, and the ornaments and flowers are exquisite. There are several modes of manufacturing papers for hanging. *Paper with a satin ground* is said to be produced by rubbing on the ground powdered French chalk (a variety of steatite) with a hard brush, till the lustre is produced. *Flock paper* is made by printing the pattern on the paper with some kind of varnish, and strewing this over with what is termed *flock*, produced by cutting to a fine powder woollen rags or pieces of cloth by means of machinery. This operation causes the pattern to appear as if it were cloth cut out and fixed on. In some of the best papers, the patterns are partly painted by hand. Some paper, finished with varnish, will bear washing, which is useful in places where it is liable to be much soiled; but the gloss has an unpleasant appearance, and such papers are not fit for elegant apartments.

Subsect. 11.—*Sun Blinds.*

243. *Sun blinds* are, in many situations, very necessary for keeping the apartments cool in summer, and for protecting the curtains, carpets, and other inside furniture, from the sun's rays, which are injurious to colours. They can scarcely be considered as ornamental in an architectural point of view, but they are tolerated on account of their great utility. They are placed either on the outside or inside of the sash; but are most effective in the first mode, because the sash and glass are thus protected from the heat, and, of course, the air in the apartment kept of more equal temperature. The simplest kind of outside blinds consists merely of a piece of cloth fixed to the top of the window, and either hanging down, or stretched out a little way at the bottom by some support. This is the most usual sun blind employed in Italy, and may be seen in pictures of that country, generally resting at bottom on a balcony often filled with flowers. They are usually made of striped cloth or canvass, and hence have a very picturesque effect. These are occasionally used here, but usually with a spring roller at the top, in a frame. Those termed by us *Venetian blinds*, are made of a number of narrow slips of wood, hung horizontally, as *fig.* 48, so that, when turned one way, they touch each other, and fill up the whole opening; but when moved a little, the surfaces are inclined, and then the edges being apart, they admit the air, though they exclude the sun's rays: the laths are confined at their ends by frames in the reveals of the windows, and they draw up entirely into a box or cornice fixed at the top. Blinds of the same kind are often placed at the inside of the sash, and then they turn upon lines of tape; but when they are upon the outside, a brass chain is employed, as being more durable. These are effectual in keeping off the sun's rays. *Shutter blinds* are a cheaper kind, which serve both as Venetian blinds and outside shutters: they are made of strong laths or luffer boards, either fixed in the frame, or turning all together by a lever handle, or pivots in the frame. When opened, they are fastened back like outside shutters. They are useful in windy situations, and where security is required. The latest improved blinds, and those now most generally used, are the *bonnet blinds*, *a*, *fig.* 49. They are of striped cloth, fixed to an iron framing at bottom, and are made to rise, by a rather complicated system of cords and pulleys, into a case of wood at the top of the window, and which is generally made ornamental. In these the sides are filled up, to exclude the oblique rays of the sun: *b* is the manner in which they are made for bedchamber apartments.

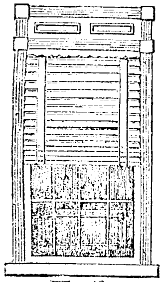
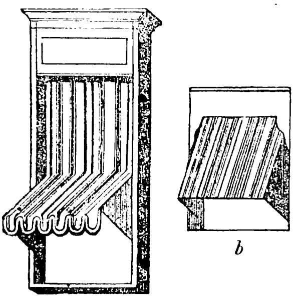


Fig. 48.



a *b* *Fig.* 49.

Subsect. 12.—*Bell-hanging.*

244. *Bell-hanging is performed by the smith*, and requires great attention. A bell should ring with a very slight exertion of the hand, and it should ring a sufficient time, and not too long, so as to be sufficiently heard where the servants are placed. The bell itself (*fig.* 50) is fixed to an elastic spring, by which it vibrates on being pulled by the wire; and there is another spring of spiral wire, to prevent the vibration from being too great. The wires are carried round the angles of apartments by means of cranks, which are of various kinds, to suit the external and internal angles. In some cases the wire or bell rope goes to the ceiling of the room, but now usually only down from the surbase moulding, where it may be rung by a small brass lever, or some other contrivance. The bell wires are always of copper, as iron would decay by rust.

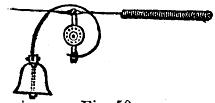


Fig. 50.

245. *An improvement in the method of disposing of bell wires* has been announced as

practised in Edinburgh. Instead of causing the wires to go along beneath the cornices, and across partitions and passages, in the usual manner, till they reach the bells they are designed to pull, a plan is followed by which not a single wire is seen in any room in the house. From the top of the bell-pull in each apartment the wire is carried straight upward in a small tin tube sunk in the plaster, to the vacancy below the slates; here the wires of the whole house meet, and from thence descend in another tube, branching off to their respective bells. By this means each wire has only two cranks, or at most three, in its entire course: all boring of partitions is avoided, and also the appearance of wires in the rooms.

246. *It is convenient to arrange all the bells in the basement story in a line*, each having the name of the apartment it belongs to; for though in a small house the servant knows each bell by its sound, yet when there are many this may be difficult; but on going to the place where they are hung, it may be seen which bell has rung by something of the vibration being still visible.

SUBSECT. 13.—*Verandas and Balconies.*

247. *The Veranda is an ornamental addition borrowed from India*, where the climate demands every assistance from shade. Although they are not equally necessary with us, yet they are often useful, and have an appearance extremely agreeable when tastefully attached to a country residence. They do not unite well with architectural decoration, but have this advantage, that of themselves they give an air of elegance to a house otherwise extremely plain. The framing is generally formed of wood painted; and in case of being highly enriched with ornament, cast iron has been found both durable and economical. The roofs are painted oil cloth, sheet copper, zinc, or tinned iron painted. Care should be taken that the balconies are sufficiently strong, and securely fixed in the wall. Not being necessarily connected with any particular style of architecture, they are capable of endless variety in their design.

248. *Balconies* are well known, and are made of stone or iron, and of various patterns. When of iron, it is an important precaution not to place the bars at such a distance that a child coming into the balcony can get its head between; since cases have occurred (and the writer of this article was witness to one) where a child, having put out its head between the bars, could not by any means draw it back again, and a smith was obliged to file or saw the bars through before the child could be extricated from this dangerous situation.

SUBSECT. 14.—*Decorative Sculpture and Carving.*

249. *There is generally more or less of these in every modern house.* The talents of the sculptor in marble are exercised occasionally in statues, bas-reliefs, vases, and other ornaments, as likewise in capitals and other parts of columns, and in chimney-pieces; but this material is too expensive to be in general use among us. Few of our native stones are fit for durable architectural sculpture, with the exception of one variety of magnesian limestone that has been employed for the sculpture in the triumphal arch before Buckingham Palace: Portland stone has been a good deal used; but it is coarse, and, except selected with care, not very durable, as may be seen in some of our public buildings. Bath stone is easily carved, but is less durable than Portland. This deficiency in a good material has led to the invention of various kinds of artificial stone.

250. *Coade's artificial stone* was at one time much in use for architectural ornaments. It is a sort of pottery, and easily worked, when soft, into any form: it is perfectly durable, but liable to warp in baking.

251. *Ranger's artificial stone* is composed of fresh-burned lime and sand, put into moulds: this sets extremely hard, and has been employed with some success in building.

252. *Austin's artificial stone* is excellent for architectural ornaments of all kinds, as vases, statues, chimney-tops, &c., and is now much in use. Ornaments in plaster of Paris we have mentioned when describing the business of the plasterer; and those made in Parker's cement when treating of stucco.

253. *A great variety of ornaments*, particularly light Gothic enrichments, are now made with advantage in cast iron.

254. *Carving in wood*, at one time carried to such perfection, has declined through the inventions of a *composition* of whiting and linseed oil, in which ornaments are cast and fixed on to wood with glue; and also by the employment, now so very general, of *papier-machée*.

255. *A process for imitating wood carving* may be mentioned as one of the novelties of the day. It is the invention of Braithwaite. The wood, instead of being cut as in the usual manner, has the pattern burned out by the application of a heated metal mould, and the charcoal so formed is brushed out after each successive application of heat, until sufficient depth is acquired. Care, of course, must be taken that the wood does not inflame during the process: this is prevented by wetting the wood.

256. *Papier-machée* is a very elegant manufacture, now much employed for forming

ornaments, as a substitute for carving, and casts in plaster of Paris. It is made of a pulp from rags or paper, which, being mixed with size and glue, and cast in a mould, becomes extremely hard when dry. It is much used for flowers and other ornaments in the ceilings, and various other places in apartments. There are several manufactories of it, one of the best of which is Messrs. Bickfield & Co., London. These ornaments are much less liable to break than those of plaster.

If decorations of a sculptural kind are introduced, the design and execution should display good taste ; otherwise they are better entirely omitted.

257. *Scagliola* is a very beautiful imitation of coloured marble, and porphyries ; so close an imitation, indeed, that, without a near inspection, it cannot be distinguished from these stones. It is much employed in internal decoration, for columns, pedestals, and various supports of statues and vases, and sometimes to cover parts of the sides of apartments. It is composed chiefly of plaster of Paris, with colouring matters, cemented by glue, and having sometimes fragments of alabaster inserted, to imitate verd antique. From the nature of its composition, it is not fit to be exposed to the weather out of doors, and requires to be kept dry ; but answers admirably in interiors, where great richness at a small expense is required.

Subsect. 15.—*Water-pipes.*

We have already mentioned the necessity of an abundant supply of good water in every spot where it is resolved to build, either from wells, rivers, or by some artificial means. In most cities of England this is now well managed by means of public water-works, that supply every house with this great necessary of life. The disposing of the water-pipes and cisterns in a building should not be left to the plumber only, however skilful ; but all the details should receive the attention of the architect, in designing, when provision can be made for placing the pipes properly, which, if not done at first, may sometimes be found difficult or inconvenient afterward.

258. *In London* [and still more in New-York, and some other American cities] *the abundance and cheapness of the supply of excellent water by means of the water companies* is admirable, notwithstanding the outcry raised by ignorant or unprincipled persons : in many parts of the metropolis water can be served to the upper stories from the ordinary sources ; and when this cannot be done, it may be elevated sufficiently high by force pumps.

259. *The advantage of having water laid on in the bedchamber stories* to supply baths,* or for other purposes, is too obvious to require being stated, and should not be neglected in a new house, where the expense does not forbid so great a convenience. Wherever there is any degree of complexity in the pipes or other apparatus necessary for the supply, an accurate drawing should be kept of the whole, that may give the requisite information in case of repairs or alterations. For the properties of good water, and the methods of filtering, we refer the reader to the article in this work on that subject, Chap. I., Book VIII.

260. *To prevent the water in the lead pipes from freezing* in winter, which frequently causes them to burst by the expansion of the ice, any portion that is exposed to the external air should, at the commencement of a frost, be well wrapped round by some non-conducting substance, as straw ; and in case of the pipe passing through the house, it is a good plan to have a cock on the part of the service-pipe where it enters, which being shut as soon as the cistern is filled, the pipe may be emptied of water, and remain so until the water comes on again, by which means all danger of the water freezing in the pipes may be avoided, a circumstance which, when it happens, is very annoying.

261. *The construction of cisterns* with *ball-cock* and *waste-pipe* is too well understood to require being mentioned in detail : the first being to prevent the water running after the cistern is full, and the last to prevent the cistern from overflowing in case of any accident to the former. It is a good precaution to lay the pipes in such a manner that they can be easily got at, in case repairs should be necessary. Sinking and forcing pumps are provided by the plumber.

262. *For pumps*, see "Kitchen Furniture," Book XI

Subsect. 16.—*Water-closets.*

263. *The great utility of water-closets* is so well known that little need be said on the subject, but that they are indispensable in every house where comfort is aimed at. As they are very troublesome when out of order, some pains should be taken to select one of good construction ; and it is better to give a higher price than, through too great economy, to run the risk of getting one imperfect. Various patents have been taken out for this apparatus ; but we believe that no construction is superior to the original one, that by the late Bramah. The general principle of all is the same : a cistern of water is placed above, and in the bottom is a valve, which is opened by the motion of the han-

* [In the city of New-York all these, and still greater advantages, are furnished to the citizens at a very low rate by the municipal authorities, who have introduced pipes conveying pure water from a river forty miles distant, the particulars of which are related in a subsequent part of this volume.]

dle on the seat, by which the water rushes down into the basin, while the same handle, by means of a lever, opens another valve below in the soil-pipe, the water passing through it. It is scarcely possible to render a description intelligible, without inspection of the apparatus itself.

264. *A simple and cheap water-closet* is the following: *a*, *fig.* 51, is the earthenware basin, the lower end of which terminates in a neck that dips under the water in a leaden vessel, from which a pipe descends to the drain. *b* is the cistern of water placed above at a proper height: this cistern has a waste-pipe, *c*, which not only prevents the water in the cistern from overflowing, but it also goes into the leaden vessel, and keeps it filled every time the water comes on, thus preventing that part from becoming ever dry, if it should not be used. The supply to the basin is by a pipe, *d*, coming from the cistern, and having a valve at the bottom, seen on a larger scale at *e*: this valve is raised, when water is required for the basin, by pulling a string, attached to one end of a small lever, fixed on the edge of the cistern, to the other end of which is a chain that raises the valve. The lower end of the basin being thus always under the water, no foul air can ascend. Some, instead of this valve and lever, put a cock on the pipe, *d*, which may be turned when necessary; and this cock, if brought to the seat, may be turned by a handle similar in appearance to the better kind of water-closets: but the cock does not afford sufficient water way, which occasions the water to flow too slowly; whereas the valve may be made of any size, and may, therefore, give a sufficient and sudden supply.

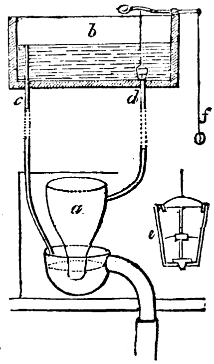


Fig. 51.

265. *Portable water-closets* are described under "Furniture."

266. *Privies to be used without water* may be constructed in various ways. One is, to have a basin, as in a water-closet; and to continue down from it a tube so far into the cesspool below as to prevent the rising through it of air, and, consequently, of smell. If all the waste water of the house is poured into the basin, neither that nor the tube will ever be choked up; in which case, this construction may be considered one of the best for preventing smell. Another mode is to have no basin, but to take care that the surface of the cesspool exposed to the air is no larger than necessary, and that the seat be secure and free from crevices. It is best to have, besides the usual circular cover, another square, large cover, such as is used in water-closets.

267. *An ingenious contrivance was invented by Mr. Strutt, of Derby,* and employed in the Derbyshire infirmary, by which the air in the place was changed by the motion of the door, which, at the same time, disengaged the water for the closet itself, without any care of the person using it.

Subsect. 17.—*Fountains.*

268. *Fountains,* so great a luxury in warm climates, do not appear to be generally wished for in this country; and they are expensive ornaments, except in remarkable cases, where the supply of water is very easily obtained. The principle upon which the simplest kind is formed is sufficiently obvious; the height of the source for the water must be as great as that to which the fountain is to play. Fountains on a very small scale, on the principle of that called Hiero's, are sometimes put into conservatories, and similar places, and then are elegant decorations.*

Subsect. 18.—*On rendering Houses fire-proof.*

269. *To render all dwelling houses fire-proof* is obviously desirable; but although many inventions have been made with this view, and experiments have been made sufficient to show that it is quite practicable, yet none of the methods have been found so free from objections of some kind, either on account of the expense, or from some other cause, as to be brought into general use. The chief means proposed have been iron roofs, floors supported by iron or flat brick arches, plaster, or what is called pugging under the flooring boards, stone or iron staircases, brick, or at least brick-nogged, partitions, metal sashes, iron plating round all timbers: in short, using metal, or brick and slate, wherever it is possible, instead of wood. By taking advantage of these, any house may be rendered fire-proof in building, although the expense will be somewhat increased; and, considering that the additional cost need not be very considerable compared with the comfort of security, it is much to be regretted that, in all apartments where valuable property, such as libraries, museums, or galleries of works of art are deposited, means should not be resorted to, to render them safe from destruction by fire; and we add, that it is surprising that the practice of rendering houses fire-proof should not become gen-

* [In the city of New-York, public fountains on a large scale adorn the numerous parks and open squares, while in the gardens, and even at the doors of the citizens, the supply of water is so abundant, that ornamental fountains and jet d'eaus can be placed at a trifling expense, a convenience of which many are availing themselves.]

eral. But the description of the details respecting the various methods that would effect this object would far exceed the limits of this work.

The importance of this for a house built in the country must appear so much the greater, where that assistance from fire-engines cannot be had that towns afford.

BOOK II.

ON WARMING DOMESTIC EDIFICES.

CHAPTER I.

ON HEAT.

270. *Introductory Remarks.*—The various modes of producing an agreeable temperature in our apartments, at all seasons of the year, are important to be understood. Many uncivilized nations, accustomed to a life of hardship, and passing their time chiefly in the open air, are rendered nearly insensible to slight changes in its temperature, and the comforts of domestic life are little known to them.

271. *A few centuries ago, the inhabitants of this country,* whose time was spent principally in war and the chase, appear to have attached little importance to their ordinary domestic edifices; and while their ecclesiastical buildings, their palaces, and castles, displayed the skill of the architect, the habitations of private individuals were, in general, only wooden buildings of mean appearance and inconvenient arrangement. The habits of modern life require the interior of our houses to be objects of more attention, and the infinite number of pursuits causing a great part of our time to be passed within doors, make it necessary, both for health and the advantageous employment of our faculties, that we should not suffer from cold or deleterious air, while deprived of that bodily exercise which imparts warmth and animation to those whose employments carry them chiefly into the open air.

272. *In the southern parts of Europe,* indeed, artificial warmth is so seldom required, that the means of obtaining it are even now exceedingly rude and imperfect, frequently amounting to no more than introducing a charcoal stove, or, rather, a brazier, or open vessel filled with burning charcoal, into the apartment, a practice which would be extremely injurious to health if continued for any length of time. But in this country, where the cold season is not only more severe, but of much longer duration, various modes are adopted which are much less objectionable. Still, we are far from being under the necessity of employing the methods used in the north of Europe, where nothing less than close stoves, which produce no change of air in the apartments, are sufficient to ensure the degree of warmth essential to comfort.

273. *When we treat of Ventilation,* we shall explain particularly why this change of air is so important to health: at present, we shall consider this to be admitted; and we may do so the more readily, as the subject is beginning to be generally attended to. It is desirable, therefore, in the method we may adopt for warming our buildings, to contrive not only the most economical, but also that which will secure to us the enjoyment of a salubrious atmosphere.

But as the subject of warming and ventilating cannot be understood without an acquaintance with the properties and laws of heat, we shall inquire into the nature of this agent previously to pointing out the most judicious manner of directing and employing it.

SECT. I.—ON HEAT.

274. *Heat is recognised as a principle rather by its effects than by any knowledge we possess of its essential nature.* Every one experiences the presence or absence of it in the sensations of warmth and of cold; and we all witness the changes produced by it on other bodies, in causing them to expand, or to melt; and likewise in the process of combustion. But if we inquire, what is this heat, the effects of which are so evident? the answer is not so easy.

By some, heat has been considered as an extremely subtile fluid, capable of insinuating itself between the particles of all bodies; of remaining there in a dormant and inactive state, or of being put in motion or activity, by which only it is rendered sensible. This supposed fluid has been named *caloric.*

By others, the existence of any such peculiar fluid is denied, and heat is said to consist merely in a rapid motion of the solid particles of bodies that are heated. A third opinion is, that heat depends upon the rapid vibrations or waves of an inconceivably subtile fluid, or ether, which fills all space, and is quite independent of the ordinary matter appreciable by our senses.

Since all these opinions are hypotheses only, and as neither of them can be completely proved in the present state of our knowledge, we may speak of heat as a distinct substance, which is the doctrine that can be most easily adapted to the explanation of the usual phenomena we shall have to consider; observing, that we do so for convenience only, without intending to express any opinion as to its absolute truth; and we shall proceed to describe some of the properties of heat, which are essential to our present subject, as they have been deduced from experiment, and entirely independent of every speculation respecting its essential nature.

275. *Heat has a strong tendency to diffuse itself equally through all adjoining bodies;* so that if several bodies, heated to different degrees, are brought together, either in contact or near one another, those which have most heat will give out some to those which have least, until they have all an equal quantity. This is one of its most important properties, and is usually expressed by the term *propagation of heat.*

276. *Heat is propagated in two ways:* by *conduction,* and by *radiation.* When bodies are actually in contact, the superabundant heat of the one passes directly into the other, and diffuses itself through it until the quantity in both be equal: this is propagation by conduction. When heat is propagated by radiation, a heated body sends out invisible rays of heat in all directions through the air, which strikes upon and enters into all adjoining solids; tending, in like manner, to equalize their temperature.

277. *An increase of heat causes all bodies to expand,* or *become larger in their dimensions.* This is easily shown by a few simple experiments. 1. With regard to solids: procure a small cylinder of metal, *a*, and also a plate of metal, *b* (*fig.* 52), having a notch cut in it exactly equal to the length of the cylinder; make also a hole in this plate so large that the cylinder may just fit it. Now heat the cylinder in the fire, and, on applying it to the notch, it will be found to be increased in length by its no longer fitting it; and the thickness will likewise be found greater, as it can no longer be pushed through the hole in the plate. When the cylinder cools, it will shrink again to its former size. By similar observations on other substances, it will appear that all expand by heat, and contract by cold or the decrease of heat; but some more than others: metals expand most, and glass is among the least expansible; wood expands and contracts considerably across the grain, but very little in the direction of the grain; thus a bar of wood varies in its length less than a bar of iron.

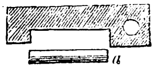


Fig. 52.

278. *The expansibility of liquids is seen distinctly in the thermometer,* where the quicksilver rises and falls in consequence of the increase and diminution of its bulk, as the weather becomes warmer or colder. *To observe how air expands,* lay a half-blown bladder before the fire, and in a few minutes the air within it will swell so much that the bladder will be completely extended; but when it is removed from the fire, the air, as it cools, will contract to its original bulk.

279. *The shrinking of baked clay,* when exposed to a high degree of heat, may seem to be an exception to the general law just mentioned; but it is only apparently so, for this contraction is owing to the heat expelling the moisture which the clay contained, in consequence of which the parts come closer into contact.

280. *The unequal expansion and contraction of layers of different substances applied on each other* is frequently productive of serious inconvenience. It is this that occasions earthenware to be covered with innumerable minute cracks after some time; and this unequal expansion is also the reason why glass and earthenware are so easily broken by pouring liquids into them suddenly without gradually warming them. The surface where the hot fluid is applied expands before the opposite side has time to do so, and a crack is the consequence. The thinnest glass is the least liable to this accident, because it is soonest heated through. Throwing water upon heated cast iron produces a similar effect, by cooling one side more rapidly than the other.

281. *Heat does not pass with equal facility through all bodies.* Those which permit its passage the most readily are termed *good conductors;* and those through which it passes with difficulty are called *bad,* or *slow conductors* of heat. Metals are the best conductors, and charcoal, wood, glass, earthenware, water, and air are the worst. To illustrate this, heat one end of a rod of iron in the fire, and it will be perceived that the other end will soon become so hot that it cannot be held in the hand, because the heat passes readily from the end in the fire to the other end; but a rod of wood may be held in the fire until one end is burned without the other being heated so that it may not be easily held, because the heat passes with great difficulty through the wood. The same may be experienced with a rod of glass. It is of very great importance, in the management of heat, to know the various powers of substances in conducting it, or, in other words, suffering it to pass through them, or preventing its passage, as upon this depends our means of confining it, so often necessary.

282. *It is obvious that to confine heat, or to prevent it from escaping,* we must surround it with the slowest conductors, of which brick, charcoal, wood, and air are often the most convenient. In general, the densest substances (for instance, metals) permit the passage of heat the most readily; and, on the contrary, the most porous and lightest bodies are the worst conductors and the best confiners of heat. As a few illustrative examples of the application of this principle, we may mention that boiling water may be carried a long way hot by putting it into a thick wooden cask. Wooden handles are put to metallic

tea and coffee pots, or other hot vessels, because wood is a slow conductor of heat. Heat may in a great measure be prevented from escaping from bodies, by being surrounded with pounded charcoal, sawdust, or pumice, or by air confined between plates; and water may be kept long hot, by the vessel containing it being wrapped round with woollen cloth or any light porous material. But as there is no substance a perfect or absolute nonconductor, that is, through which heat will not be transmitted more or less, so we have no means of preventing heat from escaping in some degree: when we wish to confine it, we can only select as a barrier those substances through which it finds its way with the greatest difficulty.

283. *For the same reason, all slow conductors part with their heat with greater difficulty, and retain it much longer than good conductors.* From these principles many facts are easily explained. Brick is a bad conductor, and we have shown that metals are the best. A brick stove will, therefore, be longer in heating through than an iron one, but will be much longer in cooling or parting with its heat. Water is a bad conductor of heat, and so is glass; a bottle of hot water will, therefore, keep long warm, but still longer if wrapped in flannel. Every one has remarked that, after standing some time before the fire, the money in one's pocket feels much hotter than the clothes. This, however, is a deception, for it is not in reality any hotter, as may be proved by the thermometer. Whence, then, the sensation of superior heat in the metal when touched? The fact is, that the metal, from its being the best conductor, parts with its heat more readily to the hand than the clothes, and, consequently, excites in a greater degree the sensation of warmth. If iron, marble, wood, and flannel be exposed to the sun's rays together for a certain time, they will all acquire the same temperature, yet, upon touching them, the metal will feel the warmest; and if they are exposed together to the cold, the metal will soon feel the coldest, notwithstanding the thermometer will show the heat of them all to be equal: the reason will be easily deduced from what we have already said.

284. *It is to be observed that there is no such thing as absolute cold,* cold being only a loss of heat, and not a thing positive. It was at one time supposed that there were rays of cold as well as of heat; but this is now considered to be an error. Nor do we know any substance deprived altogether of heat: although intense degrees of cold can be produced, still it is imagined that we have never arrived at the greatest possible degree of it.

285. *Fluids of all kinds, and air, are much worse conductors than solids;* indeed, they can scarcely be said to conduct heat in the same manner as solids. The particles of solids being fixed, heat is communicated from particle to particle, until it has passed entirely through; but water and air scarcely at all transmit heat in this manner; their parts, being moveable, become expanded by heat, and, consequently, specifically lighter: hence they rise upward when they are heated, and give place for others to be heated in their turn; the several parts of these fluids are, therefore, in constant motion while heating; but if this motion be prevented or obstructed, fluids form the most perfect barriers to heat that are known. It is for this reason that double sashes to apartments are much used in Russia and other northern countries, because the confined air between them does not admit of the passage of heat through it.

286. *Count Rumford found that the nonconducting property of air was much increased by mixing with it some light loose substances,* as wool, or, what is best of all, eider down; and he very ingeniously explains the reason why these and similar substances are so effectual in forming warm clothing. He observes, that "the warmth of the wool and fur of beasts, and of the feathers of birds, is undoubtedly owing to the air in their interstices, which air, being strongly attracted by these substances, is confined, and forms a barrier, which not only prevents the cold winds from approaching the body of the animal, but which opposes an almost insurmountable obstacle to the escape of the heat of the animal into the atmosphere. In the same manner, the air in snow serves to preserve the heat of the earth in winter. The warmth of all kinds of artificial clothing may be shown to depend upon the same cause; and were this circumstance more generally known, and more attended to, very important improvements in the management of heat could not fail to result from it. A great part of our lives is spent in guarding ourselves against the extremes of heat and cold, and in operations in which the use of fire is indispensable; and yet how little progress has been made in that most important art—the management of heat!"

287. *The mode in which heat is communicated to water in our ordinary processes* is a very interesting and useful subject of inquiry. We have already stated that it is not heated in the same way as solids, and we have briefly explained the manner in which its temperature is raised; but as the heating of water forms a very important part of our subject, we must enter more minutely into some of its details.

And, first, it is proper to be known that, until Count Rumford published his very curious observations, it had not struck philosophers that there was any remarkable difference in the mode of heating water or other fluids, and solid substances; and it is worth while to mention the circumstance that led him to make so valuable a discovery, because it points out, in a striking manner, the utility of observing with attention, and reflecting upon, many of the ordinary occurrences that are continually happening around us. Wishing to cool some spirits of wine in a wide glass tube, he placed it in a window; after a short time, casting his eye upon the tube, he observed some particles of dust which had got in moving upward and downward with considerable celerity, and it struck him that these motions were too regular to be accidental. He continued to observe them with attention, and saw that they diminished gradually as the fluid lost its heat, and ceased altogether when it was cold. He found, also, that these motions were renewed upon every fresh application of heat. He afterward converted this into a beautiful experiment by employing minute grains of amber instead of the dust, by means of which the motions were rendered much more visible. Reflecting upon this experiment, and varying it in many ways, he at last was convinced that these motions were entirely owing to currents in the fluid, and that it was by these currents that the cooling, and also the heating of liquids, is effected. When any part of the water is heated, and particularly if it be that at the bottom, which is the case when a vessel full of water is put on the fire, it expands, becomes specifically lighter, and, as we stated above, rises to the surface, and sends down an equal portion to be also heated: when this is effected, the portion sent down rises for the same reason, and displaces another portion; and in this way there is a continual change of place among the parts of the fluid, and ascending and descending currents established, until the whole has received the same temperature. In the case of cooling, the motions will be similar; the surface will cool first, and this water will descend: the same will happen to what arrives at the top, which will also descend when it is cooled, and so on till the whole is equal. From this we may see the reason why water is sooner heated or cooled in a shallow than in a deep vessel: the currents upward and downward having less space to traverse, the change of the whole is sooner effected.

288. It is obvious, from what has been said, that *water cannot be heated, except in a very great length of time, by applying heat to its surface.* This may be easily shown by a simple experiment. Put some cold water into a deep glass tumbler, and hold just over the surface an iron heater made red hot; although the water at the surface will receive some heat, this will not extend downward, and the whole will be scarcely warmed in a very long time. Even if some ether be poured upon the surface, and set fire to, it will burn all away, and yet very little heat will be communicated to the water.

To heat water effectually, therefore, the heat must be applied *at the bottom of the vessel* containing it; little effect is produced even if it be applied to the sides of the vessel.

289. *As it is very important to have a clear idea of various circumstances respecting the boiling of water*, it will be worth while to make the following easy experiment: Fill a Florence flask (one of those in which salad oil is imported) about half full of water, and place it over a spirit lamp, or chafing-dish of charcoal. In a few minutes very minute bubbles will rise from the bottom to the surface; these consist of air that is always combined with water in a natural state, and which, being rendered elastic by the heat, separate from the water. A motion will soon be perceived in the water, which will be more evident if a few particles of dust be thrown into it; this motion is occasioned by the currents which we have already mentioned. At the same time, it will be seen that some bubbles of steam form at the bottom where the heat is applied, and rise upward; but many of these, instead of arriving at the surface, will disappear in the middle, being condensed again by the cold of the water in the upper part. A hissing or simmering will now be heard, owing to the formation of the bubbles of steam; the latter also increase in quantity, and agitate the water in their ascent, which is the cause of what is termed *ebullition.* At last this bubbling becomes rather violent, and much vapour rises from the surface, which shows that the water is near to boiling. The vapour, lastly, becomes steam, and the ebullition is at its height.

If the bulb of a thermometer be plunged into the water thus made to boil, the mercury will gradually rise till it reaches 212°; but it will rise no higher, however long it may be kept there, or however the fire may be urged; by which we find that water cannot be heated in an open vessel to more than 212°. The steam that rises, if examined close to the water, will show the same degree of heat. 212 degrees of Fahrenheit's thermometer (which is that commonly used in England) is called the *boiling point of water;* and as soon as this fluid is heated in a vessel without a cover, or with one loosely fitted on, up to 212°, it is converted into steam, as we have seen in the experiment.

It is necessary, also, to observe here, that, though 212° be the boiling point of water, it is not that of all liquids: thus, spirits of wine boils at 176°; ether at 96°; while, on the other hand, turpentine requires 316°, and mercury even 662°. Salt water requires more heat to make it boil than fresh; and hence, when it is wished for some purposes to make water several degrees hotter than 212°, salt is added to it. Sirup requires 220° to make it boil.

Another fact may be mentioned. The substance of which the vessel is made has some influence upon the boiling points of a liquid: thus, water boils at 212° in a metallic vessel, but in one of glass it will not boil till it is heated to 214°: water, therefore, can be made 2° hotter in a glass vessel than in one of metal.

290. *The boiling of every liquid is merely the conversion of it into the state of elastic vapour* by means of heat; and, since various fluids have different degrees of volatility, they, of

course, boil at different degrees of temperature. Thus, sulphuric ether boils at 98°; alcohol at 176°; water at 212°; turpentine at 316°; sulphuric acid at 546°; and mercury at 662°; scarcely any two liquids agreeing exactly in their boiling points. Of this fact advantage is taken in various processes; for instance, when two liquids, as alcohol and water, having different degrees of volatility, are mixed together, they are easily separated by a heat that shall raise one in vapour but not the other; and this forms the foundation of the art of distillation.

291. *But the pressure of the atmosphere modifies, in a considerable degree, the volatility of liquids;* for if that pressure be more considerable than usual, which is indicated by the barometer being high, it requires more than the ordinary degree of heat to raise the liquid into vapour. In speaking of the boiling points, therefore, we always suppose that the pressure of the atmosphere is that which most usually prevails, or which keeps the barometer up to thirty inches. Water, at this degree of pressure, boils at 212°; but if the pressure be considerably less, and the barometer fall down very low, water will boil or become steam with a less degree of heat. This fact is neglected in speaking on the subject in ordinary cases; but there are other cases when the difference is very striking. For instance, if we ascend a mountain, or even a very high hill, where the barometer would fall sensibly, we should find that water would boil although the thermometer indicated the temperature to be several degrees below 212°; and there, consequently, it would be impossible in an open vessel to heat water up to that point, since, before it reached it, it would be converted into steam; even an elevation of a few hundred feet will make a difference of a degree. In every case, however, when water is converted into steam by heat, it is proper to say that it *boils*, although the temperature may be less than 212°. So accurate is this law, that the heights of mountains are now measured by ascertaining with the thermometer the degree at which water boils on their tops.

292. *A very important application has been made* of this curious fact. As it is possible to exhaust the air over the surface of a liquid in a closed vessel, we can take away the pressure of the atmosphere entirely from it, and thus boil it *in vacuo;* and by this contrivance water can be made to boil even at 72°, which is the heat of the human body.

293. *On the contrary,* if we give additional pressure to the surface of the water, the steam is less easily produced, and the water requires a much greater degree of heat to make it boil, which might be done by forcing in more air upon the surface of the water; but this is not necessary, for the steam itself, if confined where formed, presses, by its elasticity, upon the surface of the water in the same manner as condensed air would do. All that is required, therefore, is to fix down the lid of the vessel in which the water boils, and the steam which begins to form, not being able to escape, will have the same effect as atmospheric pressure; and the temperature of the water may then be raised even to 500° or to 600°, in which case its solvent powers will be proportionally increased.

This is the principle of the vessels called *digesters,* employed in cookery. See "Kitchen Furniture." But as steam, when confined, has a prodigious elastic power, care must be taken that such vessels are sufficiently strong to resist its power, otherwise they would burst, as if by gunpowder, an accident with which, unfortunately, we are too well acquainted in steam navigation. To guard against this, safety valves are necessary; that is, valves which open outward, and suffer the steam to escape through them as soon as its strength becomes too great for the safety of the boiler.

294. *Steam is a particular state of water;* it is aqueous gas, having always the heat of 212°, and is itself quite transparent and invisible, like the common air, while it is kept at that heat; but no sooner is it cooled in the slightest degree than it is condensed into a visible vapour. This may be seen in a common teakettle when it is boiling; the steam from the spout is not visible till it is nearly an inch from the orifice: it issues quite transparent, but soon becomes a little condensed and visible by the cold of the atmosphere. Though the steam that rises from the surface of the boiling of water in an open vessel is visible, being in the state of vapour just mentioned, yet this soon disappears, having been dissolved by the air in which it mingles; but if the vessel be closed, and have a pipe connected with it, as, for instance, with the spout of a teakettle, the lid of which fits very close, the steam may be conducted in a transparent state, and of the temperature of 212°, to a considerable distance, and may be applied to many purposes.

295. *But steam requires to be kept up to this heat* of 212°; for if it meet with any colder substance, it will be robbed of part of its heat, and it then immediately returns to the state of water, which is called the *condensation* of the steam. This may be easily perceived by holding any cold substance in the steam that issues from a teakettle, when it will be condensed in drops of water upon the surface.

296. *Steam is itself, while in that state, perfectly dry,* and it is only when it is condensed that it exhibits moisture, when, in fact, it is returning to the state of water, which, we have observed, it always does when let loose into the atmosphere, or brought into contact with a surface colder than itself. The process of distillation gives a good example of the condensation of steam. The water, by being boiled in the still, rises as steam

into the still head, from which it passes in that state into the worm; it is there condensed, and runs out in the state of a liquid.

297. *We have stated that caloric, or heat, is thrown off from the surface of a solid hot body in straight lines;* and as it proceeds in every direction like radii from the centre to the circumference of a circle, it is said to *radiate* from the body.

That heat is really emitted in this manner, and not conveyed by a current of air or any other means, is obvious from the following considerations. If a heated ball be suspended in the air, heat, which emanates from it, will be felt by the hand at some distance from the ball, and nearly as much below as above the ball; but a current of heated air can only ascend, and therefore could not convey the heat downward; neither can the heat be propagated by the conducting power of the air, for this fluid is almost a perfect nonconductor of heat. It is *radiant heat* that we receive from the sun, and it is likewise radiant heat which we feel in approaching a common fire, which sends off rays, as we have stated. The rays of the sun's heat are always accompanied by those of light, these forming two distinct sets of rays; but heated iron can radiate heat unaccompanied by light; and the rays of heat from a fire are not exactly of the same nature as those of the sun: for instance, the latter pass readily through a pane of glass, but the heat from the fire is almost entirely stopped by the glass.

298. *When the rays of radiant heat strike upon the surface of a solid body, they are either reflected from the surface, or are absorbed by it:* in general, both these effects partly happen. The reflection of heat follows very nearly the same laws as that of light. (See the Chapter on Light.)

The rays from the sun proceed in lines parallel to each other, and, as is well known, may be collected into a focus by a concave mirror, so as to set fire to substances placed in the focus; but the *rays of heat, as well as of light from a candle or lamp, always diverge;* and the rays from a fire proceed from it in all directions.

We may observe, that the radiation of heat from the sun, when accompanied by light, has long been known; but it is a modern discovery that heat radiates likewise from every hot body, even if not luminous, as a piece of heated iron, in invisible rays, that are subject to the same laws of reflection as those that are accompanied by light. The reflection of this heat is practically well known in some cases to the cook, who places a tin screen to reflect heat upon meat when roasting; but all bodies reflect, in a radiant manner, heat which strikes upon them: polished surfaces reflect most heat as well as light.

299. *Such part of the radiant heat as strikes upon a body and is not reflected, is absorbed by it,* for no part of the heat is lost. The heat which is absorbed remains in the body, and raises its temperature: and as it is the remainder after reflection only that is absorbed, it follows, of course, that those substances which reflect the most absorb the least; thus pieces of polished metal, as, for example, fire-irons, placed near the fire, will reflect more heat than equal pieces not polished, but will not themselves become so warm in the same time as if they were not polished, and, of course, can be more easily handled.

300. *It has lately been discovered that heated bodies radiate heat very differently, according to the nature of their surface.* If a surface be polished, it will *radiate* less when heated, though it will *reflect* more heat than if it be rough: thus, a polished teapot full of boiling water will radiate heat, or, in other words, part with its heat, more slowly than if it is not polished; and, of course, vessels of polished metal are more effectual in keeping things hot than those of any substance not polished. This principle has been applied practically in many ways, which may easily suggest themselves. A teakettle or a coffee-pot, kept bright, will preserve their contents longer hot than if suffered to become dull; and, on the contrary, an iron stove, to warm an apartment, should always be dull, and not polished, since it is to give out heat, and not to retain it. It is observed that metals are the worst radiators.

301. *Colour has a considerable influence upon the absorbing power of bodies,* and, of course, upon the degree to which they are heated by calorific rays. Black colours absorb most heat, and white the least. To show this, pieces of cloth of different colours have been laid on snow, and it was found that, when the sun shone, the snow was melted most under the black cloth, and least under the white; the other colours absorbed in the following order next to black: blue, green, red, and yellow. Hence a black hat or coat will become warmer in sunshine than a white one. The degree in which these colours reflect heat will, of course, be in the contrary order to that in which they absorb.

302. *Transparent bodies are scarcely at all heated by the rays of heat in their passage through them:* thus those from a fire do not warm the air of the room immediately. The manner in which heat is communicated to the air from the fire is the following: The rays of heat proceeding from the fire strike against some solid objects on the sides of the apartment; and such part of them as is not reflected is, as we have stated, absorbed, and acts in warming what they strike upon; the parts so warmed then communicate a portion of their heat to the air immediately in contact with them by the *mode of conduction* explained above. This portion of air becomes expanded, rises, as in the heating of water

and is succeeded by another portion of air, which also receives heat by conduction; and thus, as long as the fire continues, it first warms the solid bodies by radiation, and then the air in contact with them, by conduction. In the same manner, the rays of heat thrown upon water from a burning-glass would have very little effect, if any, upon the water, except that it strikes upon the bottom of the vessel and warms it, the bottom communicating the heat so received to the water.

303. *The sense of touch, which affords us the most obvious means of learning the presence of heat, is a very inaccurate measure of its quantity.* Whatever has a higher temperature than our hand at the time will feel warm on touching it, because heat will then pass from it to us; and, on the contrary, whatever has less heat than our hand will feel cold, because, on touching it, heat will leave our hand. Hence the apparent temperature of any body is merely relative to that of our bodies at the time, and not dependant upon its actual temperature. A good conductor of heat, as a piece of metal, will impart heat more freely, and absorb or abstract it more rapidly, than a bad conductor, such as a piece of wood, and hence will appear hotter or colder than the latter, though their actual temperatures be the same. If, therefore, we were to depend upon the touch alone in ascertaining the temperatures of different bodies, we should fall into many errors.

304. *The only accurate mode of measuring the degree of heat is by the use of the thermometer,* which is a little instrument of indispensable necessity in many domestic processes. It consists of a glass tube, having a ball or bulb blown at one end, the bulb and part of the stem being filled with some fluid, the expansion and contraction of which, by heat or cold, marks the change of temperature in any substance it is plunged into. A simple rod of metal expands and contracts, as we have stated, but the change is too small to be easily measured. Fluids expand much more than solids, and mercury is found to be the most convenient fluid for ordinary thermometers. The fluid in the bulb, when it expands, forces its way up the bore of the stem, which being extremely fine, the rise or fall is easily perceived on the least change of bulk, and, consequently, of temperature: a scale is attached to the stem for the purpose of measuring this. Two principal points are first marked on the scale: that where the mercury sinks to when the bulb is plunged into ice, or water just freezing, which is called the *freezing point;* and that where the mercury would rise to when the instrument is put into boiling water is called the *boiling point.* The first is marked 32°, and the latter is marked 212°, and the space between them is accurately divided into the parts between these two numbers; farther, thirty-two such parts are placed below the freezing point, and the lowest is marked 0, and is termed *Zero.* This mode of dividing the scale is that which was first employed by Fahrenheit, and hence it is called Fahrenheit's scale, which is universally used in Britain. All the degrees of heat which we shall mention in this work are according to this scale. On the Continent other scales are used, and a certain calculation is required to convert the degrees of these scales to that of Fahrenheit. It sometimes happens that degrees of cold are to be measured so intense as to freeze mercury, and to cause it to become solid; then a thermometer filled with spirits of wine must be employed, as this resists the most intense cold without freezing; and when degrees of heat are so high as to cause mercury to boil, no thermometer can be employed, and recourse must be had to an instrument called a *pyrometer,* the best of which consists of bars of some metal difficult of fusion, the expansion of which measures the heat.

CHAPTER II.

THE VARIOUS METHODS OF WARMING DOMESTIC BUILDINGS.

305. The various methods which have been put in practice for producing a proper temperature in the interior of our buildings may be reduced to the following: 1. Warming by fires burning in open chimney fireplaces. 2. By flues under the floors, or in the walls. 3. By close stoves of brick, earthenware, or metal, erected in the apartments. 4. By pipes kept full of steam. 5. By pipes full of hot water. 6. By streams of heated air sent into the apartments. 7. By combinations of these methods. We shall treat of these various modes separately, and we shall reserve our observations on their comparative advantages until we have given a description of each.

SECT. I.—WARMING BY CHIMNEY FIREPLACES.

306. Fires in open chimney fireplaces constituting the general method of warming apartments in Britain, it is necessary for those who wish to derive all the advantages which this method affords, to pay some attention to the subjects of combustion, of fuel, and the construction of chimneys.

SUBSECT. 1.—*Of Combustion.*

307. *The true nature of the combustion of fuel* was never understood until it was illustrated by modern chemistry: before that time, all reasoning respecting it was very erroneous, and often absurd. It is only by learning a few chemical principles that just ideas

can be entertained on this subject, and these are essential towards the proper management of artificial heat.

308. *All the fuel for making fires is, or has been originally, of a vegetable or animal nature*, and chiefly the former. We here refer the reader to that part of our work where we treat of the chemical analysis and composition of animal and vegetable substances, in Book VII., "On Food," and where the elementary principles of which they consist are particularly described: indeed, we consider it quite necessary that this should be studied before the subject of combustion be entered upon. But to save him some trouble, and to serve our present purpose, we shall here enumerate a few of the principal circumstances, which will be more fully explained afterward.

309. *All animal and vegetable substances (to which classes we have stated fuel belongs) are composed* of a few elementary ingredients: these are oxygen, hydrogen, carbon, and nitrogen; but the latter is seldom found in vegetables, though never wanting in animal substances. Wood, a very general fuel, is composed of oxygen, hydrogen, and carbon; and coal, which is of a vegetable origin, consists of the same principles, but having less oxygen than recent vegetables, and sometimes it has a little nitrogen. Two of these elements are easily conceived, the hydrogen and carbon; for the first of these is now familiar to us, as being a portion of what is called coal gas, and the last is the pure basis of charcoal; the oxygen will perhaps be better comprehended when we speak of atmospheric air. We trust the unscientific reader will not feel alarmed at this enumeration, since we can assure him that, however difficult it may be at first to follow us in the path we are tracing out, it will be found perfectly easy with a little patience.

310. *Air being absolutely necessary to the combustion of fuel*, we must likewise beg the reader's attention while we describe its nature. It is not known to half the world that the air which surrounds us is a substance, it being quite invisible, and appearing to afford no resistance to the touch of the common observer. But its invisibility is owing to its perfect transparency and want of colour; and we are immersed in this thin elastic fluid, as a fish is in clear water, which to him is, no doubt, equally invisible. That air is a substance can be shown by the apparatus called an air-pump, by which we can draw it out of a glass jar, and then its actual weight can be ascertained. It can be felt, likewise; since the hand, when moved very rapidly backward and forward through it, meets with the same kind of resistance, though in a less degree, that a stick does when moved through water. Wind is nothing more than a stream or rapid current of this invisible fluid.

The air of the atmosphere is not, as was once supposed, a simple body or element. It is now known to be composed essentially of two kinds of air or gas, united together; and modern chemistry has separated these from each other: it is likewise found that the properties of these two kinds are very different from each other, and also from the common air resulting from their combination. The names given to these gases, which form the constituents of atmospheric air, are *oxygen gas* and *nitrogen gas*.

311. *Oxygen gas* is that portion of the common air which conduces to the support of our life when we breathe; and hence it has also been named *vital air*. In respiration or breathing, we draw in air to our lungs, which separate it into the two constituent parts, retaining the oxogen, which then mixes with our blood, and enters into our system. It is this kind of air, likewise, which supports the combustion of a fire, which cannot burn without it any more than we could live without it.

312. *Nitrogen gas*, the other portion of atmospheric air, and which we throw out in breathing, has no action in the support of life or the combustion of fuel; on the contrary, if we were to breathe it by itself we should be suffocated, and a fire supplied with it would instantly be extinguished: hence we cannot breathe the same air over and over again.

Although we have said that common air is composed of oxygen gas and nitrogen gas, yet it always contains a very small portion of some other airs or gases, which we must mention as essential to our subject. Of these, carbonic acid gas is the most constantly present, and in the largest quantity, this being generally about one or two per cent.

313. *Carbonic acid gas* is composed of the element carbon, or the principle of charcoal, and of a portion of oxygen, both being chemically united; and it has a slight degree of acidity, whence its name. It is formed abundantly in nature in many instances: it is produced during the fermentation of malt liquors (for which see Book VIII., "Fermentation"), being the gas which always lies at the top of the fermenting vat, and which feels so sharp to the nose when snuffed up. It is likewise this gas which escapes when soda water or bottled porter is uncorked. Carbonic acid gas is, like all the gases, except oxygen, unfit for the support of life or combustion, and is therefore a suffocating gas; but the quantity existing in the air we usually breathe is not sufficient to be injurious to us; but, when in large proportions, it is very unhealthy. It is sufficient at present to observe, that it is abundantly produced by the burning of charcoal, and, indeed, of any other fuel. It is heavier than common air; hence, in some cases, it may abound in the lower part of an apartment, while the upper is nearly free from it.

314. *Hydrogen gas*, or inflammable air, is now pretty well known, being obtained from

coal, and burned for artificial light. It is, indeed, the cause of all the flame from coal or wood.

315. *Having now introduced the reader to an acquaintance with the composition of fuel and of air, we shall proceed to show in what manner each is affected by the process called combustion.* That a combustible body shall burn, it must be *kindled;* that is, it must be brought into contact with another substance actually burning, and thus be affected by heat.

As the simplest case, we will first consider the combustion of charcoal. When a portion of the charcoal is kindled or made red hot, the carbon decomposes the atmospheric air surrounding it, uniting to the oxygen, and thus forming carbonic acid gas, heat and light being given out in consequence of this process. If, therefore, charcoal be burned in an apartment without a chimney, the consequence will be the production of a large quantity of this suffocating gas, which, mixing with the common air of the place, may not at first prove fatal, but if suffered to accumulate in a great quantity, the room being close, will infallibly prove so, as is well known from persons dying in consequence of sleeping in a small room with a pan of lighted charcoal.

The combustion of wood or coal is more complicated, as they consist, not of carbon only, like charcoal, but of the three other principles, carbon, hydrogen, and oxygen. When a piece of wood is kindled, the heat causes these elementary principles to separate and become gaseous in the following manner: The hydrogen of the wood, united to a portion of carbon, forming a variety of carburetted hydrogen gas, or the gas that burns in gas light, joins rapidly to the oxygen; and this rapid union is productive of that heat and light which appear as flame: at the same time, a certain part of the hydrogen only, uniting to the oxygen, forms water, which becomes vapour or steam in this intense heat, and is dissipated or dissolved in the atmosphere. Of the remaining carbon or charcoal, a part joined to oxygen forms carbonic acid gas, which, being highly heated and expanded, and hence rendered specifically light, rises upward, and is mixed with a little pyroligneous or acetic acid, generated in the combustion, and which gives the penetrating effect peculiar to wood smoke, and which is not found in the smoke of coal. The rest of the carbon remains at first as charcoal; but this also burns, and finishes by being converted into carbonic acid, as in the case of charcoal above mentioned. From this we see that the wood in burning is decomposed, and separated into its elementary constituents, and likewise that several other substances are produced; for it is to be observed that nothing in nature is ever destroyed, the disappearance of any material by combustion being, in fact, merely a new arrangement of its parts in other forms. The new substances, in this case, are carbonic acid gas and water, or, rather, aqueous vapour; to which we must add nitrogen, for that is the remnant of the air, after the oxygen was taken from it, the nitrogen having no active part in the combustion. If wood, therefore, is made to burn in a room without a chimney, two deleterious gases will be produced, carbonic acid gas and nitrogen gas, the oxygen of the air being taken up to create the former; and if this combustion were to continue long enough, all the oxygen would be consumed, and only these two poisonous gases left, which are entirely incapable of supporting life. It is obvious, therefore, that to have much wood in a close room without a chimney would be as fatal to burn as charcoal The same will be the case with respect to any other combustible; as, for instance, coal.

316. *Many persons are deceived from charcoal giving out no smoke*, and they are hence not sensible of the production of so poisonous a gas as carbonic acid, which is properly invisible; they often suppose, also, that it is the smoke alone that suffocates in the burning of wood in a close apartment; but the smoke, though disagreeable, is not the chief cause of the suffocation, which is owing to the production of the carbonic acid, a few inspirations only of which are fatal. Seeing this to be the case, that all combustion produces deadly poisons, this process would be fatal to us, were it not for a wise law of nature. The heat produced by combustion causes all these gases to expand and become specifically lighter than the common air, in consequence of which they rise upward, which prevents our breathing them, except they are suffered to accumulate in a confined space; and now appears the use of a chimney with its flue. When fuel is burned in one of them, all the deleterious gases ascend through it, and escape into the open air, without contaminating that of the apartment. The ascent of the smoke enables us to perceive this rising current; but the smoke itself is nothing more than a small portion of the fuel which has escaped the combustion, and is carried up by the ascending currents of the new gases so produced, and which we have described. It is, indeed, merely an extremely fine dust or powder, which, when collected, is the soot that attaches to the flue, a substance well known to be still inflammable. The smoke being visible, assists in estimating the rapidity of the ascent of the gases that rise from combustion, but is not itself so dangerous as the gas which carries it up; and, indeed, smoke is itself heavier than the atmospheric air, and falls down when separated from the heated air.

317. *The combustion of coal is very similar to that of wood*, the elementary constituents being nearly the same. The flame of both, as we have stated, is owing to the burning of the hydrogen, or, rather, the carburetted hydrogen or coal gas; as charcoal and coke have been both deprived of their hydrogen in the process of charring, they cannot, of

course, give any flame; neither can anthracite, a kind of natural coal having no hydrogen, but consisting, like coke or charcoal, almost entirely of carbon. The nature of the various kinds of fuel will be described afterward, in Chapter III.

318. *But besides the gases we have just mentioned, a very small quantity of sulphuretted hydrogen*, another suffocating gas, is given off by *the burning of coal*; some of the sulphur, of which all common coal contains a small portion, uniting with some of the hydrogen. A part of the carburetted hydrogen also escapes without having been burned, in consequence of being disengaged when there was not flame to reach it. All these rise into the atmosphere with the smoke from a chimney, and do not come into the apartment.

In this description of coal by combustion, we have supposed it to be perfectly pure; but as all coal contains more or less, likewise, of earthy matters not combustible, these remain, after the combustion is finished, in a state of ashes; of course, the more impure the coal, the more ashes will be left.

319. *We shall not here enter upon the inquiry, in what manner is the heat generated by the process of combustion?* as this remains one of the mysteries in nature's operations not yet thoroughly understood: it is sufficient to say that it is developed in consequence of the mutual action of the fuel and the air upon each other, by which the elements of each are separated, and made to assume new forms. Some have maintained that the heat is chiefly contained in the air in a latent state, and is set loose when combustion takes place. However that may be, the heat from combustion evidently appears in two states; one part is in the form of *radiant* heat, which we explained in the article "On Heat," and which is sent off in all directions from the burning body; this may be absorbed by the substances it strikes upon, or may be reflected from them. The other portion of the generated heat is *combined* with the newly-formed gases and vapours, which carry it with them upward. This last portion of the heat does not act like the radiant part, but may be communicated, by conduction, to those substances on which the heated gases strike, as in the case of the flue of a chimney, or a pipe through which the smoke rises, or is made to pass.

Subsect. 2.—*Construction of Chimney Fireplaces.*

320. *A chimney fireplace is a recess* in the wall *a*, *b*, *fig.* 53, for the fire with a flue over it, that reaches to the top of the house for the exit of the smoke. The sides of the recess are called the *jambs* of the chimney; and the top at the opening, or *mantel*, *c*, is generally covered by an iron bar with a flat arch over it, concealed by an ornamental chimney-piece. Just above this opening the funnel is contracted to the proper size of the flue, shown by the dotted line, and the contraction is called the *throat* of the chimney, *d*. The horizontal section of the flue is usually oblong, not less than fourteen inches by ten inches, to admit of the process of sweeping. Flues are also occasionally made cylindrical.

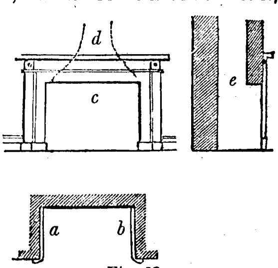


Fig. 53

321. *When wood and peat were the only kinds of fuel in use, chimneys were made very large*, and the wood was burned upon irons called *dogs* laid upon the hearth, a few of which may still be seen in old mansions. About fifty years ago, when coal had come into general use, grates for burning it in were universal; but though the chimneys were considerably contracted, the throats were still very wide, as appears at *e* in the section, and the jambs remained at right angles to the front, as shown in the plan *a*, *b*, the consequence of which was, that the smoke was frequently sent back into the apartment; and that intolerable nuisance, a smoky chimney, was very common; while a great part of the air that was just warmed by the fire made its escape through the wide throat, producing a proportional current of cold air towards the fireplace. In consequence of this, a person near the fire had one side heated and the other cooled; added to which, the fires were kept in the grates so high up from the floor, that the feet were always immersed in a stratum of cold air that covered the lower part of the room.

322. *In this state our chimney fireplaces were found by the celebrated Count Rumford*, to whom we are under infinite obligations for teaching the true principles upon which they ought to be constructed. Since that time, a great reformation has taken place in this part of our domestic economy, and our open fires are rendered far more effective in warming our apartments, and have become more comfortable and elegant, as well as more economical in point of fuel.

323. *The principal improvements effected by Count Rumford in our chimneys* are shown by the plan *g*, *fig.* 54, elevation *h*, and section *f*, of a chimney. 1. He brought the back of the fireplace farther forward into the room by building another brick back within the old chimney. 2. He placed the jambs inclined, as in the plan *g*, and elevation *h*, that they might reflect more heat into the room. 3. By bringing the grate forward, and raising the new back up above the mantel, the throat of the chimney was much contracted,

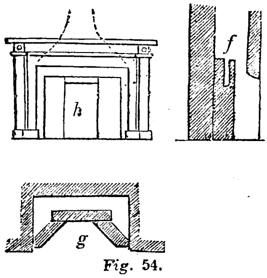


Fig. 54.

as in the section *f*; and to allow the chimney-sweeper to ascend the flue, an opening was left, closed up by a loose piece of stone, as shown in the section, which was taken down when the chimney was to be swept, but replaced when that was done: by this contrivance, the draught in the throat was very much increased, and by this simple means alone the greatest number of smoky chimneys were cured. 4. The bottom of the grate was considerably lowered, and brought down to within six or eight inches of the floor, by which the hearth and floor of the room were much more warmed. 5. By using as little iron as possible in grates, and fitting up their interior with fire-brick, they were made not only to throw out more heat into the room, but also to make better fires.

Thousands of old chimneys were altered according to these principles; the number of smoky chimneys cured all over the kingdom is scarcely conceivable; and much good, upon the whole, has resulted from these ideas having been, at least partially, adopted.

The jambs of chimneys are now almost universally *Rumfordized*, as it is termed; that is, made inclined when grates are set; and in the best fireplaces the fires are kept lower, as well as the mantels. The throats are frequently contracted, though seldom, if ever, completely in the *Rumford manner*. But one of the greatest improvements in fireplaces, namely, making the fire burn against brick or stone instead of iron, is that which is most neglected.

Although some mechanics were at first instructed in the principles upon which Rumford fireplaces should be executed, yet, from the opposing interests of trade, and the almost total absence of scientific knowledge in that class of persons on whom their construction usually devolves, these lessons have been long ago almost entirely forgotten. Since the time when Count Rumford left this country, new generations have grown up, a large proportion of whom are unacquainted with his merits, and almost with the very name of Rumford.

The limits and nature of this work will not admit of our going into all the details respecting chimneys, necessary to be understood by the bricklayer and other mechanics, in constructing and altering them so as to cure all their defects; but we shall lay down their leading principles.

324. *In investigating the best form of a chimney fireplace, it is necessary to keep in view that the objects to be attained are,* that the room should be warmed as completely as possible, and in such a manner that the air may be preserved perfectly pure and fit for respiration, free from smoke and all disagreeable effluvia, and this with the greatest economy of fuel.

325. *It may, perhaps, at first seem superfluous to inquire in what way an open fire warms a room;* but a more careful consideration of the matter will show that it is highly deserving of the most attentive examination. Here we must refer the reader to what we have already stated in the article "Heat," as to the manner in which it is *propagated*, by radiation, reflection, and conduction. Rays of heat are projected in all directions from the fire; but the rays which are directly radiated have no effect in warming the air through which they pass, on account of its transparency, as has been already shown; and it is only when the rays impinge against, or strike upon, a solid substance, that they produce any effect. In this manner, then, projected rays warm the floor and sides of the apartment, and the various articles of furniture; and these, having first absorbed the heat, give it out again to that portion of the air in contact with them. It is of the first importance to understand this fact, that it is not the air which warms the room in the case of an open fire, but the room that warms the air. It is true that the grate itself, becoming very hot, must heat the air in immediate contact with it; but this heated air, rising immediately, goes almost all up the chimney, and is therefore nearly lost to the room: the iron likewise projects radiant heat; but this is in too small a quantity to have any effect worth mentioning. Besides the heat that proceeds in a radiant form immediately from the fire, another portion of heat is reflected from the back and sides of the grate, and also from the jambs or sides of the chimney. With respect to what is reflected from the inside of the grate, here the importance of brick or stone is shown; for these materials, being nonconductors, do not absorb so much heat as iron (a conductor) does; therefore they throw it off; and when they become red hot, they radiate much heat; and this is the reason why they are preferable to iron, the latter material absorbing much, and seldom becoming so hot as to radiate in proportion.

326. *The inclined jambs or covings of Count Rumford* likewise reflect more heat into the room than those formerly used, which were at right angles to the front; and they assist also in preventing smoke. The proper angle is 130° with the back. They should always be flat: curved covings, which we sometimes see, were condemned by Count Rumford, as occasioning eddies that often cause smoke to come into the room.

327. *The importance of keeping the fire as low as possible* must be obvious, when it

is considered that air expands by heat, and then becomes specifically lighter: now, whatever part is made lighter than the rest, will rise upward, as oil will rise in water. Hence the lightest and warmest air is always at the top or ceiling of the room, and the coldest upon the floor. Whatever, therefore, will warm the floor most, will have most effect in warming the air of the apartment. Keeping the fire low must have this effect more than if it is higher, since the radiant heat must strike most upon the floor; and the difference is very remarkable in the warmth which our feet experience whether the fire be low or high up. Keeping the mantel low in proportion is, likewise, useful for warmth; for the air *below* the level of the mantel is liable to go off into the chimney, and be carried up the flue; but whatever is above the mantel cannot escape. It is evidently desirable that no air shall go up the flue, except what has been rendered unfit for breathing, by passing through the fire and serving the purpose of combustion. This we might do by shutting up the whole front of the chimney except the place where the bars of the grate are: but we should thus convert the grate into a furnace, and the draught would be too strong; the fuel would be rapidly consumed, and the rush of air towards the fire would be in proportion.

328. *The width of the throat of the chimney has a great influence*, both on the draught and on the escape of warm air. For as no fire can burn without air, and as there must be always a quantity going up the flue, just in proportion to the combustion, when the throat is narrow the current must be more rapid than when it is wider, just as the current of a river will become more rapid in the part where the width of it is suddenly contracted: hence the reason why contracting the throat, by making the ascending current of air in that spot more powerful, enables it to overcome any downward puffs that would occasion smoke.

329. *The proper height of the mantel above the fire* is an affair of nice adjustment; for if it be too low, it will cause the current of air towards the fire to be too rapid, and the fire will burn away too fast without giving out much heat; and if it be too high, the current may be too little in the throat, and much of the warm air of the room will escape. No rule can be laid down for this that will suit all cases: much will depend upon the particular form of the grate, and it must be determined by the skill of the person who directs the work. In the best grates now made with frames, this height is generally well adjusted.

330. *Although the farther out the back of the grate is brought, the more heat will be thrown into the room, yet this should be limited* by the proper construction of the throat of the chimney; and bringing it too forward is liable, in many cases, also to occasion smoke as well as the annoyance of ashes.

331. *A small flue for carrying off the dust made by the ashes which fall from the grate* was one of those numerous little inventions made by Count Rumford, which, though ingenious, and promising at first to be useful, was laid aside after repeated trials; and it would not now be mentioned, had it not lately been published as a novelty, although it had been executed in England in hundreds of places thirty-five years ago. It is obvious, that whenever any ashes fall from the fire upon the hearth, particularly when the fire is stirred, a certain portion of them, from their lightness, rises in a little cloud, and is dispersed through the air of the apartment, settling at last upon the furniture. To obviate this inconvenience, the count made a small flue to ascend from below the bottom of the grate, passing behind the back of the fireplace, and terminating in the smoke flue just above the throat. The air in this little flue being heated by the fire, a current is always set up through it from the back of the hearth, so that when any ashes fell they were carried sharply under the grate and up this flue, instead of coming into the room. This certainly had the desired effect in a great measure; but several inconveniences attended the contrivance. Its construction required great depth in the chimney, which was not always sufficient without bringing the grate too far forward. The ash-flue was very liable to be choked up by soot falling from the smoke-flue, and this soot was very liable to be inflamed, and set the chimney on fire, being, at the same time, rather troublesome to clean out; also, this flue occasioning a current of air to pass up, it was supplied by the cold air rushing towards the fire; and it thus increased sensibly one of the greatest inconveniences of an open fire, the current of cold air striking upon our legs and feet. It was chiefly useful when, as formerly, the bottom of the grates had been kept at a great height above the hearth; but, since grates have been kept low, the necessity of this ash-flue has disappeared.

SUBSECT. 3.—*On Grates.*

332. *The grate has become an essential part of our chimney fireplaces*, since coal has been the general fuel; but the forms of these now made are so various, that it would be impossible to describe all in a work like the present; nor would it be useful to give many examples, since every manufacturer has his own patterns, which are, therefore, now almost as numerous as those of the calico printer. It will be more useful to lay down some principles by which the choice may be directed in the show-room. We must therefore refer the reader to all that we have said on the essential improvements by Count Rumford, which must form the foundation of good rules.

333. *The register stove, fig.* 55, which was much in use about forty years ago, was considered as a great improvement upon the open chimney before its introduction. This grate was not invented by Count Rumford, as has been erroneously stated by a late popular author; on the contrary, he considered it as extremely faulty as it was then executed. Its name was derived from a movable plate of iron a little way above the fire, by which the draught could be regulated, and which could be shut down altogether in summer to keep out the soot or dust. These grates were frequently got up in an expensive style, with much polished steel and other ornaments. They had the effect of preventing smoke, but with the inconvenience of throwing out little heat in proportion to the fuel which they consumed. We have already described the principal improvements made by Count Rumford in our chimney fireplaces; and several small grates were cast and put up under his direction. But he was not a manufacturer; and though he gave to the public, in his "Essays," the philosophical principles on which they should be constructed, he left it to the manufacturers to invent beautiful forms; and had the first been as well understood as the latter, we should have reason to be better satisfied.

334. *The best of our modern grates are combinations* of the old register stove and the Rumford improvements. They have always an ornamented frame to fit the inside of the marble chimney-piece, and a register in the throat. The fire is brought low, or near to the hearth. But the fenders are frequently made preposterously high, which stops much of the heat from that part of the floor where it would be the most useful.

335. *It was a doctrine first taught by Count Rumford, that the great quantity of iron usually put into grates* abstracts much more heat from the fire than it can give out to the apartment, and therefore occasioning a loss of heat, and, consequently, a waste of fuel. This is certainly quite *true in principle;* and it is by reference to principles that the merits of inventions or constructions are to be determined. But it must, in candour, be admitted, that in our houses we have other circumstances to consider besides economy, or even the most effective sort of fire. A great attention to elegance in furniture is now the order of the day: this is considerably influenced by the nature of materials; and many persons will give up something of economy for the sake of appearance. Here is, therefore, another principle involved besides the saving of fuel. Besides, what would be extremely proper for a person of small income, might not be suitable for the drawing-room of a person of fortune; even in the houses of the latter class, fireplaces for the various apartments require to be fitted up on principles suited to their situations. Various materials are used in our best grates, cast iron, wrought iron, polished steel, brass, and bronze; and several of these are often happily combined. Iron has undoubtedly many bad qualities when used in great quantity about a fire; and, were economical principles alone considered, the less of it employed in a grate the better. But it can easily be cast in a great variety of ornamental forms; and it has the advantage of great neatness and durability, qualities which generally weigh against everything that can be said against it. Brick or stone cheeks in the grate are by much the best for the fire to burn against; and those who are anxious to have the best possible open fires, we advise to have them. But the ironmongers abhor them; very few will keep them; and still fewer recommend them. Hence they are difficult to procure; and to adapt them to grates, is expensive on this account; nor are they so durable as iron. Replacing them when they crack and burn out is attended with trouble; and most persons will rather waste a few coals with grates having iron sides, than follow advice which few understand.

Besides the great trouble of keeping polished steel in good order, there is an objection to having much of it in a grate, founded on a physical principle discovered by the late Professor Leslie, which is, that bright, polished metallic surfaces, though they reflect heat well, throw it off by radiation very imperfectly; but, if the same surface be rendered dull or rough, the radiation is immediately augmented. According to this principle, it has become a practice to grind flat with emery certain parts of the surfaces of the best grates, and to leave them in that unpolished state.

336. *Improved register grates of Rumford forms, with frames*, are also now made entirely of cast iron at very reasonable prices.

The smaller grates, called *Bath stoves*, the *hobs* of which are so convenient, are too well known to require illustration, and though wholly of iron, are yet useful from their cheapness and portability.

Upon the whole, though excellent fires may be made in some of the best grates now to be seen in the show-rooms of the ironmongers, yet we are much afraid that the prevailing rage for novelty, causing good models to be laid aside which have been improving for years, may occasion new forms to be attempted without sufficient knowledge of principles. We are led to make these remarks from the disappearance of many grates of excellent construction and good taste, to make way for others loaded with the now fashionable ornaments of the time of Louis XIV. It should never be forgotten that the real use of a fire grate is to warm the room; and if it fails much in this essential, the deficiency will be ill compensated by any other quality, which ought to be subordinate to the main object.

337. In common language, the necessary distinction between a *fire grate* and a *stove* is often not properly attended to. Hence a confusion of ideas: thus, a sort of common grate is called a *Bath stove*, and we sometimes hear of *register stoves*. The system should be, *not to call any contrivance a stove*, except where the fire is concealed, either always or occasionally; or, rather, where the heat is chiefly given out by the heated apparatus only, not depending upon the radiation from the fire, as in a common open grate.

388. *Out of the almost infinite variety of forms of grates that have been made at various times, we have selected a few of those which are most in use.* Grates of this kind are sold by the ironmongers, who keep large collections of various patterns in their show-rooms; and there are so many in London who have them nearly of the same quality, that it would seem invidious to recommend any in particular.

339. *Fig.* 55 *is the register grate* as it was when Count Rumford found it, and which has been mentioned already. It is not made at present in this form, and is only to be seen in old houses. The sides were not inclined, but at right angles to the front. The fire was about sixteen or eighteen inches from the floor; and the distance between the top bar and the bottom of the frame very small, so as to cause a rapid draught up the chimney. These grates, therefore, though they made a bright fire, gave out little warmth to the apartment.

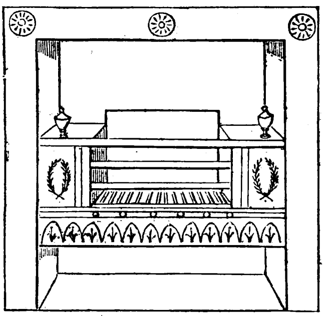


Fig. 55.

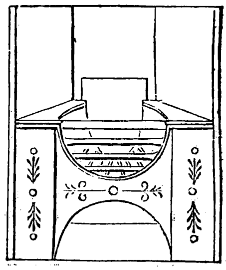


Fig. 56.

340. *Fig.* 56 is the well-known *Bath* stove or grate, but with the jambs Rumfordized, that is, with the covings of the chimney placed at the angle recommended by Count Rumford, instead of their being at right angles to the front, as they were formerly. This necessarily reduces the hobs, and therefore renders them less convenient for such persons as find them useful in cooking: but this construction economizes fuel by throwing out more heat by reflection, and still more by preventing the escape of much warm air of the apartment; and it tends to prevent smoke by narrowing the throat of the chimney.

341. *Fig.* 57 *is one of the simplest of the Rumford grates*, proper for an office or bed-chamber; the covings are placed at an angle of 135 degrees with the back, and made of stone, with the exception of the part where the fire burns against it, below the dotted line, which is of fire-brick; in fact, there is merely an iron bottom and front attached to sides of stone and brick. Some ironmongers, however, have made the whole covings of iron, which is only to be excused on the score of durability, iron throwing out much less heat than nonconducting materials. It is to be observed, that in this grate the fire is very low, within a few inches of the hearth; whereas formerly, as we stated above, the bottom of the fire was kept up generally eighteen inches; and it was not uncommon for bricklayers to raise up the grates by putting a brick or two below them, from an idea that the fire would not burn well if it was low.

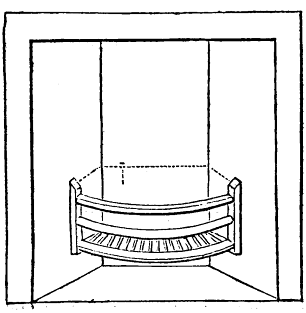


Fig. 57.

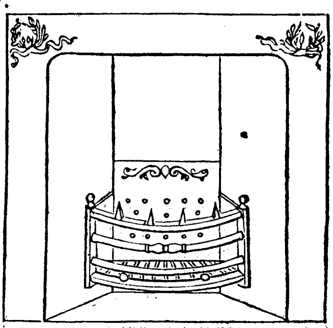


Fig. 58.

342. *Fig.* 58 is a grate of the same general construction, but *ornamented,* and proper *for a sitting-room;* it is generally made wholly of iron, the front ground flat, with brass ornaments laid on.

343. *Fig.* 59 is another still more ornamented in the style of the time of Louis XIV The iron front and covings are ground flat, and not polished, and the ornaments are of brass or bronze.

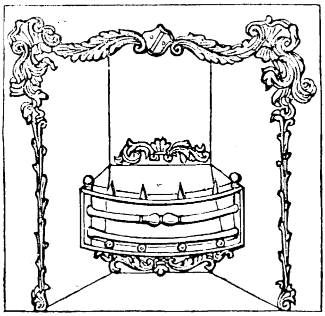


Fig. 59.

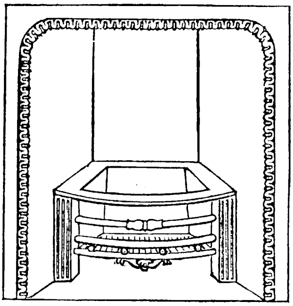


Fig. 60.

344. *Fig.* 60 is a *Rumford grate,* the sides and back of which are of artificial stone, made to stand the fire; the covings of the chimney are first executed with the proper angle; and the grate, being moveable, is simply put into its place, and may be removed when required. There are several advantages attending this arrangement.

345. *Figs.* 61 and 62 are *two of the numerous grates to be seen in the show-rooms of ironmongers:* the ornaments are in the gorgeous style of the time of Louis XIV., and sometimes of brass. This choice being a matter of taste and fashion, we avoid making any remarks upon it, except that the quantity of metal employed has more than one disadvantage.

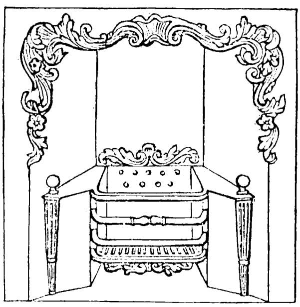


Fig. 61.

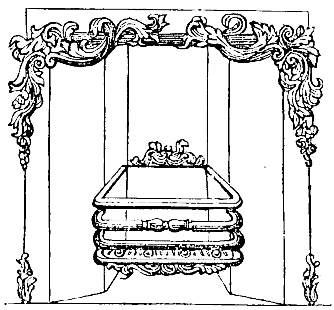


Fig. 62.

346. *Fenders and fire-irons* have varied in fashion, partly with the style of the grates, but more with the improvement of our manufactures. Some of the oldest fenders were made of iron and brass, plain, but with mouldings, and very low, to correspond with the wood fires on the dogs. Since coal burned in grates has been in use, they have been made higher, and are of an infinite variety of patterns. The cheapest fenders have been of tin plate painted, of wire painted, and with iron or brass tops and bottoms, and which are still used for bedrooms. A more durable kind has been cut out of sheet iron, and painted in imitation of iron wire. As iron fenders stain the marble they are placed upon, it is now the custom to raise them in front on a kind of pedestal, which slopes to the inside, and the front is supported by claw feet, knobs, or pieces of ornamental foliage, &c. At present the best and most elegant fenders are made of polished steel, enriched with brass or bronze, to correspond to the style of the grates; and a great many are of cast iron very highly decorated and ornamental. Fenders should not be higher than safety requires, as they thus stop much of the radiant heat of the fire, and that where it is most wanted, namely, in the lower part of the room, and keep it from the feet: to prevent this, they are always made with some open work. To the fender is usually attached holders for the fire-irons.

Sect. II.—Warming by close stoves.

347. Close stoves are enclosures of brick, earthenware, or metal, which contain a

fire that heats the stove, and by means of that, the air of the apartment in which it is placed.

348. *Stoves differ essentially from open fires in their manner of warming.* We stated that open fires act chiefly by giving out radiant heat; on the contrary, there is comparatively little radiant heat from a close stove of any kind: the radiant heat of the fire within the stove is absorbed by the material of which the stove is made, and the latter warms the air of the room in contact with it. This warmed air rises upward toward the ceiling, and is succeeded by fresh air to be warmed in its turn, and so on, until the whole of the air in the apartment has received an increase of temperature. It is evident, therefore, that a stove warms the air upon the same principle as that by which water is heated in a vessel over a fire.

349. *The common German stove*, or, more properly, the *Dutch stove*, used in this country, is as economical and effectual as any stove whatever, for warming an apartment; and were not its use attended with serious disadvantages, it might be much employed. It consists merely of a cylinder of sheet iron, *fig.* 63, furnished with a grate in the interior for the fuel, a door for the fire, and another for the ashes, with a pipe to carry off the smoke into the chimney flue, which pipe may be lengthened when much heat is required. Here no air passes up through the chimney except that which has come through the fire, and has served for the purpose of combustion, being rendered unfit for respiration; and the whole of this is carried off. All the rest of the heat, over and above what thus passes off with the smoke, is communicated to the iron, and by that to the air of the room in contact with it, at the same time that a good deal of heat in a radiated form proceeds from the iron itself, when much heated. As this stove may be placed at a distance from the wall by lengthening the pipe, it is very effectual in producing a great deal of heat, while it occasions no disagreeable draughts, no smoke, and no dust. But the inconveniences are, that there being no regulator for the draught of the air, the iron is apt to become red hot, and then it is extremely dangerous if placed near anything combustible; and as the fire is not seen except when the door is opened, it is difficult to regulate it. But another circumstance which renders its use inconvenient is, that the iron being generally much heated, a disagreeable effect is produced upon the air of the apartment, which is variously described, and has never been satisfactorily accounted for. The air is said to acquire a *scorched*, a *burned*, a *close*, or a *sulphureous* smell, and is very apt to produce headaches, giddiness, and even stupor, loss of appetite, ophthalmia, &c. The erroneous or vague nature of the description shows how little the effect is understood. The term *burned* is *improper*, for it is not known that pure air, simply heated to any degree, is altered in its quality. What is usually termed burned air is that produced by *actual combustion*, as has been previously explained. But in this stove none of these deleterious gases come into the room. The term sulphureous is equally improper, as sulphur can scarcely in any way be concerned with the effect. But whatever may be the cause, or whatever ought to be the description, all persons in this country agree that air so heated has acquired some property which renders it both unpleasant and unwholesome. Count Rumford imagined that the hot iron roasted the dust which settled upon it: and as the dust of a room is made up of all sorts of animal and vegetable matters, these, when burned, give out a disagreeable effluviæ. Others have attributed the effect, in a great measure, to the great dryness of the air so produced, resembling the African simoon, which they have endeavoured to correct by placing a small pan of water on the stove, the evaporation affording the necessary moisture to the air; others, again, have supposed that the effect is owing to some alteration of the electrical state of the air; and it has been absurdly imagined that the iron deprived the air of its oxygen. Whatever may be the true explanation of the effect complained of, and, possibly, all those just mentioned may combine, it is now universally allowed that the air is rendered disagreeable and unhealthy when it is warmed by iron heated much above the point of boiling water: hence the use of this and other iron stoves should be restricted to purposes where heat and dryness are required, but where the salubrity of the air is less important; for such uses, nothing can be more economical.

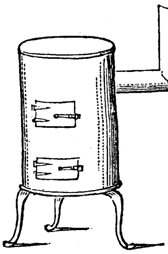


Fig. 63.

Many stoves of this kind, of cast iron, and of elegant and ornamental forms, are to be found in our halls and staircases, where it was thought the bad effect upon the air was less material, fresh air being more frequently introduced by the opening of doors. But it should be remembered that the air from these places extends all through the house, and must find its way into the best apartments. We may observe, that the draught might easily be regulated by a register to the ash pit, and a damper in the flue, though these are not usually made. The part where the fire burns might likewise be lined with brick, to prevent its getting red hot, which would lessen considerably the danger and inconvenience of this apparatus. But, from our experience of the effects of heated iron upon air, we are not admirers of iron stoves of any kind, where health is required to be much attended to.

350. *It is said that when iron is not heated above 212° it has no injurious effect upon the air.* This is not improbable; but as no series of accurate experiments or observations have been made and published to determine this important question, we think it best to leave it in its present state. There is little doubt, however, that iron heated to a small degree is less hurtful than when heated highly; but then, likewise, the heating power of the apparatus is diminished.

351. *It does not appear that close stoves, made of brick or earthenware, have the same species of injurious effects upon the air of an apartment as iron;* and stoves of these materials are much used in various parts of the continent of Europe. In Russia, and many parts of Germany, brick stoves are universal; they are generally made to project in the room somewhat like a chest of drawers, cabinet, or sideboard, and the door for the fire is sometimes in an adjoining room. Wood is kindled in them; and when this has burned so far that the smoke has ceased, and the brickwork is heated, the damper in the flue and register of the ash-pit are nearly closed, so that the combustion of the remaining charcoal goes on extremely slow, and the heat of the stove is retained during the day. In the severe climate of the north of Europe no other method would render the houses sufficiently warm; necessity, therefore, obliges the inhabitants to adopt this mode, in spite of any disadvantages it may possess. In all countries, also, when fuel is very expensive, the most economical means of using it have been resorted to, though sometimes not the most desirable on the score of health. In France, where open chimneys are likewise much used, stoves are employed through economy; but they are generally made of earthy materials, as brick, tiles, and ornamental earthenware, and are therefore not liable to the same objection as iron. In this country, it is remarkable that stoves of brick and earthenware have been seldom tried; and we have been contented with open fires, which certainly consume much fuel; or we have manufactured stoves only of iron, a material which we have in such abundance.

352. *Although close stoves certainly afford the most economical means with respect to fuel, as well as the most effectual way of warming the interior of dwellings, yet they are liable to this serious objection,* that with them it is difficult to change the air in apartments, or, in other words, to *procure that ventilation so essential to health.* When the door of the fire is in another room, and the windows and doors of the apartment made tight, as is found necessary in very cold countries, there can be very little change of the air in the room, and, consequently, the inhabitants must live in an atmosphere vitiated by a mixture of the portion that has been exhaled. This evil, perhaps, great as it is, may not in these countries be so great as that of excessive cold; but that it is an evil, it requires but a little knowledge of the subject of physiology to be convinced of. In countries where the climate is more temperate and fuel more abundant, and where, of course, the inhabitants are not compelled to resort to so unhealthy a mode, it does not appear judicious to employ it, except the means of perfect ventilation can be likewise provided. But this is by no means easy with close stoves, for even when the door of the fireplace is in the apartment, and, of course, the supply of air to the fire is taken from that in the room, and replaced by fresh air from without by some method or other; yet this is in general no more than the fire itself requires, and does not make up for what is also destroyed by respiration. With a close stove, therefore, whatever may be the construction of it, there is usually an accumulation in the apartment, more or less, according to circumstances, of gases and effluvia unwholesome to breathe. With respect to the best modes of getting rid of these as much as possible, we refer the reader to Book III., "On Ventilation." We may just observe in this place, that the foul air, which, being warmest, is at the top of the room, may in general be made to escape by keeping the upper sash open an inch or two. But this will not act except the ingress of as much cold air be provided for somewhere at the lower part of the room: if this be not done, the air will come in at the top sash, to supply the stove, instead of going out. The chief difficulty here is to contrive the ingress of cold air so that it may not incommode. This is best effected, perhaps, by numerous small apertures in places where they will be least inconvenient, and by preventing the stream of air from coming in directly, but turning it aside by some methods which must vary according to circumstances.

353. It would be unnecessary to inform those who have read with attention what we have said on heat and combustion, namely, that *all stoves which profess to heat apartments without a flue, must be in the highest degree pernicious, and even dangerous;* since it is quite impossible that combustion can go on without generating noxious gases, a circumstance well known to every one who has the slightest acquaintance with chemical science. No method has ever been discovered, nor is likely to be found out, of preventing this pernicious effect; and the consequence of putting a stove of any kind into an apartment without a flue to carry off these deleterious gases, whether the stove be fed with common charcoal, with charcoal prepared in any known way whatever, or with gas of any kind, will inevitably be, that the air of the room will become contaminated with invisible effluvia destructive to health, and sometimes suddenly fatal. This is so certain, that we trust no one will ever permit himself to believe that discoveries are made of modes of combustion without the production of poisonous gases. We might connect these ob-

servations with a description of *Joyce's stove*, which warms an apartment without a flue to carry off the fumes of the charcoal burned in it; but except the public shall become instructed in so much science as to be able to judge for itself on this subject, no pointing out of individuals will be of much avail, since one quack, impostor, or ignorant mechanic, will be succeeded by another. It is on this account we are desirous that the study of principles should be attended to, intead of mere receipts.

354. *Iron stoves are frequently made with flues to descend below the level of the floor*, for the purpose of getting rid of the smoke without the inconvenience of a pipe crossing the apartment: they are extremely useful in warming shops and other places where there is a considerable circulation of air, and where the effects of heated air are not perceived so much as in confined places.

A, *fig*. 64, may be supposed to be any hollow figure of cast iron. There is a partition in the middle that does not reach quite to the top, and in one of the divisions is the fire-grate *a*, fire-door *b*, and ash-pit, with its door, *d*. When the fire is lighted, and the fire-door shut, the smoke first rises to the top; but, finding no outlet, it is impelled, by the pressure of the air that feeds the fire, to descend through the other division, and to pass along the horizontal flue *e* to the main flue *f*, which carries it to the top into the atmosphere. This principle being kept in view, the forms may be varied *ad infinitum*, and some are made extremely elegant. It should be observed, that when good fires are kept every day in these stoves with descending flues, the heat retained in the chimney, causing a slight current even in the morning before the fires are lighted, will determine the proper course of the smoke, but in other cases it is rather troublesome to make it descend at first; but once the flues are warmed, the draught goes on perfectly well.

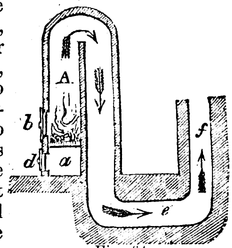


Fig. 64.

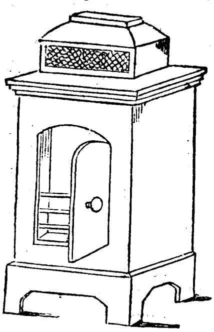


Fig. 65.

355. *The air stove*, which, some time ago, was very common in our shops, but which has now very generally given way to the *Arnott* and *other stoves*, is represented in *fig*. 65. It was one of the first improvements upon the common iron German stove. Besides the simple iron fire-chamber, there was also an external casting of iron surrounding that at the distance of two or three inches; by which construction, however much the fire-chamber might be heated, even if it were made red hot, the same degree of heat would not be communicated to the external casing, on account of the space between being filled with air. This stove is, therefore, much less dangerous, on account of fire, than the common German stove. The lower part of the space between the two casings is left open, by which the cold air enters below and gets heated between the two iron cases, and issues out at the top through a perforated regulator. The defects of this stove are, that the air may still be overheated, by using much fire, and that the warm air comes out only at the top of the stove, a considerable way above the floor.

Fig. 66 is *another air stove* of similar construction, only the fire is lined with brick or fire stone, which prevents the air being overheated, and the warmed air comes out through the grating on the sides. A sliding plate at the upper part of the opening acts as an occasional blower.

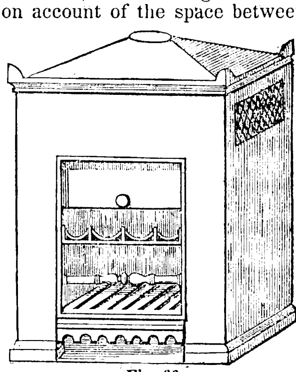


Fig. 66.

356. *The Pennsylvania* or *Franklin stove*, *figs*. 67, 68, is evidently borrowed, as to its principle, from a fireplace described in a book entitled "Mechanique de Feu," published in 1713. It is well adapted for heating an apartment, and at the same time affording a view of the fire; but being entirely made of iron, it has the usual defect of all the stoves made of this metal, in producing an unpleasant effect upon the air of the room. It was originally intended only for burning wood; lately, however, they have in America constructed it for burning coal. *Fig*. 67 is a view of the stove placed in the chimney, and *fig*. 68 is a vertical section. The fire, *a*, is made upon the iron hearth, and is partly enclosed between iron cheeks. The smoke, after rising up to the top of the stove, turns under the cover, and goes down at *b*, *fig*. 68, descending as low as the hearth to *c*, whence it passes upward into the main flue, *d*. The partition *e* is built up in the chimney, and the throat is closed by an iron plate, *f*, so that no air from the room can go out that way. The whole of the stove being of iron, is much heated by the fire, and communicates its heat to the surrounding air as

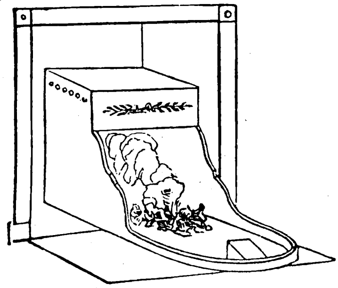


Fig. 67.

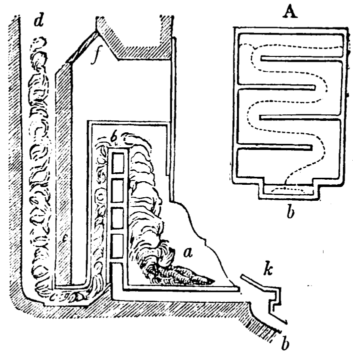


Fig. 68.

in a common German stove. But it likewise throws into the room a stream of air brought from without and warmed. This is effected in the following manner: The back of the stove, against which the smoke rises, is hollow, and contains partitions in the manner shown at A, *fig.* 68, which represents the hollow back with the front plate removed. The cold air from without enters through a flue at *b* (*see* section), passes beneath the hearth, *c*, and thence into the chambers at the back of the fire, seen in the section at *b* and at A. After winding through these chambers in the direction of the dotted line in A, it becomes heated, and issues through apertures in the sides near the top of the stove seen in *fig.* 67, but the throat of the chimney being closed, as at *f*, it comes into the room. The method of blowing the fire is by an opening in the iron hearth in front of the fire, partly covered by a little inclined plane, *k*, which directs the current of air that rises through it, against the fire. The fire is, therefore, partly fed by this air, and does not abstract so much from the apartment as would be the case were it wanting; it also reduces in the same proportion the usual current which makes towards the fire in ordinary grates. This stove is evidently not well adapted for the purposes of English cookery, and the inelegance of its appearance entirely unfits it for our best apartments, consequently it is not adopted in this country. A few have been tried in farm-houses, but it is inferior to other constructions.

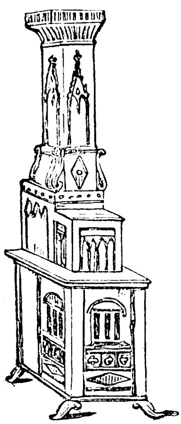


Fig. 69.

357. *The American* or *Nott's stove*, *fig.* 69, is more remarkable for the novelty of its appearance than for any important advantage. The fire is contained in the pedestal, which is lined with fire-brick. The bottom of the grate is semi-cylindrical, and, being revolvable on an axis, is intended, by a rocking motion performed by a winch at the side, to shake out the ashes, or to empty the grate altogether into the ash-pit. The coals are put in at the top of the column, lying over the fire after it is kindled, and sink down as they are consumed, enough being put in at once to serve the whole day. To afford a view, or rather a peep, at the fire, a piece of mica (erroneously called *talc*) is inserted in the front, that substance not being liable to crack with the heat like glass. Many of these have been put in shops and similar places where there is a free circulation of air, and where they have rather an elegant appearance; but they have the usual faults of iron stoves, from becoming much heated.

358. *Dr. Arnott's stove*, *fig.* 70, though constructed of iron, is said by the inventor to be much less injurious to the air than iron stoves generally are, because the metal is never made very hot, there being an internal brick chamber to contain the fire, and the combustion of the fuel going on very slowly.

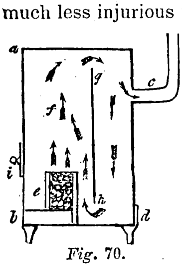


Fig. 70.

The following is the description by Dr. Arnott in his own words: "The outline section, *a*, *b*, *d*, *c*, represents a box formed of sheet iron, and divided by the partition *g h* into two chambers, communicating freely at the top and bottom. The letter *e* marks the fire-box or furnace, formed of iron lined with fire-brick, and resting on a close ash-pit, of which *b* marks the door, and near which door there is a valved opening, by which the air enters to feed the fire when the door is shut; *i* marks the door of the stove, by which the fuel is introduced: *c* is the chimney-flue. While the stove-door and ash-pit are open, a fire may be lighted, and will burn in the fire-box just as in a common grate, and the smoke will rise and pass away by the chimney, mixed with much colder air rushing in by the stove-door: but if the stove door and ash-pit door be closed, and only as much air is admitted by the valved opening in the ash-pit as will just feed the combustion, only a small corresponding quantity of air can pass away by the chimney, and the whole box will soon be full of the hot air or smoke from the fire circulating in it, and rendering it everywhere of as uniform temperature as if it were full of hot water. This circulation takes place, because the air in the front chamber around the fire-box, and which receives as a mixture the red-hot air issuing from the fire, is hotter, and therefore specifically lighter, than the air in the posterior chamber, which receives no direct heat, but is always losing heat from its sides and back; and thus, as long as the fire is burning, there must be circulation. The whole mass of air is, in fact, seen to revolve, as marked by the arrows, with great rapidity; so that a person looking towards the bottom of the stove through the stove-door, *i*, might suppose, if smoking fuel had been used to make the motion visible, that he was looking in at the top of a great chimney. The quantity of new air rising from within the fuel, and the like quantity escaping through the flue, *c*, are very small compared with the revolving mass."

To regulate the temperature of this stove and make it equable, a contrivance is attached, called the "thermometer tube," by which the opening for admission of air to the ash-pit is made to expand when the fire burns too slowly, and thereby increase the draught and combustion; and to close a little, and hence to check the combustion, when the fire is too brisk. It would appear, however, that this apparatus was more ingenious than useful, as it is now generally laid aside, and the quantity of air admitted to the fire is regulated by some of various simple methods in common use. One of the advantages this stove seems to possess is, that the fire keeps in a long time, requiring very little attention, particularly when anthracite or coke is employed as fuel. It is rather difficult to light, and therefore some prefer keeping the fire always in, which is rather a convenience, as thus the apartments never cool, and the expense of fuel is very small. Where a gentle, steady heat is very desirable, it appears to be useful; but it must be observed that the means of ventilation must be provided for in the same way as for other stoves.

359. *A few more iron stoves* lately advertised as the *Chunk stove*, *Vesta stove*, &c., do not appear to possess any good qualities peculiar and deserving of mention.

360. *Mr. Stephen Green's new terra cotta stove* avoids several inconveniences of iron stoves. To equalize the heat as much as possible, two or three concentric cylinders of earthenware are introduced between the fire-pot and the external case, which prevents the danger of the heat cracking the external casing, which is also of some kind of earthenware.

Sect. III.—Warming by flues.

361. The method of warming houses by means of flues under the floors or in the walls, though very effectual in some cases, as in hot-houses, is scarcely applicable to our private dwellings as they are constructed at present. It is true that this was the mode adopted by the Romans in their villas when they had possession of this island; but it is to be observed that their floors were altogether of bricks and tiles, often ornamented with mosaics. In the present construction of our houses with floors of wood, it would be next to impossible to warm them in this manner, which would demand so great change in our domestic economy and modes of construction, that we cannot at present speculate upon it; and numerous expensive experiments must be made before we could discover all its advantages and disadvantages, notwithstanding the idea of warming a whole house with one fire, instead of each separate apartment, may appear, at first, to promise a vast improvement. There is, however, one part of the house that might sometimes, perhaps, be advantageously warmed by means of flues under the floor: that part is the hall or vestibule, which may have a pavement of marble, stone, or tiles. Whether this would be sufficient to warm also the staircase, without making the floor of the hall hotter than would be agreeable, remains, we believe, to be decided by experiment.

There are certain other cases where this mode of warming appears to have advantages, namely, in offices, or other places with stone floors, which are very cold for the feet. When this method is employed, the fireplace should be so constructed that the smoke from the fuel must descend through the fire, and be thus almost wholly consumed, which will prevent the great accumulation of soot in the flues.

Sect. IV.—Warming by steam.

362. *Steam*, so useful on many other occasions, is capable of affording *one of the most agreeable, safe, and convenient methods of warming our apartments*. In our account of the general properties of heat, we mentioned the way in which steam is generated, and that its temperature is necessarily always the same, namely, 212°. Hence it presents us with a mode of obtaining always an equable quantity of heat. If an enclosed vessel filled with steam be brought into an apartment, the steam will be gradually condensed by parting with its heat to the vessel containing it, while the latter will communicate it to the air in contact with the vessel. The steam vessel will therefore act as a close stove; with this difference, that the steam stove can never be heated above 212°; and that

the heat given out, being always in proportion to the surface of the vessel, we can, by adapting its size to the occasion, regulate the temperature of an apartment, an advantage which we cannot obtain so completely in any other way.

363. *The manner in which a house or an apartment is warmed* by means of steam is very simple. A boiler supplied with water must be kept constantly boiling by a fire or small furnace; the cover of this boiler must be fixed on tight, and a pipe will conduct the steam to any part required to be warmed, where it may be received in a reservoir, or other convenient receptacle, best suited to the nature of the apartment. As the steam gives out its heat, it becomes condensed into water, which settles at the bottom of the receptacle, and should be conducted away by a small pipe that generally conveys it back again into the boiler. The steam is thus made to carry the heat from the boiler of hot water, depositing or leaving it where it is wanted; and thus this process will ke kept up as long as the boiler is at work. Nothing can be more quiet and regular, therefore, than this method of warming; but several precautions are necessary to be attended to. As steam has an immense elastic power if confined, care must be taken that it does not accumulate in too great a quantity under the head of the boiler, otherwise it may become too powerful for the strength of that vessel to resist, and an explosion might be the result—an accident that is well known to have happened frequently. To prevent this, a safety valve on the boiler is requisite. The safety valve is kept down by the pressure of a small weight suspended on a little lever, and, when the steam becomes so powerful as to endanger the boiler, it forces up this valve with its weight, and escapes by little at a time. An ingenious apparatus is likewise employed, by which the boiler is fed with water so as to have always the same quantity in it; as there would be danger in its being too full, and still more in its being quite empty. The pipe, also, which conveys the steam to the part where its heat is to be given out, must be surrounded and protected with some nonconducting material. The steam reservoirs, on the contrary, must be made of the best conductors, such as copper, iron, or tin plate. We stated, when speaking of heat, that a pipe or other vessel cannot be filled with steam until it be first emptied of common air. Contrivances must, therefore, be made in all steam pipes for this purpose; for, should any accident suddenly condense the steam in the pipe, the latter, having been already deprived of its air, would form a vacuum; and therefore, except very strong, could not resist the pressure of the atmosphere, and would be crushed quite flat. There must, therefore, be a valve somewhere to let in the air should this happen. Farther precautions must be taken to prevent the pipes giving way from their frequent expansion by heating and cooling. Considerable difficulty will likewise occur in providing for a situation for the steam reservoirs in our best apartments; although, in many other places, this will be sufficiently easy.

When we take into consideration all these circumstances (and none of them can be omitted), it is obvious that a steam apparatus should be under the direction of a person competent and willing to attend to it, for though in such hands it is perfectly safe and easily managed, it is far too complicated to be employed in ordinary dwellings, where the frequent change of servants would prevent it being properly understood and attended to: the apparatus must be kept in perfect order, and though only a small degree of attention is necessary for this purpose, it does not admit of neglect. The use of steam should, therefore, be limited to those places where it would be put under the management of competent persons. We do not consider it useful, therefore, here to go into the numerous details that would be necessary for constructing and managing a steam apparatus, since every such construction must vary with the locality; and, to succeed, the whole must be executed under the direction of a scientific engineer experienced in such matters. Nevertheless, warming buildings by steam succeeds perfectly in factories and other large places, where there are persons resident, and sufficiently intelligent to be trusted with apparatus requiring such strict and constant attention: and there are cases in domestic economy where it may be applied, but that can only be where persons are conversant with the subject of steam.

Methods of warming by steam, applicable only to hot-houses, do not belong to this place.

364. *Steam has an important advantage* which distinguishes it from every other mode of distributing heat, which is, that it can be conveyed to a very great distance from the boiler, and in any direction; we can cause it to ascend, descend, or move horizontally, with equal facility: but the loss of heat by condensation is considerable in conveying it to a distant point, though steam itself preserves always the same temperature. A single fire to produce the steam may be sufficient for a large establishment, and this fire may be placed where the smoke of the chimney may be least offensive, and its appearance least objectionable; it may even be outside the house to be warmed, and be placed in an adjoining building: hence the superior security from fire. The heat of steam pipes, also, as they never can exceed 212°, is not likely to injure the air.

365. *When steam is employed to warm an apartment in a dwelling-house*, it cannot be admitted in common steam pipes, on account of their form and appearance; but various means must be had recourse to for rendering the steam vessels ornamental: one of the

best is, by collecting the pipes in masses, and covering them with open screen work, in the manner of a side table or pedestals, &c., as at *fig.* 71; or the pipes may be concealed in the walls, or under the floor, and the air admitted by registers; or the steam may enter into a hollow space between two cylinders or cubes, serving as pedestals for statues or vases, by which a great surface of steam might be exposed. In this way steam may be advantageously employed to assist in warming a large apartment, in addition to an open fire, which is seldom sufficient to render every part of such a room comfortable.

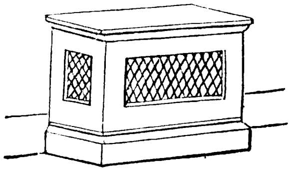


Fig. 71

SECT. V.—WARMING BUILDINGS BY HOT WATER.

366. *Warming by means of hot water, though one of the last modes brought into practice is of older date than is generally supposed.* It appears to have been first employed by Bonnemain, of Paris, just before the first French revolution. He had in this manner heated the hot-houses at the "Jardin des Plantes" at Paris, and he likewise applied it to preserving an equal temperature in little chambers, in which he succeeded in hatching chickens in the Egyptian manner, without the hen. Afterward, the Marquis Chabannes practised the same mode in England, and succeeded in some hot-houses, but failed in applying it to private dwellings. This practice has lately been revived, and larger pipes of cast iron being employed, hot water is very successfully used in heating hot-houses, or other large buildings where these pipes are not inconvenient.

367. *To cause hot water to circulate through pipes in a building* merely by the action of heat, all that is necessary is to provide a boiler, A, *fig.* 72, filled with water, and closed at the top; a pipe must proceed from the top of the boiler at *a*, entering through the part of the building which is to be warmed, *b*, *c*, and returning back into the boiler at the bottom *d*. This boiler and its pipe, being closed all round, is to be considered as one vessel, and the cause of the circulation of the water will be easily understood if the reader will refer to the description we gave of the currents upward and downward which Count Rumford observed in water while heating. Portions of water heated at the bottom of the boiler will rise to the top, ascend through the pipe, and return again to the bottom; the cooling of the water in the pipe promoting the return. If the whole of the boiler and pipe were to be kept at a boiling heat, this motion would cease; but, as the water in the pipe is constantly cooling, the circulation goes on, and the water, hot, but not boiling, is thus carried to a considerable distance.

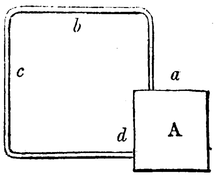


Fig. 72.

There are, however, considerable difficulties in applying this method to warming domestic dwellings. It is necessary to have the pipes of considerable size, several inches in diameter, if circular, that they may contain hot water enough to be effective, and such pipes, which must be of cast iron, are very inconvenient in a private house: also, if they are to ascend to the upper stories, the pressure of the water in them would be enormous, and would require them to be of great strength. From this, and other circumstances, it was found that this mode of warming with cylindrical pipes must be limited to certain places, as hot-houses, conservatories, and public rooms of any kind, where the pipes may be disposed of out of the way, and where there is no occasion to raise the water much above the boiler. In these cases this method by hot water is found to give a very equal degree of heat, and to have some of the advantages of steam, at the same time that the apparatus is more simple, and more easily managed: but we must observe, that it is much inferior to steam in the facility of being conducted to any part of a building, or to any distance, and, therefore, upon the whole, it is much more limited in its application: nor is the regularity of the heat so great as that of steam. The pipes with hot water are, however, sometimes made flat, the section being a rectangle instead of a circle, and thus they are more easily introduced into apartments, being made to appear as part of the skirting, or partly concealed by some artifice. When managed in this way, they have been found to give out a very agreeable heat, particularly when they are employed only as an addition or assistance to an open fire.

To cause hot water to circulate, it is not necessary that the top of the boiler should be closed; but in that case the circulation is effected upon a different principle: the pipe, when once filled with water, then acts as a siphon; the ascending part from the top of the boiler, and just dipping into the water, being the shorter leg, and the descending part, which returns to the bottom, being the longer leg of the siphon. Here the rapidity of the motion will depend upon the difference in the two legs of the siphon, and the different temperatures in the two currents, on the common principles of hydrostatics. This last method has some advantages, with the absence of danger from explosions, the close boiler requiring a safety valve.

368. *The method first employed by Bonnemain is interesting in an historical point of view;*

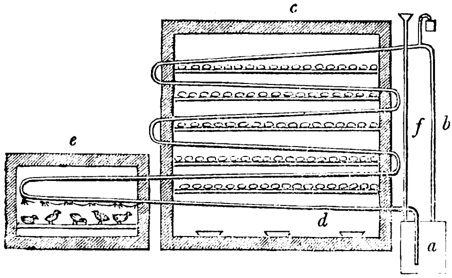


Fig. 73.

and on this account, and as his mode of hatching chickens by its means has been attempted in London, we shall describe it. *a, fig.* 73, is a small boiler, from the top of which rises a tube, *b*, that passes into the inside of a wooden box, *c*, in which are shelves on which the eggs to be hatched are laid. This tube, after being bent backward and forward through the box between the shelves, returns at *d*, and enters into the boiler, passing down to the bottom. The heated water rises through this tube, and circulates through it in the manner we have already described in *fig.* 72, causing the temperature of the air in every part of the box to be very equal. This equality was much assisted by an apparatus which regulates the admission of air to the fire, the aperture decreasing as the fire burned more briskly, and increasing as the fire slackened, as in Arnott's stoves. The details of this contrivance may be seen in Gill's "Technical Repository," February, 1828. *e* is another box, in which the young chickens were fed after they were hatched; in this they nestled under sheepskins with the wool on. In the bottom of the case are little saucers with water to supply the humidity to the air which is necessary to hatching. *f* is a safety valve to the boiler. We may mention it as a remarkable fact, that although the hot-houses in the botanic gardens of Paris were thus heated fifty years ago, yet this had been so completely forgotten by the French gardeners and engineers, that their government sent to England, in 1832, a deputation of professional men to study the subject, with the view of again heating their hot-houses in this manner.

369. *The employment of hot water for warming houses has, however, been extended by Mr. Perkins,* in consequence of a method which he adopted of conveying water in pipes heated far above the boiling point, even as high as from 300° to 600°. It will strike the reader that, as water can only be heated to 212° in an open vessel without being converted into steam, there must be here some particular contrivance by which the heat of water can be raised to 300°. The fact is, that provided the steam is prevented from escaping, or even forming, by the vessel containing the water being completely closed, that fluid may be heated to any degree that the vessel will bear without bursting; but in this case, the pipes conveying water heated so much must be sufficiently strong to prevent such an accident.

The method of Mr. Perkins, called by some the *high-pressure hot-water apparatus*, consists of a considerable length of an iron pipe, which, in consequence of being so intensely heated, is made only an inch in diameter; this is filled with water, and completely closed in all its parts. A portion of it is made in the form of a coil, *a, fig.* 74, either round or square, which is placed in a furnace or fire, and the water in it heated to 300° or more. The rest of the pipe is carried round the rooms to be warmed; and, if necessary, it is coiled also somewhere in the apartment, *b*, in order to get more pipe into little space; for the longer the pipe, the more heat it will give out. This pipe afterward, and of course the water, returns back to the coil in the furnace. As in the other mode of heating by hot water, one end of the pipe proceeds from the top of the boiler, while the other returns to the bottom of it, so in this the pipe goes first from the top of the coil and returns to the bottom of the coil, *c*, for there is no boiler. In order to allow room for the expansion of the water on being heated, which might otherwise occasion the bursting of the pipes, a tube, *d*, is fixed at top, which holds about one twelfth as much water as the whole pipe; into this the water finds its way on expanding. This hot-water apparatus, on account of the smallness of the pipes, and their flexibility, can be introduced into apartments without much difficulty: it may be led round the room near the floor, or made into a coil in the chimney, the flue being first stopped, or in any other convenient situation; and the heat may be raised to any extent that the pipes will bear.

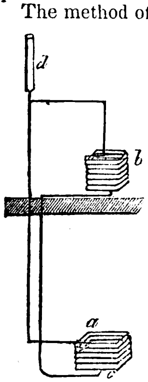


Fig. 74.

But although this ingenious invention can be used in places where the former method with larger pipes could not be introduced, nor steam-pipes either, without much trouble, yet it is liable to some defects, which must be noticed. One, that is very obvious, is the danger of accidents, by the bursting of pipes containing water so intensely heated; although the pipes may be manufactured upon an excellent principle, and proved before they are used, yet we cannot, without a caution, recommend a plan in which safety depends so much upon the care or the skill of workmen. It is also said that, in consequence of the intense heat of these pipes, rooms heated by them have, to a certain degree, the same disagreeable and unwholesome smell which results from the use of cockles or iron stoves in general, when much heated. Another objection, stated by Mr. Hood, appears to be the inequality of temperature in buildings heated by these pipes, in consequence of their being much hotter in one part than in another, a difference sometimes amounting to more than 100°, varying according to the length of the pipe, which may extend above 1000 feet. From the smallness of the pipe, also, this apparatus cools so rapidly when the fire slackens, that the heat of the building will be materially affected even by a very little alteration in the strength of the fire. From all these circumstances, this mode of heating will not afford the same steadiness of temperature as hot water with large pipes, and still less than that obtained by the use of steam. Notwithstanding, however, these serious objections to applying Mr. Perkin's method generally to ordinary dwellings, it has been employed in several public buildings, and, we understand, with considerable success. There are certain situations, indeed, where it would be extremely difficult to employ any other method. It has, for instance, been found very serviceable in the Register Office, Edinburgh, where records of great value are kept; where, of course, safety from fire is eminently important; and where no method of warming the building had been contrived on its erection. The museum in Lincoln's Inn Fields, left to the public by the late Mr. Soane, is mentioned as another instance.

Both the steam and hot-water system of the ordinary kind, with large pipes, are safe as to risk from fire; but it has been stated lately that Perkin's method is not free from danger, since pipes heated to so great a degree are capable of setting fire to many substances: care should, therefore, be taken that the pipes do not come into contact with any materials that are inflammable.

It is evident that the same difficulties of ventilation must attend this as all other stoves: and this consideration, were there no other, must also determine in what place it can be introduced with propriety in a domestic edifice. The idea is undoubtedly ingenious; but it cannot for a moment be supposed that it ought to supersede open fires for our ordinary apartments, as some have been sanguine enough to imagine.

SECT. VI.—WARMING BY HOT AIR.

370. Warming by hot air is first heating a quantity of air to a considerable degree, and then bringing it into the apartments through pipes or other apertures. This has been effected in various ways.

371. *The first method employed* was a French invention, and accomplished by causing air to circulate and get heated *behind the iron back of the fire*, and then introducing it through a register.

372. *Another method consists* in making an iron tube *pass through the fire*, the mouth being in the open air: the air entering the tube is heated by the fire, and discharges hot air into the room. Likewise, chambers are filled with air heated by iron or brick stoves; and from these reservoirs the various apartments are supplied by means of pipes.

In all these methods of warming apartments, the air has generally been heated too much for salubrity; and in most of them it has been rendered very unwholesome; added to which, the apparatus is always complicated and expensive. It is to be observed that the first two of the above methods act only partially, being intended only to assist an open fire, and they may be named *stove grates*. A great number of these, of various constructions, have been put up in England of late; but they are very ineffective, and extremely unwholesome, from the air issuing through the register being vitiated by the heated iron. When heated air is introduced from them by way of assisting an open fire, it is of little use, for the following reason: as soon as it enters the room by the register on the mantel-shelf, it rises to the ceiling, instead of readily diffusing itself through the rest of the air in the apartment; and is, in reality, worse than nothing, adding scarcely anything to the temperature, but contributing a quantity of disagreeable effluvia: these contrivances are, accordingly, now nearly laid aside.

373. *Of the very unwholesome nature of air made hot by iron*, we have an instructive account in a late examination, by Dr. Ure, into the cause of the indisposition and disease which prevailed among the officers in the long-room of the Custom-house. The hot air was discharged from two stone tunnels at from 90° to 110°, but diluted afterward with cold till about 60° or 62°; yet the effects experienced were very distressing, and the air was found seriously to affect the constitutions of numerous individuals of various ages and temperaments. In one room, where the air that issued was 170°, it is described as resembling in its properties the simoon of the desert, possessing, in an eminent degree, the dryness and disagreeable smell imported to air by the action of red-hot iron. "As cast iron," Dr. Ure observes, "contains, besides the metal itself, more or less carbon, sulphur, phosphorus, and even arsenic, it is possible that the smell of the air passed over it in an incandescent state, may be owing to some of these imperfections; for a quantity of noxious effluviæ, inappreciably small, is capable of affecting not only the olfactory nerves, but the pulmonary organs."

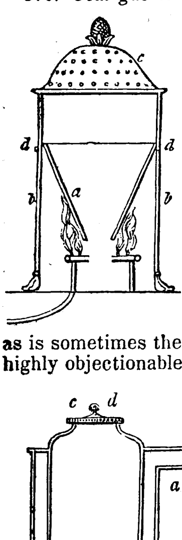
There is another objection to the warming apartments with hot air, in the mode in which it has been usually practised; which is, that the supply of hot air is frequently irregular, coming often in currents or puffs; and a current of hot air is equally injurious to health as a current of cold air. Heating by steam or hot water is far more even and regular.

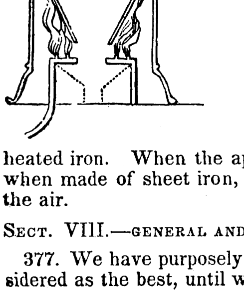
374. *Nor, independently of the usual unhealthiness of air much heated, is the danger from fire to be overlooked in this system.* In a complication of flues and pipes passing through the various parts of a private dwelling, some of the flues for the smoke will perhaps pass near to woodwork, and the smallest crack or defect in the workmanship, which scarcely any care in the superintendents can guard against, may occasion intense heat, and even flame, to be carried to parts where it may be dangerous. We may instance the lamentable destruction of the Houses of Parliament among others, which have been occasioned by the hot-air system; to which we add, that it is now believed that many conflagrations have been occasioned by similar causes.

375. *But there is another way in which heated, or, rather, warmed air may be employed, and that advantageously.* If it be warmed in a separate chamber, by means of steam or hot water pipes, and then introduced into apartments, such air, if originally pure, will continue to be perfectly salubrious; this method of moderately warming it not injuring its quality, as has been already explained when treating of the modes of warming by steam and hot water. The chief difficulty here is to find means of introducing it; for it must be evident that it is impossible to throw in such warmed air except an equal quantity of cold air can be abstracted: this operation must, therefore, be connected with artificial ventilation, and will probably be found too complicated and expensive for ordinary domestic purposes, though very suitable for large public buildings, as may be instanced in the new Houses of Parliament, which are warmed upon this principle.

SECT. VII.—WARMING BY GAS.

376. *Coal gas is also occasionally employed to warm the interior of buildings.* A flame has no effect in warming the air surrounding it, as was explained under "Heat;" where it was stated that radiant heat could not warm the air it passed through. But when flame strikes on a solid substance, the latter is heated, and then communicates its heat to the air in contact with it, which, ascending, gives place to another portion to be warmed in the same manner. The gas stove is made upon this principle. A circle of gas flame near the floor is made to play upon the outside of a hollow inverted metal cone, *a*, *fig.* 75, which is open at bottom, and surrounded by the cylinder, *b b*, standing upon three feet, but open all round the bottom. The air within the cone is heated by the metal, and rises up, permitting a fresh portion to succeed it, which enters from the open bottom; and the heated air comes out into the room by the apertures, *c*. The whole has the form of a circular pedestal. When this stove is constructed in such a manner that the deleterious gases, arising from the combustion above mentioned, are suffered to escape into the apartment, as is sometimes the case, through apertures *d d*, where the cone joins the cylinder, it is highly objectionable in confined situations. Perhaps, in some cases, as a lofty chapel, where the service is not long, the unwholesomeness of it may not be much felt. But it is proper that the true nature of the stove should be understood. No combustion can take place without a certain portion of the air being injured in consequence. Mr. Ricketts, of Agar-street, Strand, aware of this, makes his gas stove as in *fig.* 76, where the poisonous gases generated are carried out of the apartment by a tube, *a b*, and only pure warm air issues from the stove by the register, *c d*. In this form, this apparatus may be used for warming, and has some advantages. It occupies very little room, and may be put up wherever gas can be conveyed, and the deleterious gases carried away. The heat of the stove may be very accurately and very simply regulated, only by turning the cock of the supply-pipe, by which the flame of the gas may be increased or diminished. It is to be observed, however, that if the iron be very much heated, the effect upon the air coming from the stove must be of the same pernicious kind as that which is usually felt from highly heated iron. When the apparatus is made of cast iron, it is not apt to be so hot as when made of sheet iron, and is not only much more durable, but is less apt to injure the air.





SECT. VIII.—GENERAL AND CONCLUDING OBSERVATIONS ON WARMING DOMESTIC BUILDINGS.

377. We have purposely avoided giving any opinion as to which method may be considered as the best, until we had placed before our readers the various modes of warm-

ing our dwellings. The variety of opinions that are afloat on this subject occas on, with some persons, considerable perplexity; but much of this difficulty will probably disappear by consulting principles rather than authorities. Each method has some advantage, and likewise some disadvantage, to counterbalance it; and the subject has seldom been treated by persons wholly disinterested: these have too often held up to view merits or demerits, as best suited their objects.

378. *It has been a fashion for some years past, with some persons, to exclaim against our chimney fireplaces*, which have been long adopted in this country, and which still continue prevalent. Thus, we are told of the immense waste of fuel which they occasion; of their dirt and smoke; of their scorching us on one side, and chilling us by a cold current of air on the other side; and that, therefore, it is no wonder we are attacked by colds and rheumatism. It is said, that no sooner is any portion of the air warmed by an open fire, but it is hurried up the flue; that the temperature of the air is very unequal in different parts of the room; that there is a stratum of warm air above the mantel, but that our legs and feet are immersed in cold air. They are, indeed, represented as if the pecuniary interests of the coal merchant and the physician were studied at the expense of the pocket and of health. In short, all their defects are collected and exaggerated, without their advantages being pointed out; while other methods are lauded, and placed in the most favourable light. And this is not even the worst; for the oldfashioned, long-abolished chimney has been selected for pointing out defects, instead of the best constructed Rumford chimneys and grates, with all their late improvements. There can be no doubt that chimney fireplaces have defects; but so have all the methods of producing artificial warmth that were ever invented; and it is only by balancing in the various cases advantages and disadvantages, that our choice should be determined.

379. *It might be supposed that, since Count Rumford did so much towards the improvement of chimney fireplaces, he was an enthusiast in favour of the mode of warming our houses through their means; but that is not the fact.* He found our fireplaces in a wretched condition, and our houses badly warmed and ventilated; and despairing of overcoming what he considered as our national predilection for open fires, he set himself about rendering them as little hurtful to health, and producing as much comfort, as possible. In this endeavour, he succeeded in a high degree; but he would have preferred warming our apartments by stoves of some kind, in favour of which he expresses himself very stongly in his twelfth essay. He maintained the opinion that *warm* rooms are very beneficial to health, and observed, that he had gone to Germany with as strong a prejudice against them as anybody, but that, after having spent twelve winters in that country, he had learned to know the advantages of rooms warmed by stoves.

The writer of this article assisted him in erecting several stoves in his house at Brompton; but it must be observed that they were all of brick or earthenware, and that he considered iron stoves as pernicious. He remarks in one of his essays, that "it is a question often discussed in this country, whether living in a warm room in winter be, or be not, detrimental to health:" and it is to be regretted that no one, since his time, has applied to this subject that proportion of science and experience which its importance demands. This is not the place to enter upon such a discussion, which would be much more difficult than most persons are aware of, as may be gathered from the conflicting opinions of various persons. For instance, Count Rumford states "that the Swedes and Russians live in very warm houses during their long and severe frosts, yet no people are more strong and healthy than they are, nor are there any less liable to catarrhs and consumptions." On the contrary, Mr. Tredgold quotes a statement by the benevolent Howard in these words: "In a conversation with the physician of the military hospital at Moscow, on my observing that the windows of the wards were shut, he answered, almost all our disorders are in the winter, for the Russians enclose themselves in hot rooms, and dislike the fresh air, even before the cold months commence." We may observe, that it is impossible to determine upon the propriety of the practice of one country by that of another, so much depending upon climate, habit, and various local circumstances. The climate of Russia is very different from ours. They have a constancy and duration in their cold weather, which we have not; and this enables them to dress accordingly. The changeable nature of our climate forbids our imitating them in many respects.

380. *This great variableness in the nature of our climate furnishes, perhaps, one of the best arguments in favour of our chimney fireplaces*, by which we can more readily alter the temperature of our apartments than by any other method. It is one of the chief characters of stoves, that they give a very regular heat; but as it is difficult to charge this in a short time if required, they may not be found so suitable to our climate. In this country we often experience the warmth of several different climates in the course of a single day. Should we come into a room with an open fire, and find the apartment too hot, in a very few minutes we can, by taking off some fire, make the room cooler; to say nothing of opening a door and window: if the room should not be warm enough, the fire may be stirred up, or more coals added: a good fire may soon be made. We could

not effect these changes so easily with any kind of stove. Should we with them let out the air of the room that has been warming very slowly, we cannot get it up again to its former temperature but in a considerable time. We feel some benefit from a fire the moment it is kindled: not so with the stove; it must be lighted long before it gives sufficient warmth to the room.

381. *But there is another circumstance seldom thought of; an open fire does not, as we have stated, warm the air of the room directly, by passing through it;* the air is only warmed slowly by means of the walls of the room: therefore, while we feel, beneficially and agreeably, the radiant heat of the fire, we are breathing all the while a cool atmosphere. In a stove, on the contrary, this can never be the case: it is the nature of a stove to warm the air itself before we can feel the benefit of it, and we then breathe air considerably heated, often equal to that of a hot climate. This is apt to relax the body, and, without good management, may often prove injurious. Should this air be dry as well as hot, it is ten to one but we get a cold should we enter from a damp air, owing to the rapid absorption of moisture from our clothes, an effect which will not happen in the cool air of a room warmed by radiant heat. Should this warm air have been produced by an iron apparatus, we have already shown how unpleasant and unwholesome it generally is. But the advantages of our chimneys appear most striking in the case of ventilation, which with them goes on of itself, without any thought about it. While a fire is burning, a change of the air *must* happen; but with a stove, ventilation stands nearly still, and it is extremely difficult to effect, as it must be accomplished by other means: at least, it is more difficult than is usually consistent with the knowledge that may be expected from ordinary servants, and which will prevent its being performed well without much better superintendence. We shall say nothing here of the agreeable appearance of a fire, since this may be habit and prejudice, and other objects may be found equally agreeable; nor of its accessibility, since this is, perhaps, counterbalanced by its danger.

382. *Much has been said, as we have just observed, respecting the unequal manner in which a room is warmed by a fire, and of the perfect equality of the temperature in every part of a room where a stove is used.* This is, perhaps, the strongest point in favour of stoves, and, to invalids, is no doubt of the highest importance. Where the air is not injured by a stove, and the temperature preserved with great uniformity, there can be little doubt but these advantages are considerable where the lungs and state of health demand great care. But for persons in good health, this perfect equality of temperature does not appear so desirable. It does not exist in nature. The sun warms as unequally, and the warmth of his rays, with the cool freshness of the air, are agreeable, and not unwholesome, sensations. The inequality of heat in various parts of a room, though we could wish rather to correct it, has its advantages, and it would be difficult to find any degree of heat that would suit every one's feelings: some would feel it too warm, others not warm enough; but, with a fire, we can choose our places; we can draw nearer to the fire, or remove farther off. There is a certain distance from a fire that is most agreeable and most proper; not far enough off to lose the full benefit of the radiant heat, and not near enough to be in the decided current that feeds the fire. To sit quite opposite to a fire is particularly unpleasant, and often dangerous; as this is the strongest part of the current, many a cold is got by sitting directly opposite to a fire. The old-fashioned folding screens were found extremely useful, when, our fireplaces not being so good as at present, the draughts were more felt; and they are still occasionally employed with advantage.

383. *Various other reasons might be assigned for our adherence to the custom of warming our apartments by fires in open grates,* besides national prejudice in their favour. The frequent change of the occupiers in our cities, and the variety of wants, opinions, and tastes, form considerable objections to the introduction of any fixed and immovable modes of warming, while the abundance of our iron and coal, and the facility with which the former is wrought into grates extremely cheap, yet elegant in their appearance, and the ease with which they may be moved from house to house, and changed according to the taste of the occupant, together with the industry of our ironmongers, who hold out such temptations in every show-room, furnish so many reasons, among others that might be enumerated, for the continuance of their use. Besides, although they certainly are not the most economical apparatus, they are the simplest, and most easily managed, and, therefore, best adapted to the general habits of servants. Few people take the trouble to consider the difference between a badly constructed grate, and one made and fitted up upon the best principles, which are really little understood; and those who are disposed to quarrel with our fireplaces, do not care to select the best kind when they are disposed to criticise.

With our present existing edifices, our habits, and our fuel, there is little doubt but that we must continue for a long time the use of open fires; and that it will be most prudent to follow the example of Count Rumford in improving them as much as possible, until something better be fairly established or clearly demonstrated. If they have defects, they have likewise many advantages over other modes; and it may probably be ultimately found that the fondness for an English fireside is not merely a prejudice.

384. *Perhaps the greatest improvement that can easily be effected at present in rendering our houses comfortable, is to warm the air of the hall and staircase;* as all the upper apartments communicate directly with the latter, or with passages connected with it, whenever any door is opened, a rush of cold air enters; and every draught through crevices in the rooms feels unpleasant from the same cause; whereas, if the air of the staircase had a proper temperature, it would not only feel agreeable in passing from one part of the house to another, but all cold draughts would be avoided, with the exception of such as the windows occasioned; and this might be prevented by having double sashes in winter. But, if the staircase is to be warmed, the choice of the mode must be considered; since, if the air in it be in any way deteriorated, it must injure that of the whole house. Warming by heated iron we have said enough against: steam or hot water, and even brick stoves, are unobjectionable, except on the score of trouble and expense; but by no means should the air supplied be taken from the basement story, or from offices of any kind, but from some place out of doors, where the air is pure. Perhaps the best thing, where there is space, will be found to be a brick or earthenware stove, somewhat after the Russian or German fashion: these are easily managed, are not expensive, and do not injure the air.

Except the staircases are warmed, it will scarcely be possible to render very large apartments sufficiently comfortable by open fires alone, although this is extremely desirable on account of ventilation; but it would be easy to assist them by the introduction of steam heat, either by having steam pipes or vessels in the room, or by the admission of air previously warmed by steam pipes. The first of these methods is not only the simplest, but likewise the best, where it is practicable.

It is proper to observe, that although skylights in winter cause a great loss of heat, yet in summer, when there is strong sunshine, the air is heated by them to an intolerable degree. On these occasions, during the hot periods of the day, it would be extremely useful, in order to keep the house cool, to cover over the skylight with some cloth kept for the purpose, leaving just enough to afford the necessary light, a practice very common in warm climates. Through neglect of this, many houses are rendered very uncomfortable in hot weather. During the hot hours of the day, all windows should be kept closed, to prevent the admission of hot air. There cannot be a greater error than keeping the windows open in the heat of the day in very hot weather, for the air is then hotter out of doors than within.

385. *With regard to the degree of temperature proper for apartments,* it is not possible to lay down any invariable rule, since so much must depend upon particular constitutions and feelings, as well as other circumstances. General principles only can be stated. A thermometer is necessary to regulate the temperature where accuracy is required. In man, the natural animal heat, in a state of health, is about 98° of Fahrenheit, whether in the tropical or polar regions; and we have stated that this natural temperature is maintained by the function of respiration, checked by the cooling effect of perspiration. Clothing prevents the undue escape of this animal heat; but, as that protection is not perfect, it is necessary to regulate the temperature of the surrounding air within doors. It is stated by medical writers to "be a good rule for persons in England to clothe themselves in winter so as to be comfortable in a room at a temperature of 60° or 62°, and to let that be the steady temperature of their common apartments, which it could then never be dangerous either to enter or to leave." Rooms in England, where the thermometer is seldom kept, are often heated up to 70°, or so low as 50°. Accustoming ourselves to too great warmth in doors relaxes the system, and renders it more sensible of the cold out of doors, as also of those changes to which our climate is liable. We become somewhat in the condition of hot-house plants, instead of such as grow in the open garden. But though a certain approach to an equality of temperature be very desirable, we are not friends to persons in health having too great solicitude respecting it: there being no possibility of avoiding variations of heat and cold, it is better to accustom ourselves somewhat to changes of temperature. With respect to invalids, the case is different. When a staircase is warmed, the air to be admitted into the rooms may be kept at 56°, and not above that. A somewhat warmer temperature is proper for a sitting-room than for a bedroom.

SECT. IX.—ON SMOKE.

386. We have described smoke as an extremely fine dust, composed of unconsumed fuel that is carried up by the heated air; and, as the air is invisible, it is usually, by unscientific persons, confounded with the smoke itself. The cause of the ascent of the heated air carrying the smoke with it is its lightness, from being rarified by the heat. The more the air is heated, the more it is rarified, and of course the greater will be its power of ascent. Though smoke in the open air ascends at first, it soon diffuses itself on every side, and, when it cools, its particles fall down; in a flue it is confined, and will have a force of ascent in proportion to the height of the flue and size of the fire.

387. *It is not uncommon for short flues to draw badly*, as it is called; that is, to have little power of ascent: the remedy for this is to heighten the flue, if this be practicable.

388. *Flues ought to be constructed with great care*, and by an experienced bricklayer, although few things so important in a building are more carelessly executed; which is the more lamentable, since their defects can seldom be remedied, and are sometimes very difficult even to be ascertained.

389. *The most frequent cause of smoky chimneys is the width of their throats:* when that is the case, contracting the throat will remedy the evil.

390. *There can be no good reason why any chimney in a new building, constructed by an architect who understands the principles of his profession, ought to smoke*, except, indeed, there should happen to be in the vicinity some buildings still higher, from which, when the wind blows in a certain quarter, it may be reflected and beaten down the flue; or where there are high rocks, hills, or other objects that may have a similar effect.

391. *Since the cases must vary with every locality, no specific rules can be given for the guidance of the chimney doctor*, generally a quack, who promises to cure every smoky chimney with his infallible nostrum; and we can only recommend the bricklayer and architect (whose province this should be) to study the scientific principles upon which chimneys should be constructed, without which they must always be in the condition of persons groping in the dark.

When it is supposed that the cause of smoke is the beating down of air from the top from any higher adjoining buildings, or other objects, a common remedy is adding to the top of the chimney-pot a *cowl* or *turncap*, which, by turning round with the wind, gives a shelter to the smoke that issues: of these there are an almost infinite variety of forms, made of sheet iron painted, or of zinc: some of the latter appear to answer very well, particularly Day's patent windguard. Chimney-pots, likewise, of several forms, are made with the same view.

392. *It will sometimes happen that smoke comes down a chimney when there is no fire in the room.* This is generally occasioned by a current of air setting down the flue, and thus drawing the smoke from a neighbouring one. This must be corrected by some contrivance at the top.

393. *When neither contracting the throat nor putting on a turncap will have the desired effect*, the cure of the smoky chimney will probably prove difficult: *one method* we have seen described as "infallible;" this is to have a grate made so that all the front opening of the chimney may be shut up except that part just opposite the fire, thus converting the latter into a furnace, no air going up the flue except what passes through the fire. This is, indeed, generally a "cure for the smoke;" but by it, likewise, nearly all the heat goes up the chimney and is lost, so that there might nearly as well be no fire. Any one may make this addition to a grate, as a last resource when all other methods fail, by a plate of sheet iron, a contrivance well known by the name of a *blower*, which, by-the-by, is a good way of making the fire burn up upon occasion. A method, however, allied to this, but very different, has been practised with success, and found useful. This is, to carry the blower down even *before* the front of the fire, allowing the air feeding the latter to come only through the bottom of the grate, and to have even a register to this by which more or less air may be admitted: thus the fire may be kept in a long time by a very small quantity of air.

394. *Some attempts have been made to destroy the smoke from open chimney fireplaces*; but as none of these have been sufficiently successful to get into use, we do not think it necessary to occupy our pages with any description of them. Indeed, to accomplish this completely will evidently be a very difficult task, as may easily be conceived by those who will study the principles of chimney fireplaces and the generation of smoke. It is necessary likewise to observe, that, supposing smoke could be destroyed, which it might be practicable to do, particularly if close stoves were universally adopted, yet the flues (for these must still exist) would continue to vomit out on the house-tops the same deleterious gases as at present, and only in less quantity in consequence of the diminution of fuel. The smoke itself, though productive of much inconvenience from the soot and dirt it occasions, and which is really a serious evil in large cities, is not the most unwholesome part; that is the poisonous gas, or burned air, as it is vulgarly called, which we have shown to be wholly inseparable from the combustion of fuel, whatever kind that may be of. The smoke from coal fires, as is well known, not only blackens the exterior of the buildings by means of the particles of soot of which it is composed, but finds its way into our apartments, and even into the inmost recesses, staining everything contained in them, whether works of art, objects of natural history, or other precious articles.

It has been calculated that about one eighth part of the coal used as fuel is consumed and lost in the smoke, and that in this manner 100,000 chaldron of coals are annually applied in London to the blacking of our buildings, and the contamination of our atmosphere.

395. *That the smoke of furnaces for steam-engine boilers, hot-house boilers, or similar works, where the fireplaces are of the closed kind, can be effectually destroyed*, has been proved by several inventions for which patents have been taken. An act of Parliament was passed by the Legislature some years ago to compel the proprietors of manufactories in large

cities to burn their smoke; but we cannot here investigate the reason why this regulation was not complied with. The principles upon which it may be done cannot be very difficult to understand, when we consider that smoke is merely the unburned fuel that has escaped because there was not sufficient oxygen present to complete the combustion just at the part where the smoke separates; and this will be farther illustrated by referring to our explanation of the action in an Argand's lamp, where the smoke is completely destroyed.

With respect to manufactories, perhaps the best thing for many of them to do is to employ as fuel, coke, or else anthracite, the stone coal of South Wales, neither of which give any smoke when used alone, and when mixed with a small quantity of Newcastle coal, which is necessary to make them burn well, give very little. The committee of the metropolitan improvement has of late taken up this subject in earnest, and it is to be hoped that they will succeed in bringing about a reform. It is stated that Mr. J. Cubitt has completely destroyed the smoke in his new furnace chimney near Vauxhall Bridge. Williams of Liverpool, as well as others, have done the same thing.

Sect. X.—sweeping chimneys.

396. The collecting of soot in chimney-flues requires that they shall be frequently swept, and since a happy change has been made by the Legislature in the mode of effecting this, much of what we had originally written on this subject is now rendered unnecessary. For a century, at least, it had been the universal practice to sweep chimneys in England by sending little boys up these dark and dreary funnels; and were not some record preserved that this method was resorted to, it would scarcely be believed by posterity that children were ever used for the purpose.

397. *It had long been shown that the end might be answered by machinery*, but the determined opposition of the master chimney-sweepers had prevented the use of the machine from becoming general, and they continued to prejudice the public mind by representing that a large proportion of chimney-flues could not be swept except by the employment of boys. The fallacy of their representations having been at last sufficiently demonstrated, and this disgraceful and inhuman practice being now abolished, doubtless forever, it is not necessary that we should point out all the evils which were consequent upon it, and we shall only refer to those circumstances which are connected with the present practice of sweeping.

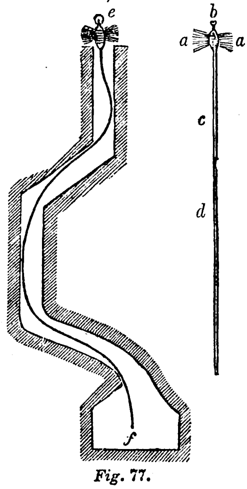
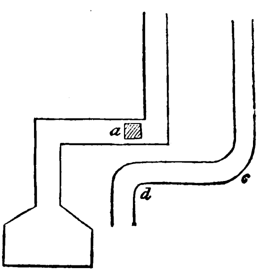


Fig. 77.

398. *When the flues are straight*, or have few or slight bends, without any of these being at right angles, there is no difficulty whatever in sweeping them with a machine, such as that invented by Mr. Smart, and afterward improved by Glass, *b c d*, *fig.* 77. This is composed of a large whalebone brush, of a peculiar construction, and fine cane rods three or four feet in length, attached to the brush. Length after length of the rods are firmly screwed on as the brush is forced up the flue, and unscrewed and laid aside when it is brought down, the flexibility of the cane permitting its easy ascent through the windings of the flue. The brush, *a a*, is made by inserting little bundles of strips of whalebone in small holes in a wooden stock. These strips are eight inches in length, which makes the brush, including the stock, twenty inches in diameter, and, consequently, sufficiently large to fill the flues, which are never made in London more than fourteen inches square, and seldom more than fourteen inches by nine. To make it pass more readily up the chimney, a small wheel, *b*, is fixed to the top of the stock. *e f* represents the machine in the flue passing the various bends. Some attention by the sweeper is necessary to ascertain when the brush has actually *arrived* at the top: from neglect of this, some have thrust the rods so far out, that they have fallen down upon the roof; others have damaged the chimney-pots, and when these have cowls or other contrivances to prevent smoke in the apartments, the sweeper, by forcing up the machine, has sometimes driven the top off. Practice and experience will prevent these accidents.



399. *The most difficult flues to sweep* are generally those where there is a right angle, as in *fig.* 78, part of the flue being horizontal: these angles it was almost impossible for the boys to pass, and never without great danger, partly from the difficulty of bending their bodies sufficiently, and partly from the accumulation of soot there, owing to its falling down. In these it was necessary to have a soot

door, *a*, made of iron to close tight, through which the horizontal part could be swept. But as this is on other accounts a bad construction, such flues are now always made with the corners rounded off, as at *c d*. Also, when any difficulties occur, on account of such a bending of the flues as cannot be surmounted by machine sweeping, soot doors are required, by the new act of Parliament, to be placed in proper parts to introduce the brush through. These soot doors are, of course, best placed on the outside of the house, if possible, but sometimes it is necessary to put them on the inside, and even in apartments, in which they may be concealed by a picture or frame of some kind.

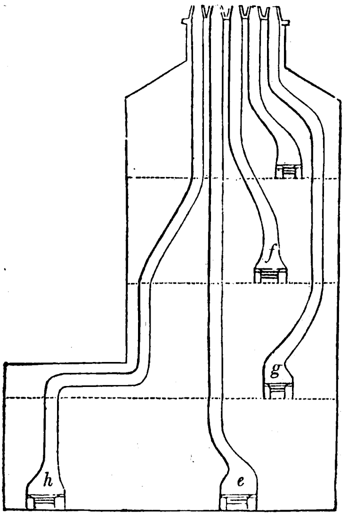


Fig. 79.

400. *Fig.* 79 exhibits the usual manner of bending the flues in the party walls of houses in London, so that sudden turns should be avoided as much as possible: *e f g h* are fireplaces. The fireplace, *h*, is supposed to be that of a kitchen under a lead flue at the back of the house, in which case part of the flue is usually horizontal.

401. *Other methods of cleaning chimneys.* In many parts of Scotland climbing boys are unknown, and the chimneys are cleaned in the following manner: An iron or leaden ball, or a stone, of a few pounds' weight, is fastened to the end of a long rope, and a man, taking this to the top of the chimney, lets the ball drop down the flue, dragging after it the rope. When the ball arrives at the bottom, another man draws the rope a good way down into the apartment, and fastens a bunch of heather to the middle of it; this bunch is then drawn up to the top, and the two men alternately pull up and down a little way at a time, until the whole of the flue has been subjected to this operation, by which means the chimney is perfectly cleaned. In that country the flues are usually rather wide, and there are steps by which the tops of the chimneys are easily reached: instead of such a bunch of heather, a round brush might be substituted in smaller flues.

402. *The present change in the mode of cleaning chimney flues will no doubt give rise to various improvements in their construction*, of which examples may be given in two papers lately read at the Society of Arts. The first is by *Mr. J. Sylvester*, "On the Construction of Flues and Fireplaces," and is thus stated in the Atheneum.

The object of this plan is to obviate the inconveniences arising from the necessity incurred by the ordinary method of building flues, of sweeping or cleaning every flue into the fireplace of the apartments to which it belongs; and also to avoid the nuisance of daily carrying away the ashes through the furnished apartments. To remedy these evils, Mr. Sylvester proposes to build every flue perfectly vertical, each flue for every fireplace, in all the stories, not only to ascend to the chimney top on the outside, but also to be continued downward into the basement, in one line from top to bottom, the fireplaces or grates not being under the flues, but in front of them, on the surface of the wall, surrounded by a chimney-piece, as a decorative piece of furniture. The smoke from the fire is made to pass through an aperture into the flue at the back, which, when the fire is not in use, can be closed by an air-tight sliding door, while another opening into the flue, under the fire grate, admits of the ashes, dust, &c., being cleared away into the descending or tail flue, whence it falls to the bottom of the flue in the basement story. By this means it is merely necessary, when a chimney requires sweeping, to close the door at the top of the grate, and the sweep may go into the basement story, open the door at the bottom of the descending flue, and take away the soot and ashes there collected. He may then, by the use of the machine, brush down from top to bottom any small portions of soot that may hang to the flue, when the whole can be removed, without the slightest interference with the room to which the flue belongs, unperceived by its inmates. The whole of the flues in a stack may be swept at the same time with as little inconvenience as one, since they all descend into one chamber, and open at the same level.

403. *Another improvement has been suggested by Dr. Atkins.* He proposes to place a series of three layers of wire gauze, four inches apart, in the aperture of the chimney, the first layer at the distance of eighteen inches or two feet above the fire, the distance being regulated according to the nature of the fuel used. Each layer consists of twelve wire gauzes, one fourth of an inch apart. The smoke which ascends will deposite its soot on the wires, and their temperature will, by their proximity to the fire, be sufficiently high to effect its combustion.

404. *Others, again, have proposed* to fix some permanent apparatus in the flue, by means of which a brush could be carried from top to bottom at any time. We have seen contrivances of this kind already; but it is too soon to pronounce upon their general efficiency However, it seems quite possible in a new house to contrive the flues so that they might be swept at any time by the ordinary servants, or by any person engaged to do such work. The flues should be circular, and bricks have been made for building them so.

CHAPTER III.

ON THE VARIOUS KINDS OF FUEL.

SECT. I.—WOOD.

405. *The most ancient fuel was undoubtedly wood.* It appears that most countries, before they were peopled, were in great part covered with forests, as we see in America at present; and the cutting down these to make room for cultivation supplied, at first, the necessary fuel. In ancient times, wood was universally used in England for this purpose, as it still is on a great part of the continent of Europe. The destruction of our forests by various causes began to be felt as a serious evil about three centuries ago, when, fortunately, the introduction of coal more than compensated for their loss. From the abundance and cheapness of the latter substance, wood is now little employed as fuel in the British Isles, except by the poorest classes, who in some parts still depend upon the refuse of plantations. In many parts of France wood is regularly planted for the fire, where the natural woods have been long since consumed. In Britain this is seldom practised; nor would it, perhaps, be generally useful while coal can be had; though some have thought it desirable to do so, for the benefit of the poor.

406. *When wood is used as fuel for warming apartments*, it is cut into certain lengths and laid across an iron apparatus, called here *dogs*, or *andirons*, formerly universally used in our mansions, but which now are rarely to be met with.

Wood makes a very cheerful fire, from its abundant and bright flame; but it consumes quickly, and requires often renewing: on this account it is expensive, and the labour necessary to prepare it is also very considerable. It is likewise bulky to store, and must be kept very dry. It has the advantage of kindling readily, but affords an unsteady heat. For some purposes its flame is convenient, and for others the contrary.

407. *Wood, when examined minutely*, is seen to consist of longitudinal fibres, finer than hair, the interstices between which are filled up with a cellular substance, or tissue, the disposition of which varies somewhat in the different species of trees. This disposition is seen in any section across the tree.

408. *The elementary principles of which all vegetables consist* will be particularly described in Chap. VII., Book VII., to which we refer the reader. We may here observe, that wood, like all vegetable matter, is composed of carbon, hydrogen, and oxygen; which, when it is decomposed by burning, are separated from each other, and are reunited in other proportions, which constitute the products of the combustion.

409. *When wood is burning*, the hydrogen unites with a small portion of the oxygen, forming the gas called *light carbonated hydrogen*, and it is the combustion of this which constitutes the flame. (The nature of combustion has been described in Chap. II., Book II.; and that of flame will be treated of fully in Chap. I., Book IV.) A small quantity of other gases are generated by the combustion, as carbonic acid and carbonic oxyde, by the union of some of the carbon with some of the oxygen; but these are ineffective in the production of light and heat. When all these volatile products are given off by the combustion, if the farther burning of the wood is stifled, charcoal would remain, which consists of the woody fibres alone, deprived of all the principles except the carbon, which, being less volatile than the hydrogen and oxygen, remains, preserving the original form of the wood. This charcoal, however, is capable of being burned likewise; for if the combustion be suffered to proceed, it will all disappear, its carbon uniting to the oxygen of the atmosphere, and thus producing carbonic acid. As wood contains, besides the principles we have enumerated, a small quantity of earths, alkalies, metallic substances, &c., incapable of combustion, these remain as ashes. (See Chap. II., Book XXII., "Laundry.") When wood is burned in a chimney, the current of air up the chimney becomes diminished when the combustion is nearly at an end; and though the embers of the charcoal still retain a state of ignition until they become reduced to ashes, yet as the fire becomes weaker the draught up the flue becomes less, and then there is danger of the carbonic oxyde and carbonic acid gas that are generated from the charcoal coming into the apartment, their weight being greater than that of common air. A fire in this state, therefore, cannot be considered as healthy to sit over, and the air of the apartment must become vitiated. But wood can give off no sulphuretted hydrogen, as it has no sulphur, like coal. During the combustion, there is, likewise, some

pyroligneous acid formed, the vapour of which gives that penetrating effect peculiar to wood smoke.

410. *The heavy and dense woods give the greatest heat*, burn the longest, and have the densest charcoal. To the dense woods belong the oak, beech, alder, hazel, birch, and elm: to the soft, the fir, the pine of different sorts, larch, linden, willow, and poplar. Clement and Desormes found that woods give out heat in proportion to the relative quantities of their carbon.

Under like dryness and weight, different woods are found to afford equal degrees of heat in combustion. The effect of wood in producing heat depends much upon its dryness.

Count Rumford showed that unseasoned wood contains one third of water; and much of the heat is expended in converting this into steam or vapour, which escapes up the chimney. With his improved boilers he made twenty pounds of ice-cold water boil with one pound of dry pine wood: the same wood unseasoned produced an effect less by one seventh.

The quantity of moisture in newly-felled wood amounts to from 20 to 50 per cent.; birch contains 30, oak 35, beech and pine 39, alder 41, fir 45. Wood felled for twelve months still contains from 20 to 25 per cent. of water; there is never less than 10 per cent. present, even when it has been kept long in a dry place; and though it be dried in a strong heat, it will often absorb from 10 to 12 per cent. of water. If it be too strongly dried, its heating powers are impaired.

Trees that have attained their maturity without passing into decay are the best for the production of heat when employed as fuel. Thus, the value of an elm of one hundred years is, for this purpose, better than one of thirty years, in the proportion of twelve to nine; and of ash of one hundred years to one of thirty years, as fifteen to eleven. When trees begin to decay, their value as fuel rapidly diminishes.

411. *The wood used in heating ovens for baking bread* generally consists of small branches of trees, made into what are called fagots.

A fagot is a bundle of any sort of small wood, consisting of the spray and shoots of trees of three or four years old, tied closely up together by means of a *withe*, which is a name given to very small splittings of willow, hazel, or some other pliable wood, twisted. They are mostly made up from the cuttings or thinnings of underwoods and coppices, and the prunings or superfluous branches of a spray of hedges. They give a clear and rapid heat, and they are sold to those bakers or others who use wood. In making up these bundles, the workmen trim off the superfluous spreading branches from the sides and ends, which gives them a neater appearance. The trimmings are put into the middle of the fagot. Formerly, when wood was the fuel of the country, and before coal was used, fagots were regularly kept as a part of the stock of fuel. As they kindle readily, and give a great quantity of flame, they are used where a strong and quick heat is required; but, as they burn away proportionally soon, they are not fit for an ordinary durable fire: in conjunction with other wood, they supply the means of producing any degree of increase of heat that may be wanted. They require to be very dry. On the Continent, where the apartments are heated by means of stoves, branches of this kind are much employed in them.

412. *Cones of the fir tribe*, particularly of the pine, which are found dropped on the ground in the autumn and winter, are extremely inflammable; in the north of Italy, these are collected, and much used for kindling their wood fires, as they are easily set on a blaze by the flame of a candle, and they cause the fire to burn briskly.

413. *Wood is analyzed by distillation in close vessels*, as in the process for making pyroligneous acid. The first product that comes over is the watery vapour or steam from the moisture in the wood, mixed with pyroligneous acid. Next follows a considerable evolution of gas, which is inflammable, being hydrogen combined with a small portion of carbon, not usually above half the density of coal gas, and not affording nearly so strong a light. Then follows carbonic oxyde, a gas consisting of carbon, with its minimum of oxygen. But though the gas from the combustion of wood, containing less carbon than that from coal, gives less light, it gives more heat than coal gas; and hence we see the reason why the flame of wood is so much more efficacious in making a vessel boil than the flame of coal. The purer the hydrogen, the greater affinity it has for oxygen, and, therefore, the more rapidly it burns: the addition of carbon to the hydrogen retards the combustion and diminishes the heat, though the light is increased by it. That the most intense heat results from the attraction of oxygen and hydrogen for each other is shown by the hydro-oxygen blow-pipe, in which a stream of each gas coming together is ignited at the point of contact. The fuel that contains most hydrogen will give out the greatest quantity of heat. But to produce the greatest effect of fuel, it is necessary that it should be put in close vessels, and that the heat evolved shall be carried to one spot, instead of being suffered to radiate and become dissipated by escaping into the atmosphere. This is the cause of the great heat produced by a few sticks in such culinary vessels as the "conjurors," or in closed fireplaces, and of the great waste by boiling kettles over an open fire. See "Culinary Apparatus."

414. *There are many cases in domestic economy where wood, cut into small pieces*, is the cheapest fuel, a circumstance too much neglected. Count Rumford was of this opinion; and states, that in very small fires for some purposes, it is the most cleanly, the most convenient, and most manageable fuel. He found by experience that any given quantity of wood, burned in a closed fireplace, gives very near three times as much heat as it would give if reduced to charcoal, and burned in the same fireplace. Another great advantage of using wood for closed fireplaces, is the quantity of flame it affords, and the facility with which it may be kindled and put out by a damper.

SECT. II.—CHARCOAL.

415. Charcoal is extremely valuable as a fuel, and possesses peculiar properties. It is the carbonaceous part of wood, or the carbon alone which remains after the other elements, the oxygen and hydrogen, have been volatilized by combustion. Charcoal is not any part of the wood altered by burning, according to the vulgar notion; but it existed in the wood originally, and is only made apparent by the escape of the other ingredients.

416. *When a branch of charcoal is examined by the microscope*, it exhibits the structure of the tree in its living state; for what is the woody fibre of the plant, and which may be called its skeleton, is deprived, by having been burned, of all but its carbon, which still remains in its original position. Numerous pores may be seen disposed in order, and traversing the branch lengthways, which are the vessels of the plant; so that there is no piece of charcoal but might be blown through. This may be best seen by breaking off a piece short. In a piece the eighteenth part of an inch thick, Dr. Hooke reckoned 150 pores; whence he concludes that in a piece of charcoal of an inch in diameter, there are no less than 5,724,000 pores, which agrees with what is known respecting the amazing minuteness of the tubes of which plants consist.

417. *Although the charcoal remains after the rest of the wood is consumed by combustion, it is itself, as is well known, a combustible body;* and the reason why it does not disappear like the rest of the wood when burned is, that carbon is less combustible than hydrogen, and that, in the process of carbonizing, time was not allowed for the combustion of the carbon, nor a sufficiency of atmospheric air, the fire being checked and smothered just in time to prevent its destruction. If, however, this charcoal, so preserved, be again exposed to the action of fire, with free access of air, it will burn, that is, it will unite with the oxygen of the atmosphere, giving out heat, and forming a gas, which is the carbonic acid gas, or the ordinary vapour of charcoal, the suffocating properties of which are so dangerous.

It must not be supposed, however, that charcoal consists of pure carbon; for it retains a small quantity of some other principles in the wood that were not capable of being volatilized, and those appear in the ashes of charcoal when it is burned.

418. *The ashes of charcoal consist of several of the earths*, as clay, silex, and lime, together with some alkali or potash: sometimes even a minute portion of iron is found. The ashes of charcoal, or of wood, for it is the same thing, are much esteemed by agriculturists as a manure for land, as also for washing and scouring, and from them potash is obtained. (See Book XII., " On the Laundry.")

419. *In the combustion of charcoal* no flame can appear, for the flame of burning wood arises, as we have shown, from the hydrogen of the vegetable; but, as that has been dissipated by the first combustion, no more remains in the charcoal to cause flame.

Whether the blackness of charcoal is the natural hue of the element, carbon, is uncertain, for absolutely pure carbon is unknown to us in a detached state, except it be, as is supposed, crystallized in the diamond.

420. *The common process of making charcoal in this country is as follows:* Men accustomed to the business cut and cord the wood in winter: charcoal-burning takes place during the summer months, and is, for the most part, carried on in the woods, to save the expense of carriage. After it has been felled, the timber is cut into billets, and when it is become sufficiently dry, the process of converting it into charcoal is begun by raising a plot of ground a little higher than the surrounding surface, and bringing it to a slightly convex form by beating it: thus a hard, dry, and solid floor is formed. In the centre of this area is placed a circle of sticks, adjoining each other, and composing a vertical hollow cylinder from three to four inches in diameter, and about six feet high. Round this interior cylinder are ranged successive circles formed by pieces from one to ten inches in diameter: several flues are formed through the pile, and the whole is so constructed, that it kindles in a short time, and burns very equally.

The outermost circle is composed of brushwood and chips. When the pyramidal pile measures from twenty to thirty feet in diameter, it is sufficiently large. It would burn out, when kindled, into a vast blaze, and be quickly consumed to ashes, but that a coating is now laid on of turf, the grassy side being next to the wood; and dry earth is heaped up round the bottom of the pile, and well rammed, in order to prevent the admission of air. Three or four screens, formed of large hurdles well stuffed with brushwood, are also prepared, in order to protect the pile from the violence of the wind. All the preparations being now completed, the pile is kindled by dropping lighted chips down the hollow cylinder in the centre, which, in proportion as they are consumed, are supplied by others during the first three or four days, at the end of which period the kindling of the pile is completed. The top of the cylinder is now closed, and a row of holes, each about two inches in diameter, is pierced at the base of the pile, by which the requisite quantity of air is supplied, and a passage is afforded for the smoke and vapour. Whenever the white watery smoke is succeeded by thin blue and transparent smoke, which may take place in about a fortnight, it is reckoned that all the watery and volatile part is dissipated, and that the burning of the coaly matter is commencing; therefore the fire must be stopped. The holes are now all closed in succession, and the pile is covered over with earth as accurately as possible, till the fire is completely extinguished, going out for want of air. The pile is now allowed to cool, which requires many days; for charcoal, being a very bad conductor of heat, the pile remains long red hot in the centre, and if opened in this state, will immediately burn with fury.

421. *In France they use a great deal of charcoal for many purposes, particularly in their kitchens.* In the forest of Benon, near Rochelle, great attention is paid to the manufacture of it. It is there made from the black oak, and is sold above 20 per cent. dearer than any other. It is made in heaps covered with turf, nearly in the manner described above. An improvement has lately been made in its manufacture, by filling in all the interstices of the heap of wood to be charged with powdered charcoal. The quality of the fuel made in this manner is equal to cylinder charcoal, and the quantity is one fifth by weight greater than in the usual method.

422. *Charcoal for ordinary purposes is made in the open air, as above described*; but when it is required of greater purity than common, as for the manufacture of gunpowder, *the charring is performed in closed iron cylinders*, fixed in masonry over a grate: this is furnished with a door at one end that can be accurately closed, and terminating in the other in a curved pipe. The cylinder is filled with pieces of the willow, elder, and other aquatic woods. When the fire is lighted, the volatile products escape though the pipe, and the charcoal remains in the cylinder. Lately, the making of charcoal in closed vessels has been converted into profit by collecting pyroligneous acid in the process, from which vinegar is made. But it is remarkable that, though the charcoal made in this manner is so superior for making gunpowder, yet it is not so well calculated for some other purposes. It is not of half the specific gravity of the charcoal which is made out of doors in the common way, covered up with turf; the makers of iron, particularly, will not buy it.

423. *Charcoal varies in its quality*, not only according to the most or less judicious modes of manufacture, but likewise according to the nature of the wood it is made from. The hardest woods, as oak and beech, make the best charcoal for fuel; while that from the softer woods, as the willow and the alder, is most proper for making gunpowder, crayons, polishing copper plates, toothpowder, and medical purposes. That commonly sold in London is pile burned, and made of oak, beech, and hazel: sometimes willow charcoal is mixed with it.

424. *The great convenience of charcoal for ordinary operations* has rendered its employment almost quite necessary in some of the processes of cooking, particularly in the French manner. By its means a fire may be made in any part of the kitchen, as it gives no smoke, kindles readily, and burns with very little draught of air, continuing till the whole is burned out.

It burns away very quickly, requires frequent renewal, and is very expensive; but is the best fuel where a very regular heat is required, as in stewing. It is particularly useful in some furnaces, as it gives a strong heat, and makes no clinkers.

425. *Although charcoal gives no smoke, it should never be forgotten that its combustion can not go on without the formation of carbonic acid gas*, the dangerous nature of which has been explained. This gas, indeed, being heavier than atmospheric air, generally occupies the lowest place in the apartment, and is, perhaps, almost always below the level of ordinary breathing; yet a certain quantity cannot fail to mingle with the air, and render this unwholesome to breathe. The air arising from charcoal when burning is as clear and invisible as common air; but this very circumstance prevents us from perceiving its presence, and it may, therefore, prove highly dangerous before we are aware of it. The air rising from coal or any other fuel likewise contains much carbonic acid; but the smoke, which always accompanies it, gives warning, and becomes highly disagreeable before it is dangerous. This is not the case with the vapour of burning charcoal; hence so many fatal accidents from its use in confined places, where there is no flue. The first sensation, when it has become dangerous, is a slight sense of weakness: the limbs seem to require a little attention to prevent falling. A slight giddiness, accompanied by a distinct feeling of a flush or glow on the face and neck, succeeds. Soon after, the person becomes drowsy, wishes to sit down, but commonly falls on the floor, insensible of all about him, and breathes strong, snoring as in apoplexy. If the person is alarmed in time, and escapes into the open air, he is commonly seized with a violent headache, which gradually abates. But when the effect is completed, as above described, death very soon ensues, unless relief be obtained. In short, the

effect is suffocation. The most prudent treatment in a case or accident of this kind is to take off a quantity of blood immediately, and throw cold water on the head repeatedly. A strong stimulus, such as hartshorn, applied to the feet, has also a very good effect.

426. *Besides its use as a fuel, charcoal possesses several properties* which qualify it to render very important services in the arts. Its indestructibility renders charring the outside of wood that is to be driven into the ground a very useful practice. Its tendency to absorb various gases makes it very serviceable in preventing putrefaction; it is accordingly one of the best preservers of meat for a short time, and will even remove a slight taint when meat has been kept too long. (See "Preservation of Food.") It makes an excellent toothpowder.

Its nonconducting property renders it very useful on many occasions for confining heat. It has also the property of freeing many liquors from their empyreumatic flavour, and also of depriving them of colour.

Sect. III.—COAL.

427. This substance, sometimes distinguished by the term *pit-coal*, and now the most important fuel in the world, has not been in use above three centuries. Vast strata of it are found deep-seated in the earth, and it is raised by the regular operations of mining. Notwithstanding its situation would appear to present great difficulties to the supposition, yet it is now completely ascertained that it has been formed from vast collections of *vegetable matter* that have got together, and been subjected to the action of water, compression, and other causes, but in what particular manner time has wrought so great a change is not distinctly understood. The analysis of coal is not very different from that of vegetable matter in general: each consists chiefly of carbon, hydrogen, and oxygen; only the latter exists in much smaller proportion in coal than in recent vegetables, and coal contains a little ammonia, sulphur, and a good deal of earthy matter. The hydrogen of coals is exhibited in the gas-light, and the carbon in the coke, which remains after the distillation of the gas. (See "Illumination by Coal Gas," Chap. V., Book IV.)

The superiority of coal over every other combustible, for domestic as well as many other purposes, is now generally acknowledged. The chief objection to it seems to be the smoke it sends out, which blackens or stains the surrounding objects to a great degree, and even in our apartments.

428. *The coal of every different coal-field, almost of every pit, differs in some particulars;* but we may conveniently class them all into three kinds: 1. Caking coals, called also bituminous coals. 2. Open burning, or noncaking coals. 3. Anthracite, or nonbituminous coal.

429. *Caking coals* are those which soften with the heat, and partly melt like pitch or bitumen, throwing out at the same time jets of very bright flame. Small coal of this kind will, by melting, run together, and bind into a hard mass that requires being broken by the poker to admit fresh air, otherwise it would not continue to burn. Caking coal is the kind that is mostly used in London, and it is brought chiefly from Northumberland and Durham, where there are extensive coal mines. The whole goes by the name of *Newcastle coals*, that being the place where the greatest quantity is shipped; and it is sometimes called *sea coal*, being brought by sea. The best of the Newcastle coals for domestic use is from the pits called *Wallsend:* they burn with a very white and brilliant flame, and do not cake so hard as some others. The small coal of this kind is what is used by the blacksmiths. The *Tanfield moor* coals are the strongest, and cake the hardest: they are mostly used in furnaces.

Cannel coal is a much rarer variety of the bituminous sort, that burns with a very bright white flame, and is employed by the poorer people in the north for affording light instead of candles, "cannel" being the mode of pronouncing "candle" in the north. It does not soil the fingers, and is sometimes turned on the lathe into various ornaments. When put into the fire it is apt to split and fly out, but is sometimes mixed with other coal, on account of the flame which it affords. Scotch coal is generally of a large kind: some of it is a strong, well-burning coal, but not nearly so bituminous as the Newcastle. It is scarcely known in London.

430. *Open-burning coal*, called also *cherry coal*, is much less bituminous than the Newcastle, gives much flame and ashes, but does not cake. The Shropshire coal is of this kind. This coal, which gives a white ash, is convenient for burning in a chamber in summer, because a very small fire will keep in; whereas with a strong coal the fire requires frequent attention. From this circumstance the cherry coal is often very useful to an invalid.

431. *Anthracite* is a coal very different in its properties from all the others. It consists almost wholly of carbon, without any, or at least very little, hydrogen: consequently it gives no flame nor smoke; nor can it afford any gas. It is, indeed, nearly a mineral charcoal, and differs little from coke, which it resembles in most of its properties, though very unlike in appearance, for it is smooth in its fracture, and has a high

shining lustre, superior to that of the richest Newcastle coal, and does not soil the fingers. It is difficult to kindle, and cannot be burned in an open grate without an admixture of bituminous or Newcastle coal; but it may be easily burned in close stoves or furnaces. Abundance of it is found in South Wales, and it begins now to be brought to London for stoves. It is likewise used for drying malt, and in breweries, distilleries, &c.

Anthracite is known by several other names, as *blind coal*, *culm*, *stone coal*, *Swansea coal*, and *glance coal*. This coal is also dug at Kilkenny in Ireland; and vast quantities are found in Pennsylvania, where it has been for some time employed in the iron manufacture, for which purpose it is now likewise used in South Wales.

432. *When coals are dug they are liable to be broken more or less;* hence there is always a quantity of fragments, which constitute the small coal. When the coal is bituminous, and of the best kind, this small coal is still useful, as it will cake together, and is particularly desirable for the blacksmith's forge; but when the coal is little bituminous, as the Shropshire, this small coal does not cake, and it is then of little value. It is customary in all coal to separate the large from the small by screening; and the small is sold at a much lower rate, under the name of *slack*. It is no uncommon thing for dishonest dealers to mix some of this slack with good coals, though some of it is scarcely combustible.

433. *The price of coals to the consumers in London* is said to be considerably enhanced by a class of middle men, who are called in the trade *Brass-plate coal merchants*. These consist principally of merchants' clerks, gentlemen's servants, and others, who have no wharf of their own, but merely receive orders and transmit them to some true coal merchant, who sends in the coal from his wharf: all that is effected by the brass-plate coal merchant being to receive a handsome commission for his agency, with this attending circumstance, that the coals are likely to be of an inferior quality, with the means of redress being rendered more difficult. In ordering coals, therefore, it would be prudent not to deal with any but those who actually keep wharves of their own.

434. *To derive the greatest advantage from open coal fires*, it is necessary not only that the fuel should be well selected, but that the fire should be properly managed. It is not sufficient that the coal burns well; for it may do so without giving so much heat to the apartment as if it were managed differently. Here, again, we shall find that by resorting to a few principles we shall comprehend more clearly what is the best practice.

We explained above that air is essential to combustion, and that it is by the decomposition of the air during this process that heat is evolved: it follows from this that to throw out the most heat, the fuel should be so arranged, that the air shall have free access to every part; care should, therefore, be taken that the coals do not lie in too compact a body, but that interstices should be left that the air may penetrate through the fire.

435. *Lighting a fire* may appear so simple and well-known a process, that it may be thought quite superfluous to give any directions respecting it; and yet how often do we suffer the inconvenience of seeing the fire go out soon after it has been lighted? Perhaps few circumstances try one's patience more than to witness abortive attempts at lighting a fire. To do this methodically, a basket should be provided, with a separation into two parts; one for paper or wood shavings, the other for wood split and cut into proper lengths. If the paper is put on the bottom of the grate, as is frequently done, and the wood in too large pieces, the iron of the grate abstracts the heat so much from the commencing flame that it will not have strength enough to kindle the wood; or if it does take fire, the combustion is too feeble to set fire to the coals that are heaped upon it. The better way is to have some pieces of very choice inflammable coal, and to lay a few pieces at first on the bottom bars, but without covering them entirely; then lay on the paper or shavings, then the wood, and on that some pieces of round coal of the size of eggs, and no small coal: when the whole is kindled, let it burn up before any more coal is added. If the small coal be put on at first, it is sure to choke the fire by filling up the vacancies, and preventing the air from having access to the centre. The coal laid at the bottom will take fire by the time that the wood is nearly burned out, and will, by its flame, keep the fire alight. If a fire is thus laid and kindled, there is no reason why it should go out, and it ought to burn up with certainty when left to itself. Some have recommended to have kindling balls made of coal, mixed with some very inflammable substance; but as these have not come into use, it will do very well to select some of the best ordinary coals, that take fire very readily, which may be had of the coal merchants, and kept for the purpose of lighting fires: the trouble of this will not be great, and may, in some situations, prevent much annoyance. It has often been condemned as a bad plan to throw too much coals on the fire at a time, as by this a great deal of the hydrogen is distilled off, and escapes up the chimney without catching fire, which is absolute waste. That some hydrogen, which we may call the most inflammable part of the coal, does generally escape unburned in open fires, we may convince ourselves of by holding a piece of lighted paper in some of the smoke which is rising from the fire where there is no flame; we shall perceive that sometimes a flame will instantly appear, owing

to the escaping hydrogen being set fire to. To manage a fire in the best manner, little hydrogen should escape up the flue, otherwise there is a loss of fuel. We may here repeat, that the manner in which open fires warm apartments is by the radiant heat almost entirely. We should, therefore, prevent the front of the fire from being clogged with unburned coals, while the combustion is going on in the centre; the front should be of a glowing red, since that is the condition in which the fire throws out most radiant heat. To promote this, some persons have employed brick balls to put into the fire, and when these are well managed, they do assist in throwing out radiant heat by becoming red hot; but they require much care and attention, as they are apt to collect together and choke up the fire, thus doing more harm than good: we cannot, therefore, recommend them. Much of the comfort and advantage of open fires depend upon the quality of the coals: they should not be too bituminous, otherwise they cake so fast as to require frequent stirring and breaking. Bad coals leave too much ashes, and are not inflammable enough; also, though cheap, they are far from being economical; and we may here repeat the advantage of having the fire burn against brick instead of iron. In short, to arrange a fire well requires some judgment, and is interesting to those who can perceive it as a constant exemplification of the chemical laws of nature.

436. *Coals are at present sold by weight;* and by a late act of Parliament, under a penalty of £10 to the carman, and £20 to the vender, a perfect machine must be carried for weighing coals. The correctness of any machine may be easily tried by putting a 56lb. weight into each scale, and see if it fairly balances. By the same act it is ordered, that machines and weights should be kept at the different watchhouses and police stations, for weighing any coals about which there may be any dispute, and power is extended to any two justices of peace to appoint other places for the same purpose.

When the coals are shot down into the coal cellar through the circular aperture, they form a conical heap under it; and, as is always the case with loose materials, the largest pieces roll farthest down on the outside of the heap, the smallest occupying the top. Were the coals to be used from this heap as it is formed, the result would be, that all the large pieces of coal would be used first, and towards the last there would be only small coals. To prevent this inconvenience, a person, called a *trimmer*, is sent by the coal merchant, whose business it is to mix the small and large together properly by throwing the whole into the end of the vault; but, unless the trimmer be looked after, he is very apt to neglect doing this properly, his only object too often being to keep them within the door of the coal cellar, without caring whether they are mixed or not, although this is of much consequence to their burning well. This man is paid 3*d.* per ton by the coal merchant; and it is proper for some one to see that he does his duty.

437. *The complete decomposition of coal* is explained in Chapter II., Book II., when treating on "Combustion;" and in Chapter V., Book IV., "Gas light."

Sect. IV.—coke.

438. *Coke is prepared from coal by depriving it of its hydrogen;* consequently, coke can give neither flame nor smoke. It is, in fact, to coal, what charcoal is compared to wood, and is prepared by a similar process. When made on the great scale, for smelting iron, the coal is laid in heaps, covered over with earth and clay, and set fire to: a smothering combustion, having very little access of air, causes the hydrogen to separate from the coal, without the carbonaceous part being consumed, as in the making of charcoal; and, when this is effected, the fire is put out, and what remains is coke. A great quantity of this combustible, and particularly that which is chiefly employed for domestic purposes in London, is what remains in the iron retorts after the gas has been extracted from the coal for illumination; and this is superior for domestic use to that made in the large way for smelting.

439. *Coke has the advantage of giving out an intense radiant heat, without any smoke,* and is therefore particularly convenient for many purposes. It is, in fact, a mineral charcoal, being the carbonaceous part of the vegetable substance from which the coal was formed; but the woody structure is no longer visible, as in charcoal. It is likewise more dense than charcoal, containing more carbon in the same compass, and therefore capable of affording a longer continued heat. From the clearness with which it burns, and the intensity of its radiant heat, it is excellent for certain operations of the cook, where a bright, clear fire is wanted, as broiling, roasting, &c.; but it is difficult to kindle, and does not answer well in a grate without an admixture of coal; but these two together make the strongest fire. Coke, however, leaves a great deal of ashes. It is also convenient to mix with coals that are very bituminous, to prevent their caking together too much. Some attention is required in trying any particular kind of fuel, as each demands a peculiar management. Coke, when used in an open fire, should be broken of the size of a goose egg, and laid on the top of the fire, when it has burned well up; the pieces will collect the radiant heat that would have escaped up the chimney, and soon themselves become red hot, in which state alone they are effective. Care should be taken that they do not get in front of the fire before they are red hot, as they will only obstruct the rays of heat.

440. *There is some difference in the density, and, consequently, in the strength of the coke,* according to the kind of coal from which it is produced, or the mode of preparing it. The heaviest gives the most heat, and will last longest; but that which is shining and light will burn most readily.

441. *It is a notion with some that coke is more sulphurous than coal;* but this is impossible, since the very object of coking coal for smelting iron is to deprive it of its sulphur, which is dissipated in the coking; and the same effect takes place when it is left after the coal gas has been taken from the coal. Coke burned by itself has, however, all the bad qualities of charcoal, of giving out carbonic acid gas, which, if the current or draught up the chimney is not sufficient, will fall down into the apartment; but while it is burning in a fireplace there is no danger of this, as the current upward carries the carbonic acid along with it.

442. *In very cold weather*, putting some coke on the fire is a decided improvement, from the greater heat thrown out than can be given by coal alone. Coke is also, in many cases, economical, when properly managed. The heating power of good coke is to that of pit-coal as 75 to 69.

Sect. V.—PEAT.

443. *Peat, sometimes called turf, but improperly*, is a fuel much employed in many countries; although in England, from the abundance of coal, a much superior substance, it is little esteemed. Nevertheless, it is the only fuel which the poorer classes can procure in parts of the north and west of Scotland, and a great part of Ireland. In many parts of Holland there is no other fuel; and in several districts of France, Germany, and other kingdoms of Europe, where coal and wood are scarce, the poorer inhabitants burn nothing but peat.

444. *Peat is a vegetable production* comparatively recent. In low grounds, and sometimes even on the flat summits of hills, where the water cannot run off, certain plants peculiar to such situations accumulate, and grow on each other. When these decay, they are converted into the substance called peat; and sometimes this growth is increased by fallen trees, which, by rotting, add to the peaty matter. If a portion of peat be examined, it will be found to consist almost entirely of the roots, stems, and leaves, of small plants matted together, and changed into a dark-brown substance. The accumulation of peat in some countries, called *peat mosses* and *peat bogs*, are sometimes many miles in extent. Their depth varies from a few feet to several yards, and it is certain that they have required many ages for their growth; but peat still continues to form when circumstances are favourable. The substance of peat is soft when in the peat moss, and is easily cut with a spade, by which it is formed into pieces of the shape of large bricks: these are exposed to the air; and, when they are dried, they are very firm and inflammable.

445. *Peat, as a fuel, being loose and spongy in its texture, compared with more solid kinds*, is not so fit to be employed for the production of strong heat, as it is too bulky, and burns away too fast; but, when we desire to keep up a long-continued and extremely gentle heat, we can scarcely use anything better than peat. There is a very great difference in the quality of this fuel. Some of it is very light and spongy, of a brown colour, appearing to consist of a mass of the fibrous roots of plants and dead leaves, &c. This kind burns readily, but consumes rapidly. The best peat is compact and heavy, of a brownish black colour, with scarcely any vestiges of its vegetable origin remaining. This last is an excellent fuel, gives a steady heat, though mild and gentle, with a brilliant white flame, and does not require so much attention as wood; but, when lighted, preserves the fire a long time, and, when red hot, bears to be moved about: still, it consumes much faster than coal.

446. *The smoke of peat* is copious and penetrating, and affects the eyes like the smoke of wood. It gives an odour disagreeable to those who are not accustomed to it, owing to the pyroligneous acid which is disengaged. As this smoke occupies the upper part of the cottages where chiefly it is burned, it is less felt by sitting down. It likewise imparts a peculiar empyreumatic smell to everything it comes in contact with, which adheres with great obstinacy; but this smoke is well adapted for curing some kinds of meat and fish, imparting to them a peculiar flavour, much esteemed.

447. *The best and densest peat is generally found at the bottom* of the peat mosses, being older, and subjected to most pressure. In farm-houses and cottages, peat is usually burned upon the hearth, which cannot be done with coal; and when it is dry, good, and properly disposed or built up, it blazes and makes a cheerful fire, which, from its low situation on the ground, diffuses a great deal of warmth. The best kind burns very well in a grate, but the quantity of ashes it makes renders it inconvenient in this way; whereas, on the hearth, the ashes, instead of being inconvenient, are extremely useful to poor people in various processes of their cookery. Hot peat ashes are excellent for roasting fish, eggs, &c.; and likewise for stewing, and any kind of cookery that requires a mild heat. In this respect it approaches to charcoal.

448. *Peat is not well adapted for furnaces*, or any fires where the draught is very quick

as it consumes too fast. It has been calculated by Clement and Desormes that it gives only one fifth of the heat afforded by an equal weight of charcoal.

449. *A process has lately been tried*, which promises to render peat more available as fuel. The peat is, when soft, put into a powerful press, by which the water is expelled, and the parts brought close together. One man can, by a lever, work the press, and the operation requires only a few seconds. By this the peat is reduced to one third of its original bulk, and rendered so compact as to approach the properties of coal. This method has been for some time practised in France, and likewise in Ireland.

450. *Charred peat.* The smoke of peat being exceedingly acrid and disagreeable, it is in some countries charred before it is used as fuel. The Dutch, who use a great deal of peat, char what they put into the pans with which they keep their feet warm at home and at church. It is first burned in the kitchen, and when it is red hot, they take it off the fire, and stifle it in an earthen pot by covering it up with a wet cloth. This charred peat they also use for cooking, as the French do the charcoal of wood in stoves, or cast iron kettles. When peat has been treated in this manner, it is found to contain 40 per cent. of charcoal, and is sufficiently strong as a fuel to be employed in smelting works. But it possesses one inconvenience: if laid in a heap, it is apt to take fire of itself, on which account it is forbidden to keep a store of it in towns. A very simple process for charring peat is given in the Farmer's Mag., vol. xvii. "Take a dozen or fifteen peats, and put them upon the top of the kitchen fire, upon edge: they will soon draw up the coal fire, and become red hot in a short time: after being turned about once or twice, and done with smoking, they are charred, and may be removed to the stores: if more is wanted, put on another supply of peat, and manage it as above."

By this plan a supply of the best charred peat may be obtained, while, at the same time, the kitchen fire is kept up. This charred peat, when burned, is free from smoke and sulphureous vapours, and is much fitter for warming beds than coal, which always has some sulphur: the charred peat gives out no smell; but it is to be observed, that it has all the dangerous effects of charcoal, which we have described.

Sect. VI.—Prepared fuel.

451. In England, we are so accustomed to a good coal fire, that we do not perceive that inelegance in its appearance, which has sometimes struck those who have been used to burn wood. Count Rumford, in one of his early essays, observes, that "nothing surely was ever more dirty, inelegant, and disgusting, than a common coal fire."

Much of this, however, it must be confessed, is now done away with among us, by the neatness of the grates in which the fuel is burned, and the great care which is taken to keep our firesides clean. No doubt improvements may still be made by a careful selection of the kind of coals, and by these being broken nearly to certain sizes, and mixed judiciously with a proper proportion of smaller, which is separated by screens.

452. *In countries where fuel is scarce and dear*, attempts are made to cause what they have to go as far as possible. In several parts of Germany and Flanders, particularly in the Duchies of Juliers and Bergen, where coals are used as fuel, though not plentiful, and of an inferior quality, they are always prepared before they are burned. They are pounded to powder, mixed up with an equal weight of clay, and a sufficient quantity of water to form the whole into a mass, which is kneaded together and formed into square cakes, which are afterward well dried, and kept in a dry place for use; and it has been found by long experience that the expense attending this preparation is amply repaid by the improvement of the fuel. The coals thus mixed with clay not only burn longer, but give much more heat than when they are burned in their crude state.

But in England, where coals are abundant and labour is dear, we cannot expect that much pains will be taken on this subject for the mere purpose of economy: probably its complete study will be reserved for posterity, when our coal fields begin to be exhausted. Nevertheless, attempts have been made to produce here a better or a more economical fuel than coal; and several patents have been taken out for this purpose. The mixture of small coal with clay has been tried, and formed into square pieces; but though those burn very well and give out much heat, they are objectionable, from the large quantity of ashes which they necessarily leave.

On visiting the coal districts, it is impossible not to see with regret enormous quantities of small coal, called *slack*, lying near the coal shafts, exposed to the weather and totally neglected: one might suppose that it was possible to convert this to some useful purpose, perhaps to make a cheap fuel for various purposes; and the writer of this article, in his "Lectures on Geology," in 1827, at Birmingham, Dudley, and the environs, pointed out distinctly the neglect of this material, and suggested modes in which it might be rendered available as fuel.

A variety of mixtures have since been tried, of small coal with clay, bitumen, tanner's waste, peat, sawdust, and other inflammable substances. Some of them promise to be advantageous, particularly in steam-engines for navigation.

453. *Cow dung* is used as a fuel in many parts of the world; even in some parts of Britain, where better fuel is scarce, and the people very poor. When thoroughly dried

it burns slowly, forming a remarkable contrast to thorns and furze. Dr. Clarke, in his Travels, informs us, that the common fuel used by the inhabitants of Egypt is prepared from a mixture of camel's dung, mud, and straw, or the stalks of any other plants: these ingredients being mixed as a paste, they collect it into balls, which are flattened upon the walls of their huts for drying in the sun, and made into circular cakes. The same custom prevails in Persia and Arabia, where wood is scarce.

454. *Sea wrack*, or *fucus*, forms a tribe of marine plants, which, when cut off the rocks, and driven ashore by tides and storms, and dried, is used for fuel in some places on the seacoast where a better material is not to be had, or is too expensive, as in parts of Sweden.

Sect. VII.—Liquid Fuel.

455. *The fluid inflammables*, as fat and essential oils, bitumens, &c., so much used for light, are occasionally employed also as fuel for giving heat; although, in this country, on account of their great price, they are used only on a small scale, and where a gentle or slight degree of heat is sufficient.

456. *Alcohol*, when pure and free from water, is as convenient and manageable a fuel for producing a moderate and gentle heat as can be desired. It is burned in a lamp, and its flame is perfectly clear, of a pale blue colour, and free from any kind of soot: it can easily be made to burn slower or faster, and to produce less or more heat, by changing the size or number of the wicks upon which it burns; for as long as these are fed with spirit in a proper manner, they continue to yield flame of precisely the same strength. The cotton, or other materials of which the wick is composed, is not scorched or consumed in the least, because the spirit in which it is constantly soaked is incapable of becoming hotter than 174°, as above that temperature it boils and is evaporated; and that heat is not sufficient to inflame the wick. It is the vapour only that rises and is inflamed: the outer parts of the flame are the hottest, being most remote from the wick, and where only the combustion is going on, in consequence of communication and contact with the air. At the same time, as the alcohol is totally volatile, it does not leave any fixed matter, which, by being accumulated on the wick, might render it foul and fill up its pores. The wick, therefore, continues to imbibe the spirit as freely, after some time, as it did at the first. These qualities, however, belong only to a spirit that is pure. If it be weak, and contain water, the water, being less volatile than the spirit, does not evaporate so fast from the wick as the more spirituous part; and the wick becomes, after some time, so much soaked with water, that it does not imbibe the spirit properly: hence the flame becomes weaker, and at last is extinguished, the remains of the spirit having too much water to burn. Were it not for the expense, therefore, we should always use pure alcohol: but common spirit of wine is generally employed, and is found extremely useful for table teakettles, apparatus for making coffee, heating a little water, and a variety of similar purposes. The products of the combustion are only carbonic acid and water; and, owing to the combination with oxygen, the weight of the water produced, but which dissolves in the air, exceeds that of the alcohol consumed.

Spirit of wine is probably the most portable kind of fuel, and was employed in this way by Sir Edward (then Captain) Parry in his expedition undertaken with a view to reach the North Pole. His account of it runs thus: "Our fuel consisted of spirits of wine, of which two pints formed our daily allowance, the cocoa being cooked in an iron boiler over a shallow iron lamp, with seven wicks; a simple apparatus, which answered our purpose remarkably well. We usually found one pint of the spirits of wine sufficient for preparing our breakfast, that is, for heating twenty-eight pints of water, though it always commenced from the temperature of 32°. If the weather was fair and calm, that quantity of fuel brought it to the boiling point in about an hour and a quarter; but more generally the wicks began to go out before it had reached 200°. This, however, made a very comfortable meal to persons situated as we were."—*Parry's Voyage.*

457. *Fat, oil, or tallow gives a higher temperature than spirits of wine*, but a common wick produces much smoke and soot. A cluster of several small wicks somewhat diminishes the evil. A lamp of this kind, and of considerable size, is occasionally employed in portable apparatus for cooking; and, when confined, the heat is sufficient to dress meat in various ways. The Greenlanders and Esquimaux, in Baffin's Bay, have no other fire or method of producing heat than by means of lamps with fish oil, and wicks of moss. Over such lamps their cooking vessel of potstone is suspended, containing the flesh of deer, seals, or fish. By employing an Argand's lamp, the smoke is consumed; and chemists find this to be a very convenient method of applying a considerable degree of heat in small distillations and other processes. In this case the chimney of the lamp is made of copper instead of glass.

458. *Oil of turpentine mixed with water and alcohol* has been tried with success for burning in a lamp for the purpose of giving light and heat. An apparatus for this purpose was contrived by Mr. Morey in the United States, and mentioned favourably in Silliman's Journal. The mixture is put into a tin cylinder, which is heated by means of a common

lamp. The vapours from the mixture are made to issue through small holes at the top, where they are inflamed, and this flame may be employed in warming a building, cooking, or for any similar purpose.

459. *Oil of turpentine mixed with fat oil* has likewise been employed where a very large quantity of flame has been required, as in contrivances for heating water.

SECT. VIII.—COAL GAS.

460. *Among modern improvements* may be enumerated the application of coal gas as a fuel. Although it is chiefly employed for illumination, it is likewise on some occasions successfully used for giving heat, and has been already adverted to in Book II., "On Warming Buildings." In our description of culinary apparatus, we shall mention some instances where it has been tried with this view. It is continually employed in manufactories as a substitute for the oil used in the lamps for soldering.

SECT. IX.—ECONOMY OF FUEL, AND COMPARATIVE HEATING POWERS OF THE VARIOUS KINDS.

461. In some parts of the world fuel is so plentiful, that the study of economy in this article is little worthy of attention. In the wilds of America, or some other new settlements, wood costs nothing but the trouble of felling and splitting, and the consumption of it is sometimes a convenience; but in countries long inhabited, and where cultivation has destroyed the natural growth of timber, this kind of fuel has become expensive. In England, in many districts where coal is worked, and the price of it is low, much attempt at economizing may seem almost superfluous; but that is not the case in all parts of the kingdom, and the expense of carriage being considerable, would give importance to all inventions that tend to reduce the necessary consumption.

462. *In the fireplaces of our apartments and kitchens, as they were constructed forty years ago*, the waste of fuel was excessive. Although we are under infinite obligations to Count Rumford for the plain practical rules for effecting the greatest saving in fuel, through which numerous improvements have been effected, yet this subject is far from being generally understood; nor can it be, until the philosophical principles upon which it depends are more particularly studied than they are at present by those who are concerned.

463. *In our descriptions of the modes of warming and ventilating our domestic edifices, and of fitting up kitchens* and the various apparatus for culinary purposes, the reader will find some remarks on this subject, and examples of the best modes at present employed of economizing fuel; for all directions with this view, to be useful, should be accompanied by application to practice. Some there are who, having no taste for economy of any kind, have endeavoured to turn the economy of fuel into ridicule, and to represent it as not worth the pains and time bestowed upon it; but it should be observed, that, even although there may be some truth in this remark as applied to particular instances, yet it is one thing to establish a principle, and another to determine when and how far it is useful to apply this principle. All experiments demonstrating how any effect can be produced by a diminution of trouble or expense must be of value as matter of science, although the propriety and occasion of adopting the improvement made must be determined by various circumstances. We cannot, therefore, consider any successful attempt to economize fuel as entirely without value, in a general view, since one improvement frequently leads to another, perhaps of greater value. We feel it necessary, however, to put our readers upon their guard against the numerous puffs and quacking advertisements respecting pretended savings, by the adoption of newly-contrived apparatus for warming and cooking. Many of these contrivances are altogether ineffective; others are of so complicated a construction, and so liable to be out of order, that no saving can compensate for the trouble attending them, and the difficulty of teaching servants their use, together with the expense of repairs and alterations. Those who wish to engage in experiments, have a taste for such inventions, and who can manage them themselves, may make great and real improvements. But to economize fuel, an article of such vast importance, and to apply it in the most judicious manner, the nature and properties of the various combustibles must be studied, as well as the philosophical principles upon which combustion depends, without which all endeavours at improvement must be useless; and it will also be necessary to obtain accurate information respecting what has already been done, lest inventions should be made, and supposed to be original, that have been already long known.

464. *With respect to the quantity of heat that may be obtained from the several combustibles* when a comparison is made, they should all be burned in the same way. One method employed for this comparison has been to ascertain the quantities of ice that could be melted by a pound of fuel, which is thus stated:

One pound of	*Melts of ice*	*One pound of*	*Melts of ice*
Good coal	90 lbs.	Carburetted hydrogen	85 lbs.
Coke	84	Olive oil	120
Charcoal of wood	95	Wax	110
Wood	32	Tallow	105
Peat	19	Sulphur	25
Hydrogen gas	370		

The heating effects of fuel will likewise depend very much upon the apparatus employed, the subject to be acted upon, and the quality of the fuel. Thus, if a boiler is to be heated, the fuel that gives out flame will be most effectual by striking upon the bottom of the boiler, whereas, in heating apartments by open fires, it is the steady radiant heat that we depend upon, and not the flame: therefore, strong Newcastle coal, when brought to a red heat, and still more, coke, will be more effectual than Staffordshire coal, that blazes, but which is soon obscured by ashes; and both these will warm more effectually than wood that has ceased to blaze.

465. *Every kind of fuel should be kept as dry as possible.* When improperly exposed to the weather, or put into damp places, a great deal of its material when burning is employed in converting the water it contains into vapour, which escapes up the chimney, carrying with it the heat that was necessary for its conversion, and which might have been employed in giving warmth where it was wanted. Count Rumford found that unseasoned wood contained about one third of its weight of water, and, consequently, produced much less effect in boiling water than the same quantity of dry wood. The same remark will apply to coals; but there are other reasons why it is sometimes useful to damp small coal slightly. When perfectly dry, they are apt to run to waste among the ashes. A little dampness causes the dust of caking coals to adhere together till the heat fuses it into a mass, which is then broken up by the poker.

SECT. X.—SPONTANEOUS COMBUSTION.

466. *Serious accidents, and often considerable conflagrations,* have frequently been occasioned by substances taking fire of themselves; and it is proper to know what materials are liable to spontaneous inflammation. The following are examples:

467. *Sulphur and iron filings* moistened and buried in the ground, or laid in a heap, will inflame in a few days.

468. *Iron pyrites,* composed of sulphur and iron, found naturally in coals, when laid in a heap in the coal mines, often takes fire, and burns for a long time, and ships freighted with coal have been set fire to from the coal containing too much of this substance.

469. *Chips of wood impregnated with turpentine,* if laid together in a heap, will burst into a flame in twenty or thirty hours. This has been observed in manufactories of oil of turpentine, when the chips, which the raw turpentine brought from America contains, have been separated by straining.

470. *The mixture used at theatres for a red light* has ignited spontaneously when a paper parcel containing a pound of it was laid by on a shelf. This powder consists of nitrate of strontium, sulphur, chlorate of potash, sulphuret of antimony, and a little lampblack.

471. *Peat, when charred,* is very apt to take fire of itself.

472. *Wool that is much oiled,* and laid by in quantities, has been known to inflame spontaneously.

473. *Tow with lampblack and oil* is extremely liable to spontaneous inflammation. Both these last have frequently been the cause of places where they were kept being set fire to, without the cause having been at first suspected.

BOOK III.

ON VENTILATION.

CHAPTER I.

CHEMICAL PRINCIPLES OF VENTILATION.

474. *Perhaps there is no subject of equal importance, the knowledge of which is less generally diffused than that of Ventilation.* Though the fact is now generally admitted, that pure air is essential to health, yet in what that purity consists, and how it is to be preserved or attained, are considerations too much neglected. We will endeavour to place this interesting subject in a clear point of view; but we must observe, that, to put in practice the best modes of ventilation, it is necessary to be familiar with its theoretical principles.

475. *It is only since the modern discoveries in pneumatic chemistry, respecting the composition of atmospheric air,* and the changes effected in it by respiration, that rational ideas have been entertained on this subject. When mankind were in utter ignorance as to the nature of air, of the manner in which it supports life, and of the causes which destroy its salubrity, we cannot wonder that the necessity for a strict attention to ventilation was not very obvious. Practically, indeed, to a certain extent, it was known that there was a difference between good and bad air; but, as the nature of that difference was not ascertained, nor in what way air becomes vitiated, it was impossible to know the means of preventing it; but now that science has developed the necessary facts, we may expect that this valuable part of domestic economy will meet with due attention.

476. *When treating on combustion, we showed* that the air of our atmosphere is not, as was formerly supposed, a simple element, but that it is essentially composed of several kinds of air mixed together, viz., oxygen gas and nitrogen gas, with a small proportion of carbonic acid gas, together with aqueous vapour. All these gases are highly important in the general economy of nature; but our present object is to point out in what way they contribute to the support of animal life.

477. *Air is essential to the existence of every living being;* nor can either animal or vegetable come to life if this element be entirely excluded. In the act of breathing or respiration, atmospheric air is inhaled or drawn into the lungs, which process is termed *inspiration.* After a very short time the air is again sent out by *expiration,* when it is found to have been remarkably altered in its properties. The particular nature of the alteration can only be explained by reference to pneumatic chemistry. It appears that the lungs decompose the atmospheric air, and separate it into two principal constituent gases; retaining one part, the oxygen, for the support of life, and rejecting another part which is unfitted for this purpose. Since the oxygen is more particularly necessary for maintaining the vital principle, on the first discovery of the chemical constitution of the atmosphere, it received the name of *vital air*—a term now laid aside, or only occasionally employed. The fact of the chemical change in the air, by breathing it, is easily ascertained by examining it previous to its being taken into the lungs, and afterward when given out. One hundred parts of common or atmospheric air consist of about twenty parts of oxygen gas, seventy-nine parts of nitrogen gas, and about one of carbonic acid gas. These proportions of the first two are very nearly constant in whatever part of the world the air is examined, whether at land or at sea, in doors or out of doors; but the proportion of carbonic acid is variable according to the place: if it exceed one fifth it will be fatal to the animals that breathe it.

478. *The air, when expelled from the lungs,* is found not only to have lost a considerable portion of its oxygen, but to have received a large proportion of carbonic acid gas, and likewise of aqueous vapour: the quantity of nitrogen being diminished in a small degree only. That much watery vapour is contained in the breath is familiar to every one, from the common practice of moistening substances by breathing upon them; and that carbonic acid is given out at the same time, will appear from the following experiment:

Quicklime is pure lime obtained by driving off the carbonic acid by heat from carbonate of lime; and this quicklime has a strong attraction for carbonic acid when presented to it again. Dissolve some quicklime in water by letting it remain in it for about a day; the clear solution is called *lime water.* Put some lime water into a glass vessel, and having provided a small glass tube, or, for want of it, a straw, place the end of the tube in the water, and impel the breath through it by blowing for a little time. The water will soon begin to exhibit a milky turbidness, an effect which is to be explained in the following manner: Though quicklime is soluble in water, carbonate of lime is not: now the lime attracts the carbonic acid thrown out from the lungs, and is thus converted into the insoluble carbonate, which, in consequence of its insolubility, appears as a white powder like chalk, producing the milky appearance through its suspension in the water. This effect appears to be the result of one of nature's laws, that we shall thus part with a quantity of carbon which has been taken in with our food, but which is more than sufficient for the animal economy.

479. *We come now to consider the oxygenous part of the atmospheric air, a great part of which we observed was retained by the lungs.* By experiments varied in many ways, it is found that a small quantity only of oxygen is contained in the air which is expired. When treating on the combustion of fuel, we showed that oxygen was necessary to its support, and that fuel would not burn in air which had already served this purpose. The action of the respiratory organs appear to produce an effect very analogous to what we perceive in combustion: the oxygen is abstracted, and hence it must follow that air which has served to support life by being breathed will be as unfit for maintaining life or flame as that which has passed through the fire and has supported flame. This, accordingly, we find to be the case.

480. *If we were to breathe the same air over and over again,* at every inspiration, we should abstract a fresh portion of oxygen from it, until at last, having entirely consumed the oxygenous part, the remainder would be incapable of maintaining either life or flame. This fact has been put beyond all doubt by experiments which are perfectly demonstrative. A mouse was confined in a glass jar quite closed, so that no air could get either out or in; and, consequently, the animal confined was obliged to breathe the same air continually. It remained for a little time without feeling any inconvenience, since the quantity of air in the jar was at first sufficient to supply the necessary proportion of oxygen; but after a time, as this diminished, and the animal was obliged to inhale nitrogen, and the oxygen being reduced to too small a quantity for the continuance of life, the animal appeared to be gradually more and more oppressed, and at length died of suffocation. A lighted taper was now introduced into the air in which the mouse had died, and it was instantly extinguished; showing that the oxygen had been entirely, or almost entirely,

abstracted; an effect which was proved by an accurate chemical examination of the remaining air.

This instructive experiment will serve perfectly to illustrate the effect produced by being too long shut up in small or confined rooms, without sufficient ventilation or change of air.

481. *We shall not here attempt to go farther into the subject of animal Physiology, nor trace the part which oxygen acts in the support of life*, than briefly to notice, that in the well-known circulation of the blood from the heart to the superficial parts of the body, by means of the arteries, and back again to the heart through the veins, it is observed that the blood which had become dark-coloured in its passage through the veins, has, by being brought into contact with the fresh air inspired by the lungs, its florid red restored before it is received back into the heart to renew the circulation; and thus it is concluded that it is by means of the oxygen that its vital properties are kept up.

If, therefore, we attempt to breathe any gas containing no oxygen, the consequence will be suffocation, from the want of the supply of that element which is essential during every minute of our existence. It must now be evident, from what has just been said, that, if we continue to breathe a limited quantity of air over and over again, we must by degrees deprive it of the whole of its oxygenous principle, and, since what remains would be unfit for the support of life, we must then die like the mouse in the experiment.

482. *Before the nature of atmospheric air, and the important part which it performs in respiration, and the preservation of life and health, were properly understood*, it is not surprising that many practices and customs existed extremely destructive to health, without the cause being perceived; and at present it is lamentable to observe the consequences which still frequently result from ignorance in regard to this subject. Persons often sleep or pass a long time in small and confined rooms, where the quantity of air contained in them must have had its vital principle nearly exhausted or so much reduced as no longer to be fit for the purposes of healthy respiration.

483. *Instances almost innumerable might be adduced of serious and even fatal effects* proceeding from similar causes. We shall mention one which has also been quoted lately on the same subject by Dr. Coombe. In the Edinburgh Advertiser of 1st March, 1833, we are informed that "a distressing circumstance was discovered on Wednesday forenoon, on board the Magnus Troil, Shetland trader, Captain Ganson, lying at Leith. The master and mate, who are brothers, went, as usual, on Tuesday night to sleep in the cabin of the vessel, but not appearing at the customary hour in the morning, the crew thought they had merely slept beyond their time. A little time having elapsed, they were repeatedly called; but no answer being returned, one of the men went into the cabin, where he found the two brothers almost dead through suffocation. It is thought that they had shut the companion and skylight so close, that they had, during the night, exhausted the whole of the vital air necessary for respiration. Medical aid was procured." Captain Ganson, however, it appears, did not recover, but died convulsed on the following morning. A similar instance is stated by the same author to have occurred on board a French ship in the harbour of Jersey, where the captain and mate lost their lives by suffocation, in consequence of sleeping in a very small cabin, the door of which was so carefully shut, that any access of fresh air was completely prevented; and accidents such as these are probably more frequent than is generally supposed. But instances so fatal seldom occur, because, however confined apartments may be, there are few where there are not some openings or cracks through which the air is changed in some degree. The most dreadful example on record of the destructive consequence of an inadequate supply of atmospherical air, exists in the horrible fate of 146 Englishmen, who, in 1756, were imprisoned in a small room only 18 feet square, called the Black Hole of Calcutta. There were only two very small windows in this place, and as both were on the same side, ventilation was impossible. Soon after the door was closed, they began to experience heat accompanied by intense thirst; within a short time many became delirious, and at the end of six hours, 96 were relieved by death from their torments. In the morning only twenty-three were found alive, reduced to the last extremity, and of these a few only ultimately survived.

484. *It must be obvious that the greater the number of persons who assemble in any apartment, the more quickly they must consume the oxygen of the air contained in it;* and if the supply of fresh air be not equal to the consumption, it must be continually more and more deteriorated, until at last it becomes highly deleterious. In such places, the candles and lamps also contribute to destroy the vital portion of the air; for we have shown that there is a very strong analogy between combustion and respiration, in each case oxygen being consumed, and carbonic acid given out. In small and confined rooms, therefore, many lamps or candles are particularly injurious and unhealthy.

485. *A very simple experiment will show that lights consume the oxygenous or vital part of the air.* Put some water into a dish, and having fixed a short taper upon a flat piece of cork or wood, light it and set it to swim upon the water; then invert a tall bell-glass over the taper. At first the light will burn perfectly well; but, by degrees, it will soon grow

dim, and at last will go out, having consumed all the oxygen, and the air remaining in the jar being only nitrogen. The air will not appear at first to be diminished, because what remains, being expanded by the heat, it occupies as much space as before; but when the air cools and contracts, the water will rise up in the glass, and show how much air has been destroyed by the combustion. If the bell-glass is so contrived that another lighted taper could be introduced into the remaining air, the latter would be found incapable of supporting the flame. From a variety of chemical experiments, which cannot be detailed in this place, it is easy to demonstrate that it is the oxygen alone, and not the nitrogen, which is consumed by the flame: an animal introduced into the residual air will die immediately.

486. *It is a beautiful provision of nature*, that, even without our being aware of it, we are prevented from immediately inhaling again the impure and poisonous air which we throw out in breathing. When it issues from the chest, being heated nearly to the temperature of the body, or 98°, it is dilated, and, consequently, rendered specifically lighter than the surrounding atmosphere: hence it instantly ascends, as wood from the bottom of water; and before the next inspiration, it is removed out of the way, giving place to purer air. But this natural ventilation, as it may be called, is complete only while we are in the open air: when we are shut up in an apartment, the vitiated air rises, but it is stopped at the ceiling, and preserves its lofty situation only so long as its elevated temperature remains; when it has gradually given out its surplus heat to the walls of the room, it becomes of the same density as the rest of the air, mingles with it, and thus descends to our level, where we are liable to inhale a part of it again, together with the purer portion. From this it is evident that the upper part of a room, next the ceiling, is the place where, in general, the worst air is collected, and, of course, that this is the place for letting it out: but it must be recollected that no air can make its escape from the room except an equal quantity enter to supply its place; and it follows that there should be a contrivance somewhere for the admission of fresh air, and the lower part of a room is the proper situation for this purpose. This last observation will be reconsidered when we describe the practical methods to be adopted in ventilation.

487. *It is evident, also, from what we have said, that in crowded rooms*, if no judicious means are employed for getting rid of the bad, and the introduction of good air, that what has been exhaled by one person will be breathed by another, the poisonous air which each person gives out mingling with the mass, and vitiating it. Such an atmosphere, consisting of good and bad air mixed together, may not be immediately dangerous, although extremely unhealthy: the degree of its insalubrity must depend upon the number of persons collected together, and the more or less confined nature of the place.

488. *It is calculated that each person consumes, on an average, five cubic feet of air in an hour*, or, in other words, deprives oxygen of such a quantity of atmospheric air. If a hundred persons, therefore, were confined in a room 30 feet long, 25 broad, and 30 high, the whole air in that apartment, consisting of 22,500 cubic feet, unless renewed, would be noxious and dangerous to breathe in about four hours and a half. Is it wonderful, then, that crowded rooms, heated and close, where routs and assemblies are held, theatres, and other places of public amusement, and even churches, should be so pernicious to the health of those who frequent them, where proper ventilation is neglected? For besides the destruction of oxygen, or vital air, the great increase of carbonic acid gas, together with the noxious effluvia from other causes, tend to vitiate the air in a very great degree. The additional deterioration of the air, produced by many lights, will be alluded to afterward.

489. *From our having stated that it is the oxygen alone which supports life in respiration*, and that air deficient in oxygen is unhealthy, it may perhaps be supposed that an atmosphere of pure oxygen, or one having more than its usual quantity, would be eminently salubrious. This, however, is not the case; an increase of the usual proportion of this gas, which can be artificially given, is found to give too strong a stimulus to the system, and fever would be the result: we should, in fact, burn out too soon, like a wooden splinter in a jar of oxygen.

490. *Health demands that the usual and natural proportion in the constituents of air should be neither increased nor diminished*, except in a very minute degree; and by the most wonderful contrivance of Providence, the proportion is preserved nearly the same, at all times and in all places, as we have already stated. And here we may perhaps be excused for departing for an instant from what is strictly our subject, to point out a remarkable proof of wise design. The carbonic acid, produced by combustion of all kinds, and by the respiration of animals, and which might in time vitiate the whole atmosphere, is consumed by the vegetable creation, to which it serves as a pabulum or food, in the same manner as oxygen does to animals. Nay, more; vegetables, at the same time that they attract and retain carbonic acid, give out, in sunshine, pure oxygen gas. Thus, vegetables improve the atmosphere when it has been deteriorated by animals.

But notwithstanding the consumption of oxygen, or the vital principle of the air, by combustion and respiration, and its rapid abstraction in confined apartments and other places in doors, this is not so considerable as to affect the general atmosphere, or the air out of doors, very sensibly: still we know from the above reasoning that it must suffer from the above processes, were it not renewed.

491. *When atmospheric air was first discovered to be composed of oxygen and nitrogen, and that the former was the principal supporter of life,* it was very naturally supposed that the air of those countries which were known to be very healthy would be found, upon analysis, to contain more than the usual proportion of oxygen; and, on the contrary, that those which were unhealthy would be deficient in that principle. Upon making careful experiments, however, with a view to determine whether this was the case, the result did not prove it; for portions of air being taken from the open fields, from hills, from the sea-side, from towns, even from prisons, were examined, and the proportion of oxygen was found to be the same in all. It is evident, then, that the salubrity or insalubrity of air out of doors does not depend upon the proportions of the elementary principles, oxygen and nitrogen, they being the some everywhere, but rather upon the absence or addition of some other invisible substances, some of which may be of a highly deleterious nature. Thus carbonic acid, sulphuretted hydrogen, or carburetted hydrogen may abound, or even some other gaseous matters; or unknown vapours may be mingled through the air of particular places, rendering them unhealthy. It is well known that some of these noxious gases are disengaged from marshes, stagnant waters, common sewers, and all places where animal or vegetable substances are in a state of putrefaction; and other deadly poisons may be diffused through the atmosphere, which the skill of the chemist does not enable him to detect.

492. *The subject of ventilation is not confined to the dwelling-house alone, but extends to the air of cities and towns.* It is scarcely necessary to allude to the innumerable sources of deleterious vapours, exhalations, odours, and gases, that are constantly generated in cities where there is a deficiency in sewers, pavements, water, and general habits of order and cleanliness. This subject, fortunately, has attracted much attention, and we may be excused for not pointing out many facts that are now beginning to be pretty generally known; but the subject is too important to be entirely passed over. History informs us that pestilence, the scourge of society, has prevailed frequently and virulently in ages, countries, and even districts, in which cleanliness and the proper ventilation of houses have been little considered. Without entering on the various theories respecting the exciting causes of pestilential disease, a little research will afford sufficient proof, that want of cleanliness has been a principal cause of their aggravation and rapid diffusion. If we read the account of our own metropolis during the last calamitous visitation of the plague, in 1665, and compare it with its present state, we may convince ourselves that our present exemption from the recurrence of such an evil is secured to us on more grounds than those of precautionary laws of quarantine. At that period in the history of this vast city, the streets were narrow, the houses projecting in the upper stories, and the spaces between them crowded with large signs hung across, and checking the free circulation of air, essential to the health of the inhabitants. To the miasma constantly engendered, and rising up from the open drains and neglected sewers, were added those caused by the fermentation of heaps of rubbish and garbage ejected from every house, and which the indolent inhabitants could scarcely be compelled to remove. Nature has provided means for carrying off impure air, and replacing it with such as is suited to animal respiration; but here its intentions were defeated, both by the construction of the buildings, and the habits of the people. Nor were the interior arrangements better calculated to promote health. The windows were small, the rooms low, the floors made of clay strewed over with straw or rushes, among which lay rejected fragments of food and dirt of all kinds. Ventilation was totally disregarded, and the result was a perpetual recurrence of fevers, from which the English, at that time, were scarcely ever free. In this condition of things, infectious diseases spread with a dreadful rapidity, and the history of the plague by Defoe exhibits the condition of the people in frightful colours. It is almost needless to advert to the improvements that have probably banished pestilence in its aggravated form, and rendered our metropolis one of the most healthy on the globe. The principal of these are, undoubtedly, well-constructed sewers, and an abundant supply of water; streets wide, well paved, and kept, if not as clean as they might be, yet far more so than formerly; large sashes to open, wooden floors, with a frequent renewal of the papering and painting of the interior, and open chimney fireplaces. It is not intended here to attribute the existence of pestilence, cholera, and other violent diseases to want of cleanliness alone; they may originate in natural causes, though unknown to us, but it appears from evidence that they have produced the most fatal ravages where indolent, filthy, and disorderly habits prevailed.

Though the improved state of knowledge in this country has produced the most happy effects in averting the most desolating and wide-spreading evils of disease, still we should recollect that the same causes, though acting upon a smaller scale, will always tend to produce more or less derangement of health.

493. *The great importance of ventilation must be perceived,* when it is considered that, although respiration may proceed, and life exist for a time, in cases where the atmospheric air is vitiated to a considerable degree, yet, as pure air is essential to the full en-

joyment of health, every degree of vitiation of it must be prejudicial, although this effect may not be perceived immediately. It has been well observed, that "in the great majority of situations to which man is exposed in social life, it is the continued or reiterated application of less powerful causes which gradually, and often imperceptibly, unless to the vigilant eye, effects the change, and ruins the constitution before danger is dreamed of; and hence, the great mass of human ailments is of slow growth and slow progress."

494. *Ventilation, as the means of preventing disease,* is not only necessary in the habitations of the poorer classes, as far as their health alone is concerned, but the middle and higher ranks of the community have an almost equal interest in securing good ventilation wherever the habitations of human beings are to be found, more particularly where they are crowded together in towns and villages; since disease, once generated by the neglect of ventilation and cleanliness, spreads its frightful ravages far beyond the boundaries of filth and wretchedness, and falls, as a punishment, upon those whose duty it was to have been the guardians of the labouring poor. The late visitation of the cholera has, perhaps, done more to place this subject in its true light than volumes of writing could have effected; and there cannot be a doubt but that the whitewashing, cleaning, and ventilating of the houses of the poor, during the prevalence of the epidemic, did much to check its progress.

CHAPTER II.

PRACTICE OF VENTILATION.

495. Having now investigated briefly the principal causes which deteriorate the air, or render it unhealthy and unfit for the purposes of respiration, it is necessary that we should turn our attention to the means of preventing this evil, or of correcting it when it has occurred. Prevention being always better than cure, the importance of understanding the causes which injure the salubrity of the air cannot be overrated, since this alone can enable us to avoid them. To remove the evil when it has already taken place is more difficult, but still partly within our means.

496. *It is an error to suppose that air can become unwholesome merely by being stagnant.* Pure air, like pure water, never changes of itself, however long it may be kept; but it may have impurities mingled with it, arising from various sources, without these being easily discoverable. In this manner air may be contaminated if shut up, an effect which, indeed, usually takes place, it being the great receptacle for a variety of invisible effluviæ and vapours that rise from the earth, or from surrounding substances. The most prudent thing, therefore, is not to use air that has been long pent up, but to change it for the fresh air of the atmosphere.

497. *It has been imagined that fire has the power of purifying air* by burning and destroying the noxious particles with which it may be contaminated; and as a remnant of this idea still exists in the minds of some persons, it is necessary to show the fallacy of it. Fire, instead of purifying air by burning anything in it, actually vitiates the air which has passed through it, as we have shown, by its abstracting the only portion of the air that is useful in supporting life: burned air, therefore, or what has gone through the fire, instead of being purified, is rendered poisonous. What has led to this error has been the observing that the air of confined places is often improved by lighting a fire in them; but this improvement is solely owing to the current or circulation of air that is produced, and the consequent introduction of fresh air: if the fire was made in a confined place, where no change or current of air could happen, as in a room without a chimney, so far from purifying the air, it would render it doubly noxious.

498. *Fumigating pastiles* are preparations formed of odoriferous resins and other substances to be burned in an apartment to perfume the air, either as a luxury, or to overcome some disagreeable odour. It was supposed, formerly, that the burning of aromatic, resinous, and balsamic substances, had the property of purifying tainted air, and destroying contagious miasma; but they are now considered as wholly inefficacious for this purpose, and though they may conceal offensive exhalations, and render them less discoverable by the senses, they offer only a deceitful security. Various mixtures are employed for making pastiles; but they all contain charcoal mixed with fragrant materials, as benzoin, balsam of Peru, storax, gum benjamin, oil of cloves, and nutmegs, myrrh, nitre, mastich, labdanum, &c.; and though these odoriferous gums produce an agreeable perfume, yet the vapours of the charcoal, instead of purifying the air, tend to increase its unwholesomeness by giving out carbonic acid.

499. *Since, when air has lost that constituent by which it supports life, there are no means of restoring it,* it follows that our only resource is to get rid of the foul air, and to replace it by what is fresh and good. The mode of effecting this necessary change of the air of apartments constitutes properly what is termed "ventilation," a term derived from the Latin word signifying *wind,* the motion or current of air furnishing the most obvious method of accomplishing this object.

500. *Before we proceed, we must beg the reader's attention to what we have stated respecting the air being a substance as much as any other fluid;* and that we cannot possibly cause any air to go out from a room, except an equal quantity come in at another opening: for it is a law of nature, that every place which, in common language, is *said to be empty*, is, and must be, always *full of air:* if we were to draw the air out from an apartment through some aperture by means of a machine, more air from without would force itself in by means of the whole pressure of the atmosphere to supply its place, if not through an equal aperture, yet through all the innumerable minute crevices that exist in the walls, doors, windows, floor, &c.; and if these were absolutely tight, so that no air could come in, then it would be impossible for any air to go out. This fact is sometimes evinced in the bad draught of a chimney of a small apartment in which the work has been very well executed, or well finished, as it is called; that is, with all the joints very close, so as to let in no draughts. The reason of this is obvious; though air that has served the combustion has been rendered lighter by the heat, and therefore has a strong tendency to go up the chimney, yet it cannot move and be succeeded by more air to the fire, except an equal quantity of air can enter the room by some openings, large or small, to supply its place, otherwise the room would be emptied of air by such a current making its exit: but nature has willed that every place *must* be full of air; hence the absolute necessity for openings in some part of the room for the admission of fresh air, in order that a fire may burn. This necessity is generally overlooked by those who are unacquainted with the philosophy of this subject, the material nature of air, and the manner in which it presses in to fill every space. It is in vain, therefore, to think of stopping up every crevice capable of occasioning a draught: a draught *must* exist where a fire of any kind burns in an apartment; and the study must be to contrive that the air shall be admitted where and how it will be the least inconvenient.

501. *Where a fire is burning in the chimney of an apartment, a certain degree of ventilation is going on constantly*, and must go on, of itself, without the thought or attention of any person; and this, as we have stated above, is an immense advantage in open chimney fireplaces, which, it is desirable, should be properly understood and appreciated. It is obvious that the current of air necessary to feed the fire produces a continual change of all that part of the air which is below the level of the mantel; but this cannot happen without a partial change, at least, of what is above that level; for, as we observed, the air vitiated by respiration and the burning of lights, first ascends to the ceiling in consequence of being warm, and, although it must remain imprisoned there for a time, if there are no apertures for its escape, yet by being cooled gradually, it descends and mixes with the rest of the air of the room, and it then more or less falls into the current of air rushing towards the fire.

Among the various kinds of air with which that of our apartments is contaminated, some are of different degrees of specific gravity from atmospheric air; and it might therefore be supposed that we might find them at different heights. It might be imagined that the carbonic acid, from its greater specific gravity when cooled, occupies the lower part of the room, though, while warm as just escaped by the breath, it had risen to the ceiling. But this complete separation from each other of the different gases never takes place, for it is the nature of gases very soon to diffuse themselves and commingle, and the warm and cold portions soon change places by becoming of equal temperature; at least this is their constant tendency, and we cannot draw any line of separation between them, as if they were so many strata. All the time, therefore, while a fire is burning in an apartment, the air is constantly, though slowly, changing, by one part passing through the fire and going up the chimney flue, while fresh air to supply its place is forcing in at all the crevices in the apartment. Whether this change is sufficient, must depend upon the number of persons in the room who destroy the vital part of the air, and also upon the number of lights, which act in the same way.

502. *If the vitiated air be not removed with sufficient rapidity by the draught of the chimney alone*, then some other mode will be necessary in addition. Formerly, in England, the dwelling-rooms of the middle and lower classes were so low, that the air which was injured by respiration could scarcely ascend above the heads of the inhabitants, who were, therefore, always immersed in an impure atmosphere: it is to be observed, that this must be the constant effect of low apartments, and is an evil which attaches to the habitations of our poor of the present day, and often to the bedchambers of the wealthy. A room only seven feet high cannot possibly be healthy to live in, as then there is not space for the expired air, which consequently becomes mixed with the purer air of the lower part of the room, and is breathed over again.

As our best houses are now constructed, with the rooms lofty, and the sashes made to open at top and at bottom, or, as it is called, *double hung*, ventilation becomes comparatively easy. The warm vitiated air ascending to the ceiling, finds there sufficient space above our heads, till it cools and mixes gradually with the rest, as we have shown; and if we wish to change the air more completely, we have only to pull down a small part of the upper sash, that the hot air near the ceiling may escape. But this escape of foul air will not always take place while a fire is burning, except we attend to some circumstances. Should the aperture made by pulling down the top sash be greater than the area of the crevices in the apartments from which the fire was supplied, some cold air will come in by the window to supply the fire, instead of hot air going out, and the effect of this will be unpleasant. It is necessary, therefore, that some other apertures, at the lower part of the room, should furnish this necessary supply of air to the fire, and permit the warm to go off: opening a door for a short time will effect this, or lifting up the lower part of a sash. But this mode of ventilation, though perfectly effectual and easy, cannot with convenience be always well applied while persons are in the room, on account of the draughts of cold air which must enter, though it is quite sufficient whenever the room is empty; and this principle being understood, it is not difficult to modify to suit it to most occasions. Dwelling-rooms which are only occupied during short periods, and thoroughly ventilated by the windows between those periods, seldom require any other systematic ventilation than what we have just described. French sashes, which open like folding-doors, are the best for this purpose where they can be introduced, as the whole extent of the window can be opened; whereas with double hung sashes only one half of the window can be open, though this half may consist of one portion at top and another at bottom.

503. *The necessity for good ventilation in the basement story and offices* of every house must appear evident, when we reflect how the air in the lower story ascends up the staircases, and that if there are any noxious effluviæ disengaged below, they are sure to contaminate the air of the whole house. It is in vain, therefore, that great pains are bestowed upon the upper apartments, if the lower ones are neglected. We believe there are few houses that do not suffer more or less from this cause, and that many are rendered really unhealthy, though the occupiers never suspect the truth *itself, nor the* cause of it. It should be a constant practice of the principals to make regular descents into these lower regions, and to examine with their own eyes the condition of things, in a case in which not merely their comfort, but their health, and that of their family, are seriously concerned. Frequent thorough cleaning and scrubbing, whitewashing and painting, with regular visits, would do much to improve the atmosphere of every mansion, and care should be taken that every place should have proper openings for a free circulation of air.

504. *Good ventilation is nowhere more important, although nowhere more neglected, than in our bedchambers.* The bad effect of sleeping in small and close rooms has been already mentioned; to which we may likewise add, that of having thick curtains drawn close round the bed, which confine the air that has been exhaled, surrounding us with an impure atmosphere. Provision should be made for a continual change of air in the apartment during the night, by the escape of the heated and foul air, and the introduction of cool and fresh air. The first may be effected by some aperture at the top of the room; perhaps keeping the top sash open for about an inch may be sufficient: of course, care must be taken that the fresh air brought in at the lower part of the room does not act as a draught striking upon the bed, but that it enters by small apertures, and diffuses itself as quickly as possible; and likewise that there may be the means of regulating the quantity according to circumstances. If the temperature of the fresh air can be regulated, it will be better.

[The practice of sleeping in illy ventilated rooms, and especially with curtains drawn closely around our beds, would scarcely be persisted in if we did but reflect on the effect of thus depriving ourselves of pure air during the hours of sleep. Air that has been once breathed is rendered unfit for animal life until it has been again purified; it being composed of two gases, termed oxygen and nitrogen; the first of these is the great agent in respiration and combustion, and is often called vital air; the latter is of a contrary nature, and is fatal to animal life, and is also incapable of supporting combustion; it is hence often designated deadly air. Yet in the proper mixture of these two gases, the purity of our atmosphere depends.

In the process of respiration the air is deprived of a large portion of its oxygen, and obtains in its stead a portion of carbonic acid gas, which also, like nitrogen, is not capable of supporting life. It therefore follows that air, after having served the purposes of respiration, or combustion either, is no longer fit for man till it has been purified in Nature's vast laboratory, where that portion which was unfit for animal life is absorbed by the vegetable world and the other substances with which it is brought into contact, and from them it again absorbs its proper proportion of oxygen gas.

Dr. Priestley has given a beautiful exemplification of the powers of vegetables to restore the purity of air which had been deprived of its oxygen. He says, "Finding that air was not spoiled by the growth of a plant of mint which I kept in it for some months, I thought it possible that the process of vegetation might restore the air injured by burning candles, and, accordingly, I put a sprig of mint into air in which a wax candle had burned out, and in a few days after I found that another candle burned perfectly well in the same air which had extinguished it before." He then repeated the experiment with various other plants in a vegetating state, with the same result; and also in air which had been deteriorated by animal respiration and putrefaction, and thus deprived of its oxygen. From these proofs of restoration of the air, he justly inferred what is now amply proved, that the injury continually done to the atmosphere by the respiration of such a multitude of animals, and the putrefaction of such masses of matter upon the earth's surface, is repaired by the vegetable creation. And notwithstanding the prodigious mass of air that is corrupted perennially by the causes named, yet if we consider the immense profusion of vegetables upon the face of the earth, inhaling and exhaling continually in accordance with their laws of vitality, we may perceive it to be a rational supposition that the remedy is fully adequate to the evil. Thus, by the wisdom of the Creator, the two great departments of the organic world, animal and vegetable, are mutually made to sustain each other; that which is rejected as superfluous by the one being reciprocally nutritious and even necessary to the other.

Again, the air, as it passes through the lungs, is brought into very close contact with the blood as it returns from its circuit round the system; it is then in a dark, discoloured state, and unfit to be again circulated; in the lungs, however, it is brought into very close connexion with the atmospheric air, from which it speedily obtains a large supply of oxygen, which turns it to a beautiful bright red, and it is again fit to be expelled by the action of the heart to the extremities; the blood by this means has become pure; but the breath, at the same time, has also become vitiated, being deprived of its vital quality, and having imbibed other impurities, chiefly carbonic acid gas, in its stead; it is therefore expired, and fresh air inhaled in its place.

It is, therefore, obvious, that the more we are exposed to the free air of heaven the better will be the state of our blood; whereas, deprived of our full supply of this invigorating fluid, the animal frame becomes pale and emaciated; and we have only to compare the healthy ploughman, and the ruddy and hearty foxhunter, with the pale and sickly inhabitant of an over-populated manufacturing district, or the votary of fashion —the victim of the close and unwholesome air of a city fashionable life, to witness the benefit arising from a free circulation of pure air. Of this pure air, an adult requires about a gallon per minute. Now, the space within the curtains of a bed is not capable of containing more than sufficient for two persons for twelve hours; so that if the curtains were quite air-tight, we should cease to exist; and, as it is, such an atmosphere must be prejudicial to health. Nothing can be more ridiculous than the absurd plan of elevating the bed to a great height from the floor, and at the same time bringing the valance down to a considerable depth from the top, thus shutting in a quantity of vitiated air just above. It is said that a bird hung up in a cage within the curtains of a bed where a person is sleeping will be found dead in the morning.]

505. *A little apparatus for ventilating a bedchamber in the night*, invented by the Marquis de Chabannes, though not very effectual for a large room, is perhaps worth mentioning for a small one. It consists of a little box or enclosure of tin or other metal, having an opening in front, *fig.* 80, in which may be placed a small lamp. The upper part or flue is to be inserted into the wall on the chimney breast, and is to go quite into the flue of the chimney. The air which the lamp requires for combustion will thus pass into the flue, occasioning fresh air to come into the room to supply its place. This machine is, in fact, a little chimney, in which the lamp is the fire. It should be placed near the top of the room.

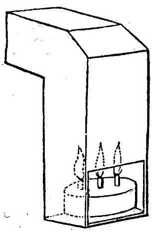


Fig. 80.

506. *It is highly deserving of attention, that although we never use fires without flues, yet we very absurdly have long continued to burn lamps of considerable size, which are, in fact, so many fires, in the middle of our apartments*, even when small, without the least attempt to carry off the burned air which they are constantly generating. No wonder, then, that the air, in such places, is often felt to be oppressive; it is, indeed, extremely unwholesome. It is in vain that we get rid of the smoke by the use of Argand burners; for this, though an evil, is not the greatest one, so far as health is concerned: the poisonous gases given out are much worse. It is to be observed, however, that it is the size and number of the lamps, compared with the size and ventilating condition of the apartment, that creates the mischief; and we wish to draw attention to the fact, that every additional light destroys, or, rather, renders injurious, a certain portion of the air in the apartment where it is burned. We have the satisfaction of stating, however, that the bad effect which suspended gas lights have upon the air of a room may be completely obviated by adopting the invention by Professor Faraday, described in the chapter "on Lamps;" but this will not apply to lights placed upon a table, nor to candles, nor oil lamps.

Our apartments, where large parties are received, are in general lofty, which renders the vitiation of the air less perceived; but when they are lighted up in the evening by numerous lamps or candles, the vital part of the air becomes quickly exhausted, and the visiters, particularly those in delicate health, suffer considerably by remaining long in them, except some means for ventilation be employed. It is difficult to effect this after the houses are finished in the ordinary way; but if the subject be attended to while they are constructing, methods may be resorted to for producing a change of the air.

507. *The centre of the ceiling of an apartment, fig.* 81, *would appear to be the fittest place for the exit of the vitiated air*, which might then be carried off by means of large tin or other tubes laid horizontally between the joists, and thence to the open air at the top of the house by a flue built in the wall. The aperture in the ceiling may be easily concealed by a large ornamental flower, in plaster or papier machée, which is usually placed there, and from which a lamp or chandlier is suspended. This aperture may be regulated, by having some contrivance by which more or less air may be permitted to escape, as occasion may require; and this regulation may be effected by cords and pulleys worked by a winch or key in the apartment. It may be observed that a coved ceiling is the most favourable for the escape of the bad air. To replace the air that thus escapes, there may lie tubes along or under the floor, by which fresh air may be brought from outside the house, and the admission of which, through gratings or valves placed in convenient parts of the room, should also be regulated.

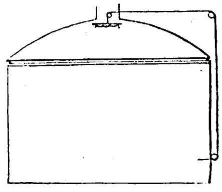


Fig. 81.

508. *In admitting fresh air into apartments* care must be taken that it does not come as a direct stream or current, which will extend to a great distance, and produce draughts not only very unpleasant, but perhaps very dangerous effects: the air may easily be dispersed at its entrance by plates placed before the apertures to divert its direction, or by numerous small apertures. The manner of effecting ventilation of this kind must depend so much upon the particular locality, and other circumstances, that it is impossible to give any positive rules for it adapted to all places.

509. *We have frequently advocated the necessity of studying the principles of science with a view to their application;* and in no subject is this more essential than in the art of ventilation; for a practice that may be the best for one case may be absolutely worthless in another. The air, an invisible fluid, is to be put into motion, which depends upon certain alterations in its specific gravity, to effect which demands some acquaintance with natural philosophy and chemistry. How, then, are persons totally unacquainted with the elements of those sciences to accomplish the task of ventilation under its various complicated cases? All that can at present, perhaps, be safely recommended here, is to confine the methods employed as much as possible to those which are the simplest, as the least likely to be misunderstood.

But if any difficulty can be supposed to exist with chimney fireplaces, which, in spite of all that is said against them, must be admitted to be powerful, simple, and cheap ventilators, giving no trouble, but acting silently, though surely, what, we observe, shall we say of close stoves of every kind, which do not ventilate of themselves, or so inefficiently that it amounts almost to the same thing.

510. *With close stoves the difficulties of ventilation increase considerably*, while the necessity for it remains undiminished. If the fire door is not in the apartment, the stove absolutely occasions no change of air; if in that case the doors and windows of the rooms are kept shut, the air has no chance of being renewed except what little may take place through imperfect workmanship of the house. If the fire is supplied with air from the apartment, still the quantity so supplied, and, of course, replaced from without, is so small, from the economy of fuel and slowness of combustion, that it amounts to a change far short of what is usually wanted for ventilation. On this ground alone, all physiologists must allow that close stoves cannot be healthy, except means can be devised for changing the air independently of their own action; for, otherwise, with them the same air must inevitably be breathed again and again, if there are many persons in the same room, or if it be inhabited long at a time.

511. *Count Rumford considered the ventilation of an apartment warmed by a close stove as a matter easily accomplished;* and he thus expresses himself: "When, in cold weather, a room is kept warm, the air in it, so far from being confined, is continually changing. Being specifically lighter (in consequence of its being warm) than the air without, it is impossible to open and shut a door without vast quantities of it being forced out of the room by the colder air from without, which rushes in; and if at any time it be required to ventilate the room in so complete a manner that not a particle of the air in it shall remain unchanged, this may be done in less time than one minute, merely by letting down the top of one of the windows, and at the same time opening a door which will admit the external cold and heavier air. And it must not be imagined that the room will be much cooled in consequence of this complete ventilation. So far from it, a person returning into it three or four minutes after it had been ventilated, and the air in it totally changed, will not find its temperature sensibly altered. The walls of the room would still be nearly as warm as before, and the radiant heat from those walls, passing through the transparent air of the room, without any sensible diminution of their calorific powers, would produce the same sensation as they did before. And even the cold air admitted into the room would, in a few minutes, become really warm. And as the

specific gravity of air is so very small compared with that of the dense solid materials of which the walls, floor, and ceiling of the room are constructed, the warming of this air will not sensibly cool the room. Hence we see how easy it is to ventilate warm rooms in cold weather, and also how impossible it would be to live in such a room without the air in it being perpetually changed, and replaced by fresh and pure air from without." These principles and directions by the count are good, and generally practicable, provided the occupier of the apartment will put them in practice himself at proper times. Although we are of opinion that considerably more than "one minute" will be necessary for the operation, yet there is no doubt that in this manner a warm room may be easily ventilated. Still it must be recollected that it may not be always convenient to set a door and window open, particularly in winter, in rainy or snowy weather, when such a stove is most wanted; and since much care and judgment will be required in choosing the proper time, and determining how long these apertures shall remain open, this operation could scarcely be intrusted to ordinary servants. It is, however, useful to know that such ventilation is not absolutely impossible, nor extremely difficult, provided sufficient means are employed for the regular performance of the above process.

Some have recommended keeping a small part of the top sash always open, when a close stove is used. It is obvious that another aperture must be provided for the admission of fresh air, otherwise the stove will supply itself from the window, and counteract the intended ventilation, except, indeed, the crevices are sufficient, and these are apt to produce unpleasant draughts.

512. *The cases we have hitherto considered of ventilating, by means of sashes,* suppose that the air in an apartment is considerably warmer than that out of doors; but when the temperature within doors and out are the same, which is often the case in summer, spring, and autumn, little or no change can be effected by opening windows, except, indeed, in a small degree, if the wind should happen to blow that way; and it may happen that a number of persons may be crowded together in a room in warm weather. For such cases, which are not, it is true, of common occurrence, no provision has hitherto been made or brought into common operation in domestic buildings.

513. *Forced ventilation* has been practised in some buildings, and often with great success. Various means have been used to *force* a portion of the impure air out of an apartment; and, from what we have stated, it will be easy to see that, to introduce fresh air to replace it, certain openings only are required, as the air will come in of itself; but care should be taken that this fresh air shall be pure, which it can scarcely ever be from a basement story.

514. *One of these methods of forced ventilation* is by having a lofty tube to proceed from the ceiling by which the hot air escapes, and in which a current of air sometimes is still farther excited by heat applied to it. This heat may consist in a fire, or lamps, or steam tubes. The hot air being drawn off by this contrivance, cool air, or air slightly warmed, is admitted at convenient places in the lower part of the building.

515. *Another mode is the employment of a machine* that draws out a portion of the air in the manner of a large pump with valves, or like a revolving fan enclosed in a box. Some of these mechanical modes have been very successfully applied to ventilate ships, prisons, manufactories, or places of that kind.

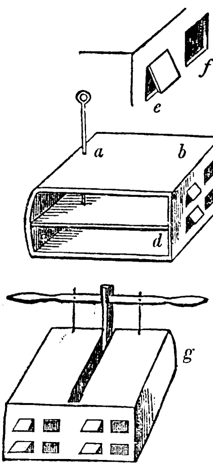


Fig. 82.

516. *The following description of Dr. Hales's ventilator* is given in this place as being exceedingly efficacious, and at the same time so simple, that it might be easily executed by any carpenter; it may suggest ideas to those who wish to contrive mechanical methods of ventilation. It is described in the "Trans. of the Roy. Soc., 1741." *a b*, *fig.* 82, is a square box, in which there is a partition, *c d*, moveable up and down upon hinges of leather at the end, *d*, the other end, *c*, coming close up to the curved side of the box, so as to move easily, but without permitting much air to pass. The motion of the partition is effected by means of the upright rod and handle fixed at *a*. On the side of the box are four valves of wood, two opening inward, and two outward: these valves are represented on a larger scale at *e* and *f*, above.

When the partition *c d* is made to rise, the air in the upper division is forced out through the valve that opens outward, while, at the same time, in consequence of the partial vacuum formed in the lower division, air enters into it by the lower valve that opens inward. When the partition is depressed, the contrary action of the valves takes place; that which before permitted air to enter now suffers it to go out. There are, therefore, two valves constantly permitting air to enter while two others are permitting it to escape. If such a machine is worked into any place where the air is foul and is to be expelled, at each movement of the partition *c, d*, a quantity of the bad air is taken into the box through two of the valves, and thrown out by two others, to which tubes (not represented in the woodcut) may be connected to convey it away. *g, fig.* 82, shows how two of these machines may be joined together, so as to produce double the effect. Considering the simplicity of this contrivance, and the ease with which ships and buildings might be ventilated by its means, it is surprising that it has not been brought into general use: this can only be accounted for by recollecting that the great importance of ventilation was not generally understood when Dr. Hales first drew attention to the subject of foul air; and that it has been only within a few years that the eyes of the public are beginning to be opened to the great value of ventilation to health.

517. *In Hindostan a sort of ventilation is produced* by the use of the *Punka*, which is a large fan suspended from the ceiling; to this a rope is attached and passed through an aperture in the wall into the verandah, where a man is placed who keeps constantly waving it by pulling the rope. By this the largest rooms, and some churches, have the air put into constant motion, to the great comfort of all present.

518. *In cotton factories the foul air is extracted by machinery.* Fans are made to revolve with great swiftness, at the rate of 100 feet per second; and by their means a constant renewal is ensured of the atmosphere in any range of apartments, however large and closely put up they may be. When such a fan is in full action, and placed at the end of an apartment 200 feet long, it creates a draught at the other end of the apartment capable of keeping a weighted door 6 inches ajar. As this method is found to be very effectual, and as it is applicable in many other situations as well as manufactories, we shall quote the description of it as we find it in Dr. Ures's "Philosophy of Manufactures."

519. *Fig.* 83 *represents a side and front view of the simple and economical fan, which has been of late years employed for ventilating factories*, by drawing the air out of every apartment; for removing through tunnels the dust disengaged in cleaning their fibrous materials; for blowing the air into their extensive ranges of forge fires, and many other similar purposes. It consists of two cast iron end plates, A, A, having a central circular opening, *c, c, c*, from the circumference of which the outline of each plate enlarges spirally, the point nearest the centre being near *d*, and that farther off being under E. This pair of parallel plates is connected by bolts, *a, a, a*, a mantle of sheet iron being previously inserted into grooves cast in the edges of the end plates, so as to enclose a cavity with an elongated outlet at B, to which a pipe is attached for carrying off the wafted air in any direction. Within this cavity, a shaft, C, revolves in bearing, *b, b*, placed centrally in the frame plates, A, A, and cast in the same piece. On this shaft a boss is wedged fast, bearing five flat arms, *c, c, c*, to which are riveted five plates or wings of the shape shown between *a* and *a*, in *fig.* 83, having a semicircular piece cut out of them on each side about the size of the end opening. On one end of the shaft, C, beyond the box bearing, the loose and fast pulleys, D, are fitted for receiving the driving band, and for turning the wings in the direction shown by the arrow. Thus the air is driven before them out of the end of the orifice, B, while it enters by the side openings at *c, c, c*. By the centrifugal force of the revolving wings, the air is conducted towards their extremities, and makes its escape from the pressure through the orifice B, while it is continually drawn in at the sides by its tendency to restore the equilibrium. The fans constructed by some engineers have their mantles made concentric with their central shafts, and though they do good work when turned with sufficient rapidity, they are not adapted to produce pressure by condensation, as the wind issuing from the outlet, B, consists partly of the air compressed by the extremities of the wings, and of the air rarified on its entrance near their roots. In the fan here represented, called the eccentric, the air which escapes through the outlet, B, has undergone compression during its whole progress through the spiral space with the revolving wings, and is equal in density to that compressed at their extremities by the centrifugal force. This fan discharges, therefore, considerably more air than that with a chamber concentric with its wings, because each wing, in passing the point *d*, acts as a valve to cut off the entrance of the uncondensed air, which would cause an eddy, and retard the proper current by the inertia of its particles. The fan produces its greatest effect when the extreme points of its wings percur in revolving about eighty feet per second. When the fan is employed to draw air out of a series of independent chambers, it has its circular side openings, *c, c, c*, enclosed within cases, which are connected with pipes communicating with these chambers. Slide or throstle valves may be placed in the exhausting, as well as in the condensing pipes, for regulating the distribution of the rarefying or blowing power.

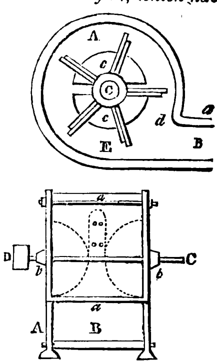


Fig. 83.

By this machine it appears that a renewal of the air is always ensured, which can seldom be the case except some such mechanical method be employed.

520. *Dr. Ure mentions another instance of successful ventilation*, employed in a range of dwelling rooms for the people employed in a cotton factory. A large iron pipe is led along the ceiling of an external corridor, shut at one end, but connected at the other with the great chimney of the mill. From the side of this horizontal pipe, opposite to each apartment, a tin tube, 1½ inch in diameter, branches off at a right angle, and enters through the wall, so as to present its open end immediately over the bedstead of the apartment. Whenever the steam-engine is stopped, either at meal hours or at night, the mechanism which shuts the fire damper is so constructed as to open, at the same instant, the valve at the inner end of the corridor pipe; whereupon a brisk current is established in each tin tube, and a stream of air rushes into it from every apartment, thus forcibly abstracting the air of the room, which, of course, will be immediately supplied by fresh air from without by means of the door and the various crevices. Since this plan has been adopted, the health of the inhabitants has been materially benefited.

521. *One of the advantages of ventilation by means of machinery, is the certainty that a change of the air is effected;* whereas, in many of the other modes, as air is an invisible fluid, it is not always easy to ascertain whether a current of foul air is going out, while another of fresh air is setting in. But however easy these modes of forced ventilation may be in manufactories, where power is at hand to work machines, and skilful people to direct them, they would obviously be too inconvenient to be applied generally in domestic economy, where the simplest means only can be expected to be generally resorted to. Nevertheless, there may be cases and occasions where the knowledge of what is done in other places may be useful. In the ventilation of the houses of Parliament, which has proved so successful, mechanical means on a great scale have been employed.

CHAPTER III.

FUMIGATION, OR DISINFECTING BUILDINGS OR APARTMENTS.

522. *Connected with the subject of ventilation, or renewing the air, in ordinary cases, is that of fumigation, or disinfecting the air*, when it is contaminated by pestilential or other highly noxious effluviæ, which are capable of exciting immediate disease. The general deleterious nature of several gases, as carbonic acid, sulphuretted hydrogen, carburetted hydrogen, phosphuretted hydrogen, &c., has been already mentioned; but there are many vaporous bodies, the existence of which we know or surmise only from our experience of their effects, but of the actual nature and chemical composition of which we are totally ignorant; and these go under the general name of *miasma*, or noxious effluviæ. From the facts which are known, there can be no doubt that, in limited spaces, as in crowded ships, jails, and hospitals, and particularly where cleanliness is neglected, or in confined apartments, where typhus and other infectious fevers exist, the atmosphere is loaded with certain exhalations, fumes, or vapours, which are the cause of contagion, and repeated endeavours have been made to neutralize these by some chemical means.

523. These endeavours have been productive of useful results; and it is now known that *several substances have the property of destroying the noxious quality of at least some effluviæ*, particularly those of certain fevers, and the poison arising from pestilence.

524. *Muriatic acid* was tried with success by Morveau, in 1773, in disinfecting the air; and though more powerful means are now known, it will be useful to describe this, among other methods, since circumstances may sometimes prevent the most efficient from being resorted to. To employ muriatic acid, put some common salt into an earthenware dish, and pour upon it some sulphuric acid: immediately whitish fumes will arise, which consist of the muriatic acid gas; they will blend with the air, and become invisible, but their presence will be perceived from their suffocating smell. All metallic substances capable of being corroded by the acid vapours should be removed; the room or building to be disinfected should be shut up for some hours, and a current of air passed through it before it is again inhabited. In this way Morveau disinfected the cathedral of Dijon, which had been rendered dangerous from the putrid emanations from the burial vaults beneath. He likewise purified, in the same manner, the air of the prison infected through a malignant fever. Twelve parts of acid to fifteen parts of salt is a good proportion. No heat is required.

525. *Nitric acid fumes* have been employed for the same purpose. These were first proposed by Dr. Johnston of Kidderminster, and successfully employed by Dr. Carmichael Smythe, in 1780, to whom the Parliament voted £10,000 for disinfecting the depôt of Spanish prisoners at Winchester, where a fever had proved very fatal. To prepare this gas, put equal parts of pounded nitre or saltpetre and sulphuric acid in a dish, as in the last case. The nitric acid fumes, which are red, are not so effectual as the muriatic, but they have a less suffocating odour, and may therefore be employed in places from

which the sick cannot be removed. For a chamber containing 700 cubic feet of air, four drachms of nitre and two drachms of sulphuric acid are sufficient. They may be put into a teacup, and stirred with a tobacco pipe. But as nitric acid can be purchased at every chemist's shop, a simpler mode of using it, when it can be procured, is to place a two ounce vial full of the *fuming nitrous acid*, with the stopper out, on the mantel-shelf in the rooms which it is wished to guard from infection. The red fumes which constantly issue from the acid will be sufficient for the purpose; they produce an odour not disagreeable, which may be felt on coming into the room, but not enough to be perceived on remaining some time in it, and they destroy the close and unpleasant smell of a sick chamber.

Some recommend putting sulphuric acid upon a mixture of saltpetre and of common salt: it is evident that thus both muriatic and nitric acid fumes will be formed; but these, in large quantity, will be too suffocating for a chamber in which the patient is to remain, and will require that all articles of steel should be removed before the fumigation. In small quantities they may be employed; but the nitric acid alone appears preferable.

526. *Chlorine is the most effectual gas for the purpose of disinfecting the air in apartments.* It was first suggested by Fourcroy, in 1791, and it is now very generally employed. It has the advantage of destroying some noxious vapours that the above-mentioned gases have little effect upon, as sulphuretted hydrogen; and it is, upon the whole, more to be depended upon than any other similar substance. To produce chlorine for the purpose of fumigation or disinfecting, put ten ounces of common salt, well dried, two ounces of powdered black oxyde of manganese, into an earthen pan, together with six ounces of strong sulphuric acid diluted with four ounces of water. The earthenware vessel should be placed in hot sand. This will be sufficient for a room forty feet by twenty.

The chlorine gas will be formed by this mixture, and will rise from it. It has an extremely suffocating smell, and particular care should be taken not to inhale the gas where it is formed, as it is extremely irritating to the lungs, and will produce all the symptoms of a cold and cough. When attempted to be breathed quite pure, it has proved fatal. The place, therefore, where it is used should be shut up with the gas in it for ten or twelve hours, and should be entered cautiously, taking care to have afterward a free circulation of air through it to carry off the chlorine. This method of using the gas is inconvenient in small apartments, but may be easily managed in large buildings when empty.

The irritating and dangerous effect upon the lungs by the use of the gas extricated in the above manner, is obviated by employing the following combinations:

527. *Chloride of lime and chloride of soda are the substances now used as the most convenient, and the most effectual preparations for the purpose of disinfecting.* It is found that chlorine will combine with pure lime and pure soda, making chloride of lime and chloride of soda, but that the affinity of chlorine for these substances is very weak. As the attraction of lime and of soda for carbonic acid is stronger than for chlorine, upon chloride of lime being exposed to the atmosphere, it becomes decomposed by the lime taking carbonic acid from it, and, consequently, leaving the chlorine free to escape, which it does very slowly; and the change is more rapid when the air is charged with putrid effluvia, because the carbonic acid then present promotes the decomposition. Nothing more is necessary, therefore, than to put some chloride of lime, with forty times as much water, into dishes, and place them in the room which it is required to disinfect or to guard against contagion, or to remove any disagreeable smells.

The odour of the chlorine, which issues spontaneously, is rather unpleasant, and excites coughing at first; but the best way is to begin with a quantity too small for that, and to increase it gradually. This inconvenience is, however, trivial when compared with the pernicious nature of the effluvia from contagious or infectious disorders. In cases where infectious diseases are so near that danger is apprehended, chloride of lime or of soda are the best known preventives; and they are so safe, that they may be used wherever there are sick patients, except in the commencement of fever, when it would be hurtful for them to remain in the room with the gas.

528. *Chloride of lime was formerly called the oxymuriate of lime, and is the well-known bleaching powder.* It is made by exposing thin strata of newly-slacked lime in fine powder to chlorine gas in a closed vessel; the gas is absorbed. The chloride is a dry powder, having a faint smell of chlorine. When dissolved in water, it is the *bleaching liquid.* Being made in large quantities for manufactures, it may be had at many chemists' shops, and every chemist knows how to procure it

A solution of chloride of lime in water may likewise be sprinkled over the apartment to destroy offensive smells. A cloth wetted with it, and laid over a corpse for an hour or two where putridity has commenced, will prevent any effluvia from being perceived; and in this manner it is sometimes employed in cases of dissection. By breathing through a sponge dipped in this fluid, a person was enabled to descend and walk with impunity along a public sewer in Paris, where previous attempts to enter it without this precaution had cost many lives. The same method might be used in emptying drains, cesspools, or other places where putrid matter renders the place dangerous; and it has been employed with success in destroying the stench of bilge-water in ships, and correcting the confined air of their holds. Clothes worn by persons during pestilential diseases are disinfected by being washed in a solution of chloride of soda; and the linen of sick persons, where there is any danger of infection, should be put into water with chloride of lime or soda as it is taken off. This solution is also found extremely useful as an application to ulcers or putrescent sores.

529. *Chloride of soda, which is equally efficacious with chloride of lime, is known by the name of Labarraque's disinfecting liquid.* It is prepared by passing a current of chlorine gas through a cold and rather dilute solution of common carbonate of soda. It is necessary to send as much chlorine into the solution as will displace the whole of the carbonic acid. A particular account, by Mr. Faraday, of the mode of preparing it, may be seen in the Quarterly Journal, New Series, II., 84. The employment of these powerful disinfecting agents should not, however, prevent the use of all other means which may be considered as additional securities; such as washing clothes and linen, whitewashing, scouring, &c.

530. *Tobacco smoke* is considered by some persons as a preservative from infection; but its influence is, at least, extremely doubtful.

531. *Camphor* has been very generally relied upon as a protection against infectious diseases; but its value is estimated very low at present among physicians.

532. *Vinegar* is certainly useful; and although its disinfecting properties are perhaps very small, yet it is at least very refreshing in a sick-room, both to the invalid and the attendants, in overcoming the unpleasant odour usually prevalent. It is either sprinkled over the floors, or the vapour is produced by pouring vinegar upon a hot iron. For this purpose aromatic vinegar and Thieve's vinegar are thought to be preferable, as they contain a little camphor and aromatic oils.

533. *To destroy the disagreeable effluvia from sewers, privies, and similar places,* quicklime alone, or mixed with lees of ashes, or soapy water that has been used in washing, may be thrown down into the sink of the privy. This is much employed in hot countries in places where putrefying matter is collected, to prevent its dangerous effect upon the atmosphere, which would produce disease. But, as we have already observed, noxious effluvia from all underground places should be prevented by properly-constructed traps.

BOOK IV.

ARTIFICIAL ILLUMINATION.

CHAPTER I.

ON LIGHT AND FLAME.

SECT. I.—HISTORICAL REMARKS.

534. *Artificial light is probably as ancient* as the human race or the use of fire; but the means employed to produce it among savage tribes have scarcely advanced beyond burning branches of trees or splinters of wood. Torches were probably an improvement upon these; and lamps, even of the simplest kind, display a great advance in refinement, requiring a combination of contrivances, such as the preparation of oil, a vessel to hold it, and a proper substance for the wick.

It is not a little remarkable that the ancient nations, who evinced such skill and taste in several of the elegant arts, should have made no improvement in the simplest kind of lamp, except that of its form. Although antique lamps have been found in Herculaneum, Pompeii, and other places, of almost infinite variety, made of baked clay or of bronze, from the most simple forms to those of the most studied description, exhibiting a surprising variety of designs, and admirable for the beauty of their workmanship, yet the principle of the lamp scarcely varies from what must have been the original contrivance—an open vessel, with a wick laid in the oil. The light which these supplied must have been weak and unsteady; and, as there were no means for destroying the smoke, this must have been annoying in closed apartments, when the oil was bad. The lamp was sometimes suspended, and, occasionally, was placed upon that elegant piece of furniture, the candelabrum or stand, of which some of the most beautiful forms in marble and bronze are still preserved.

535. *Simple as is the contrivance of candles, they do not appear to have been generally known to the ancients,* who continued long to make use of the lamp only. We read, however, of a species of candles sometimes used among the Romans, made of strings of papyrus, or rushes, dipped in pitch and surrounded with wax. Wax and tallow candles were, according to Pliny, likewise occasionally employed in religious offices. Torches and flambeaux were used at all times; and in the early part of the modern period we find that, at great entertainments, halls were lighted up, not only with lamps, but with flambeaux held in the hands of domestics kept for the purpose. Froissart, in

describing the magnificence of the Count de Foix, states, that he had twelve torches, held by twelve valets in his hall. These were afterward superseded by the invention of candlesticks. In the twelfth century, candles of wax, and chandeliers, were generally seen in churches; and, as refinement increased, they came gradually into use among the nobility and wealthy all over Europe, as did those of tallow among the middle classes. The discovery of Argand, by which the smoke of lamps was destroyed, produced a new era in artificial illumination; and these implements, which had long been laid aside in the best apartments, were again introduced. Various modifications of this admirable invention have resulted from the endeavour to carry the improvement still farther, and still continue to exercise the talents of philosophers and mechanics. Inflammable air, or gas-lighting, has added immensely to our means of artificial illumination, particularly in streets, shops, and public buildings; but all these modes have peculiar properties, which require to be examined separately.

Sect. II.—Nature and laws of light.

536. Although the artificial light produced by combustion is in several respects different from that of the sun, yet the general laws observed by both are the same; and we shall be able to make the nature of the former best understood by first briefly describing the chief properties of solar light, or that of day.

537. *It is not known with certainty what light really is*, but there are two prevailing opinions respecting it. By some it is supposed to consist of streams or rays of excessively minute particles, sent off in all directions from luminous bodies. Others imagine that there are no particles of this kind, but that luminous bodies have the property of causing vibrations or undulations in an ethereal fluid that fills all space, and that thus an effect is produced on the eye analogous to that on the ear in sound, which is known to be the result of invisible undulations or waves formed in the air by sonorous bodies. But, whatever may be the fact (and this cannot at present be absolutely determined), either of these theories explains most of the phenomena of light; and, as the first-mentioned has greater simplicity in its favour, we may adopt it, on the present occasion, as the most convenient for our purpose.

538. *The rays of light from the sun proceed always in perfectly straight lines, parallel to each other*, and never in curves of any kind. This may be seen distinctly by admitting them into a dark chamber through a hole in the window-shutter, *fig.* 84. But the rays which proceed from a candle or lamp diverge, or spread out, as they proceed from the flame, *fig.* 85, though they also move only in straight lines. It is important to distinguish these facts in the consideration of light employed in illuminating.

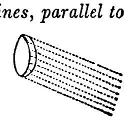


Fig. 84.

539. *When the rays of light, whether of the sun or of any other luminous body, strike upon a solid substance, a considerable portion is reflected*, or thrown off again, precisely in the same manner as when a boy's marble rebounds from a stone slab on which it is thrown: and this reflection obeys a constant law, to understand which is essential to our subject. Suppose the rays, *a b*, *fig.* 86, come to the surface, *c d*, in the direction *a b*, making a certain angle, *a b c*, with that surface, they will be reflected, or will bounce off from the surface in the direction *b c*, making the angle *c b d* exactly equal to the angle *a b c*. The angle *a b c* is called the *angle of incidence*, or striking, and the angle *c b d* is called the *angle of reflection;* and the rule in all cases is, that the angle of incidence is equal to the angle of reflection. This is the foundation of all our reasoning on the operation of *reflectors* of various kinds, which are so often used in the management of light; and a few illustrations will render this familiar to the reader.

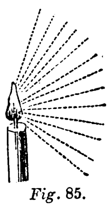


Fig. 85.

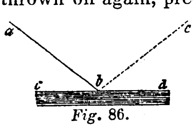
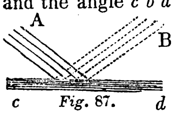


Fig. 86.



c *Fig.* 87. d

If a piece of looking-glass, *c d*, *fig.* 87, be laid flat upon a table in a darkened room, and a ray of light, A, be admitted through a hole in the shutter so that it may strike on the mirror, it will be seen that the ray will be reflected to B, making the angle of incidence equal to that of reflection; and likewise that the several rays, both of incidence and reflection, do not diverge, but continue parallel. But the beam of light from a candle, C, *fig.* 88, diverges before it strikes the mirror; and, as each single ray makes the angle of incidence equal to that of reflection, it is evident that the rays must continue to diverge when they are reflected, as in the dotted lines. When a candle, E, *fig.* 89, is put before a flat mirror, F G, on the wall of an apartment, the rays diverge, and, on striking the mirror, they are reflected, and continue to diverge, being thus diffused through the room. Although light is reflected by all bodies

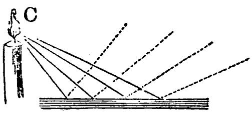


Fig. 88.

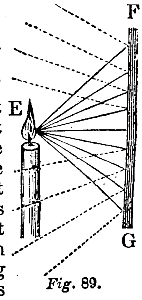


Fig. 89.

on which it strikes, yet, if the surfaces are rough, a great portion is absorbed and lost, and only a small part is reflected; but if the surfaces are polished, much more is reflected; and this quantity is in proportion to the degree of smoothness; for this reason, all reflectors should be kept highly polished, which will be known by their appearing bright.

540. *Curved surfaces reflect light* according to the same law, viz., that the angles of incidence and of reflection in each ray are exactly the same. To illustrate this, suppose a concave mirror, *fig.* 90, of which the centre of concavity is at *a*; or, in other words, that *a* is the centre of the circle, of which curve of the mirror B C is a portion: if a number of parallel rays, *d e*, such as those of the sun, strike upon the mirror B C, each separate ray will be reflected so that its angle of reflection will be equal to its angle of incidence; but, from the nature of the curved surface, the result will be, that all the reflected rays will meet together in one point; and this point will be exactly half way between the centre, *a*, and the surface of the mirror: such a mirror, if of sufficient size, would collect the sun's rays so as to burn at the point *f*. Now suppose that an artificial light, as a lamp or candle, was placed in the point *f*, the rays will diverge towards the mirror, and they will be reflected so as to be parallel in the direction *d e*. It is upon this principle that a light may be sent to a vast distance; and thus the light from the candles in coach lamps are confined to the space along the road. If the light should be placed between *a* and *f*, as at *k*, *fig.* 91, then the rays will be collected in a point farther off than *a*, as at *g*; and if it is placed nearer to the mirror than *f*, as at *m*, the reflected rays will diverge, as *h*, *i*.

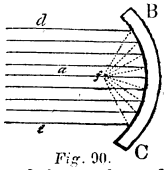


Fig. 90.

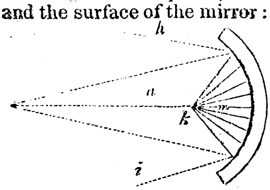


Fig. 91.

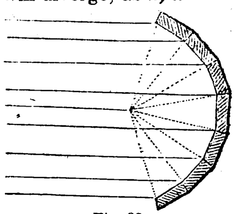


Fig. 92.

541. *Reflectors are sometimes made by* placing a number of small flat pieces of mirror so that the middle of each just touches the curve of a circle, as in *fig.* 92. This arrangement of mirrors, though less perfect than a single curved mirror, acts nearly in the same manner, each small piece throwing its rays to the centre of the circle. Here the greater the number of pieces the better, so that they are set accurately. This kind of reflection is often used where the size is very large, or where economy is much an object, no grinding to a curved surface being necessary.

542. *Light may be also collected and concentrated by means of glass lenses.* This depends upon a very different principle from the *reflection* of light. It is caused by what is termed the *refraction* of light, which is the change in their direction which rays undergo when they pass out of one transparent substance into another of a different density; but for the laws of refraction we must refer the reader to some work on optics, as our limited space will not admit of its explanation in this work. We shall content ourselves with giving some of the most useful practical results.

543. *A lens* is a piece of glass ground with one or both surfaces spherical. A complete sphere of glass, or a hollow globe filled with water, is sometimes employed to collect the rays of light into a point or focus. If a candle or lamp, *a*, be placed near to such a globe, *b c*, *fig.* 93, the rays, after diverging, will, by passing through the globe, be made to converge to a point *d* on the other side of the globe; and since all the light that falls upon this globe will be collected into a very small spot, this will, of course, be strongly illuminated. This contrivance is often used by jewellers and others for procuring an intense light to be thrown upon their work.

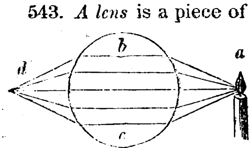


Fig. 93.

544. *A plain convex* lens is a circular glass, flat on one side, and ground spherically on the other, as in *fig.* 94. This collects the rays into a focus, which is more distant than in the case of the globe; and the curved side may be either the half or a segment of a sphere. It is used in some lamps, and the focus may be farther off or nearer, according to the place of the light.

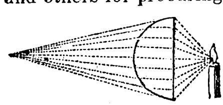


Fig. 94.

545. *A double convex lens*, *fig.* 95, is likewise employed for a similar purpose, and is frequently used in such instruments as the magic lantern, lucernal, and other microscopes, telescopes, &c.

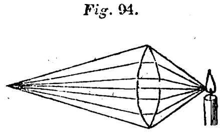


Fig. 95.

546. *We must refer the reader also to works on optics for a description of those beautiful experiments*, by which it has been shown that a beam of the sun's light, though colourless, consists of seven different coloured rays, which can be separated from each other, forming what are called the

prismatic colours; and it is this separation that gives rise to the vivid colours we see given out by the diamond and by cut glass.

547. *It has likewise been shown that the rays of the sun, which produce light and colour, are distinct from those which produce heat,* although they always accompany each other; and here we may point out a remarkable difference between the rays that proceed from the sun and those which come from a fire. In both there are rays of heat and rays of light, that is, heat-making rays and light-making rays; but both these kinds of rays proceeding from the sun pass readily through a pane of glass, as is evident, because in a greenhouse we feel the heat as well as see the light of the sun. But with respect to a fire, the *light* only, and *not the heat*, or very little of it, passes readily through glass; the greatest part of the rays of heat are stopped by it; and, in consequence, a pane of glass fitted into a frame is sometimes actually employed as a fire-screen. *Acquaintance with the above principles* we consider necessary, because they are frequently applied in the various modes of lighting apartments.

Sect. III.—On the nature of flame, as employed for artificial light.

548. In treating of heat and combustion in Book II., we described the chemical nature of flame; but it will be here necessary to consider it again, with some additional observations relative to its application in affording light.

549. *The nature of flame* has been matter of wonder in all ages, until modern chemistry explained this once mysterious subject. Flame is now considered to be matter that has been volatilized or converted into vapour, and rendered luminous by intense heat. Oxygen is necessary for the combustion which is the cause of the heat, and therefore it is required to support flame.

550. *All bodies do not become luminous when heated:* as, for instance, some of the metals; but iron becomes incandescent, or red and even white hot, when heated to a certain temperature, and various substances require different degrees of heat to render them incandescent.

551. *Common air cannot be rendered luminous by any degree of heat,* and is therefore incapable of producing flame of itself; neither can oxygen gas.

552. *Several of the permanent and natural gases, and also the vapours or gaseous states of several bodies, are capable of being rendered incandescent or luminous* when they undergo combustion in contact with oxygen. Pure hydrogen gas, produced from sulphuric acid and zinc, or iron, is extremely inflammable, and burns with a *weak blue flame* when set on fire by another flame, or even by the electric spark; but though the heat of its flame is considerable, its light is feeble. We explained, when treating of heat and combustion, that the latter effect consisted in the union of the combustible body with oxygen. When hydrogen burns, it unites with the oxygen of the atmosphere, and the result of this union is the formation of water, which is known to consist of hydrogen and oxygen, and which is converted into vapour, and dissolved in the air as soon as it is formed; the flame being the incandescent state of the gas in the act of combining. Carbonated hydrogen, or hydrogen with carbon, which is disengaged from coal or wood by heat, also burns in contact with oxygen; but its combustion affords a whiter and brighter flame than pure hydrogen, that is to say, when rendered incandescent, it throws out more light; and hence it is preferred for the purposes of artificial illumination. Carbonated hydrogen affords more light in proportion to the quantity of carbon it contains; and the carbon is a principal source of the light given by its flame. The vapours of some substances are not combustible, and cannot be rendered luminous; in other words, they produce no flame: as, for instance, steam, the vapour or gaseous state of water. On the contrary, the vapours of other substances are highly inflammable, and, as we have said above, burn with a bright light or flame: for instance, wax; but it is necessary that these vapours should be heated to a great degree before they will burn or produce flame by combining with oxygen. This may be illustrated in the following manner: Put a bit of wax into a fire-shovel heated a little: it will melt; but wax merely melted will not flame, as may be seen by trying to light it by a piece of lighted paper. To make wax produce flame, it must be heated so as to cause it to boil, and then its vapour is highly inflammable. To prove this, heat the shovel red hot; now put some wax on it, and a white smoke will rise, which is the vapour from the boiling wax. Hold a lighted paper in this smoke, and it will immediately catch fire and flame like a candle, and this flame will continue till the whole of the wax is consumed. What is shown here of wax is true also of all the other substances commonly used for producing light, as spermaceti, tallow, oil, resin, &c. They will not afford flame until they are first reduced to the state of vapour.

553. *The flame of a common lamp, or of a candle, is produced in the following manner:* Oil and tallow, we have stated, do not take fire unless previously volatilized by heat; and this is effected by means of the wick of the candle or lamp. The oil or melted tallow rises between the fibres of the wick, in consequence of what is called *capillary attraction,* in the same manner as water would rise up in a piece of the wick suspended in it. The flame of another body being applied to the extremity of the wick, so as to set it

on fire, the oil is heated to the state of vapour, which then inflames; the oil first raised is dissipated by combustion, and another portion is attracted upward by the fibres of the wick, and becoming vapour, is burned likewise, and in this way a constant combustion is maintained. A candle, however, differs from a lamp in a very essential circumstance. The oil of the lamp is always fluid, and only requires to be boiled into vapour by the heat of the wick; but the tallow, being at first solid, has first to be liquefied and brought into the state of oil. What is in the vicinity of the wick is first melted, and the external rim of the candle not being rendered fluid, a cup is thus formed, which contains the melted portion. This circumstance will be adverted to again more particularly when we treat of the management of candles. The melted tallow or oil being boiled by the flame into the state of vapour, ascends in the form of a column, and, being heated to a high temperature, it combines rapidly with the oxygen of the surrounding atmosphere, the heat evolved being so great as to cause the vapour to be white hot and very luminous, thus constituting visible flame. But the combustion that occasions this can only take place in that part of the column of hot vapour which is in contact with the atmosphere, namely, the exterior surface. The flame of a candle or lamp, then, *fig.* 96, is not solid throughout, but only a thin film of white hot vapour, enclosing a quantity of heated vapour, which, for want of oxygen, is incapable of attaining the greatest degree of heat in burning; that is, only the vapour which rises from the outside of the wick, and which is in contact with the atmosphere, can burn by uniting with oxygen; but what rises from the centre of the wick, not being in contact with the air, cannot burn, and rises, of course, unburned. The flame of a lamp or candle is, therefore, in fact, hollow; the dark in the figure representing the hollow part, the upper part tapering to a point.

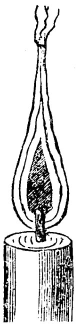


Fig. 96.

554. *That the flame is really hollow can be proved* by several experiments. By looking attentively at the flame of a candle just snuffed, it will be seen that immediately above the wick there is a part darker or less luminous than the rest, as in *fig.* 96; this is the hollow part, full of unburned vapour. If a piece of paper, held horizontally, be quickly introduced across this part of the flame, and held for a few seconds, the paper will be found to be scorched only in a ring, *fig.* 97, where the circular film of flame was below it, and the centre part will not be scorched. The scorching will be best seen upon the upper side of the paper, as the lowest side will be too much blackened by the smoke.

Fig. 97.

By a pretty experiment, it is possible to extract the unburned vapour from the centre of the flame, and to inflame it. Procure a piece of a small glass tube, having a bore of an eighth of an inch; insert the end of it dexterously into the dark part of the flame where the hollow is supposed to be, holding the tube as at A, *fig.* 98, and the unburned vapour will ascend through the tube, and may be set fire to at the top by a piece of lighted paper, forming a smaller flame of the same kind as the first.

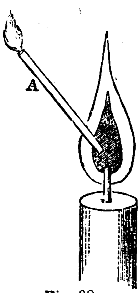


Fig. 98.

555. *It is necessary now to refer the reader to what we have said in Book II., on the chemical nature of combustion. We there stated that* the usual substances employed for giving heat and light were of vegetable or animal origin, as wood, coal, wax, tallow, spirit, &c., the chemical constituents of which are oxygen, hydrogen, and carbon, in variable proportions and that, in the process of combustion, a complete decomposition of these, or a separation from each other, was effected. This takes place in all the oil burned in lamps, and the wax, tallow, &c., in candles.

556. *We must trace the progress of this decomposition, in order to explain the phenomena which occur in artificial illumination.* When any of the substances employed for giving light is heated so as to inflame, a portion of the carbon and hydrogen unite, forming carbonated hydrogen, which is detached, and becomes luminous by uniting with oxygen in the manner described above. Another portion of the hydrogen alone combines with oxygen, and forms water, this fluid consisting of these two gases in combination. The water thus formed is dissipated through the atmosphere, being so heated as to be in the state of vapour, on which account it is not obviously visible. The light, therefore, proceeds from the combustion of the carbonated hydrogen. Another portion of the carbon of the combustible body unites with the oxygen of the atmosphere, and forms carbonic acid gas, which is likewise disengaged and spread through the surrounding air. But still another portion of the carbon remains, reduced to a vaporous form, ready to unite with hydrogen, and to burn with oxygen; this remaining portion of carbon, however, being in the centre of the flame, has no hydrogen to unite with, that being all, or nearly all, burned; or if there be a little hydrogen left, still no oxygen can find its way to the centre of the flame to complete its combustion; consequently, this carbon vapour remains by itself, and, rising in a column through the upper part of the flame, a part gets burned at the top, where it meets with oxygen, but a large portion also escapes unconsumed. It is this latter part that escapes, which, when it comes into the cool atmosphere, is condensed, and ap-

pears in the form of smoke, which may be collected as a powder in the form of soot on any surface held over it. This escape of unburned carbon vapour may be very instructively watched in the burning of a tallow candle. Sometimes the flame may be observed quite steady, and tapering to a point; then all the carbon vapour is burned at the top, and there is no smoke. Presently the flame is observed to flicker, to become red at the top, and to give out a great deal of smoke; in that case, the carbon vapour has escaped unburned through the flame.

557. *It is obvious from this that the cause of smoke in candles and lamps is because there is no supply of oxygen to the centre of the flame*, in consequence of which the carbon vapour, which fills the hollow part, cannot be consumed, and therefore escapes into the apartment unburned, by which a loss of heat and light is occasioned, into which it would have been converted could oxygen be got to it. This defect in the combustion of lamps has been remedied by the invention of Argand, to be afterward described, and by which oxygen is admitted to the centre of the flame, to consume the carbon vapour which occasions the smoke.

558. *The flames of different combustibles are not all attended with an equal production of heat and light.* Sulphur burns with a weak flame; phosphorus with a very dense one. Spirit of wine burns with a slight flame in point of light, but a very powerful one in respect to heat. If an Argand's lamp be charged with oil, and another similar lamp be charged with spirit of wine, the flame of the latter will not have a quarter of the light of the other, but will give twice as much heat, and is not accompanied by smoke. The flame of ether is denser, but produces smoke. The flame of oil of turpentine is attended with a very dense smoke. The flame of pure hydrogen is very faint, but gives much heat.

559. *The colours of flames also depends upon the nature of the combustible.* Sulphur burns with a blue flame. Spirit of wine, by itself, also burns with a bluish flame. If a little boracic acid be stirred into the spirit of wine, the flame will be beautifully green. If any of the salts of strontian be mixed, the colour will be a fine red; and it is this latter which is employed in the theatres for producing the red light in the representation of conflagrations. The flame of zinc is a bright white: that of the preparations of copper, greenish-blue.

560. *The combustible vapours and gases are not all inflamed with equal readiness.* Pure hydrogen gas may be inflamed, not only by the contact of another flaming body, but even by a very small electric spark. A spark a little more powerful will fire spirit of wine and ether, especially when the fluids are a little warm. Spirit of turpentine, and some essential oils, may be inflamed even by the action of cold acids. Put a spoonful of oil of turpentine in a cup, and pour over it about half that quantity of strong nitrous acid, previously mixed with a few drops of sulphuric acid: the oil of turpentine will immediately burst into a flame. In making this experiment, it is necessary to put the acid into a small phial, which should be fixed to the end of a long stick, that the operator may be at a distance from the turpentine; because the flame is so sudden, that it will be dangerous to bring the hand near it.

The thick fat oils must be heated to a considerable degree before they are in the state of giving out vapour, so as to be inflamed. If a vessel containing oil be set upon a fire, a smoke or vapour begins in time to rise from it, which by degrees grows denser and denser, and at last begins to shine in some places near the surface of the oil, somewhat like an electric light; yet it does not flame; but if a flaming body like a candle be brought within the vapour, the latter will instantly be inflamed, breaking out with a sort of explosion, and will continue to burn till the whole is consumed. Serious accidents frequently occur in boiling oil, pitch, and similar substances, by approaching too near with a light, or by suffering them to boil over, by which their vapour is set fire to, and the whole of the oil is inflamed.

561. *The above principles explained*, it will now be easy to comprehend many of the circumstances connected with light of various kinds, which would be wholly unintelligible without this previous knowledge. We shall proceed to describe the several contrivances which have been resorted to in employing the combustible substances used for giving light, such as lamps, candles, &c.

562. *At present there are three modes by which artificial light is usually produced:* by *candles*, *lamps*, and *gas*. We shall consider these separately; but first we shall treat of the various substances employed to burn for this purpose.

CHAPTER II

OF THE VARIOUS SUBSTANCES EMPLOYED IN THE PRODUCTION OF ARTIFICIAL LIGHT.

SECT. I.

563. *General Remarks.*—The materials from which artificial light is procured are derived partly from the animal, partly from the vegetable, and some from the mineral king

dom. Animal fat or oleaginous substances, in our common temperature, are either solid, as wax and spermaceti, or always fluid, as fish oil. Of vegetable oleaginous substances, some are always solid in the usual temperature of Britain, as palm oil: others are always fluid, as olive and rape oils. The mineral substances are naphtha, petroleum, &c.

Sect. II.—wax.

564. *Wax is both an animal and a vegetable production.* The first kind is a secretion by certain insects, of which the bee is the most remarkable. The second is afforded by plants. Wax was long supposed to be merely collected by bees from the pollen of flowers; but this opinion is now known to be erroneous: the pollen which the bees are seen to collect, and to carry home attached to their thighs, is for the purpose of feeding their young. It is, therefore, called *bee bread.* The wax of the bee is elaborated in its stomach. With his tongue he sucks the saccharine juice in the nectaries of flowers; and this is transformed into wax by certain secreting organs in the animal. The wax then exudes through apertures between the abdominal rings, into what have been termed *wax-pockets*, which were first discovered by Mr. John Hunter, and of which the working bees have eight: these are situated under the wings. From the observations of Huber, it appears that sugar is essential to the formation of wax; and that bees supplied with sugar only, and shut up in the house, manufacture wax in the same manner as those bees which enjoy their freedom; which proves that wax is not merely a vegetable substance.

565. *The cells of wax constructed by the bees* consist of two ranges, disposed back to back, in combs that are placed vertically. They are all hexagonal or six-sided; and the accuracy with which they are constructed, and the wonderful instinct by which the form best adapted for the purpose is given, has excited the admiration of mankind in all ages. But the natural history of the bee, so highly interesting, is to be found in many works of the present day; and it is, therefore, unnecessary to describe it farther in this place. The finest wax is made where the bees have access to dry heaths and hilly countries: in places abounding in vineyards it is decidedly inferior. A young hive will yield, at the end of the season, about one pound of wax, and an old hive twice as much.

566. *There are two kinds of wax found in commerce, yellow or unbleached, and white, or purified and bleached.* The yellow is the wax just as it comes out of the hive, after expressing the honey. The dark yellow colour is owing to an admixture of some honey and the bee bread, for the natural colour of wax is pure white.

567. *To procure the wax from the combs for use.* After separating the honey from them as much as possible, by draining and pressing, the combs are either soaked for some days in clear water, in order to extract all the honey, or they are broken into pieces, and spread on a sheet near the hives, so that the bees may in time suck out all the honey that is left. The whole of the comb is then enclosed in a canvass bag, and put into a kettle with boiling water; by this the wax is melted, and it is squeezed out by pressing the bag with a large wooden spoon. The melted wax rises to the surface of the water, and swims on the top. It is next skimmed off, and put into another vessel with cold water, by which it is hardened. It is then taken off, remelted, and cast in wooden, earthen, or metallic moulds, which are first anointed with honey, oil, or water, to prevent the wax from sticking to them.

Before wax is employed for the ordinary purposes, as the making of candles, for modelling, the uses of the surgeon, perfumer, &c , it is rendered white by bleaching.

568. *Wax is bleached* by exposing it in thin laminæ to the action of the light and air, by which it becomes perfectly white, scentless, somewhat harder, and less greasy to the touch. To effect this, it is first broken into small pieces, and melted in a copper caldron, with water just sufficient to prevent the wax from burning. The caldron has a pipe at the bottom, through which the wax, when melted, is run off into a large tub filled with water, and covered with a thick cloth, to preserve the heat till the impurities are settled. From this tub the clear melted wax flows into a vessel having the bottom full of small holes, through which it runs in streams upon a cylinder kept constantly revolving over water, into which it occasionally dips; by this the wax is cooled, and at the same time drawn out into thin shreds or ribands, by the continual rotation of the cylinder which distributes them through the tub. The wax, thus granulated or flatted, is exposed to the air on linen cloths, stretched on large frames, about a foot or two above the ground; in which situation it remains for several days and nights, exposed to the air and sun, being occasionally watered and turned; by this process the yellow colour nearly disappears. In this half-bleached state, it is heaped up in a solid mass, and remains for a month or six weeks; after which, it is remelted, ribanded, and bleached as before (in some cases several times), till it wholly loses its colour and smell. It is then again melted for the last time, and cast, with a ladle, upon a table covered over with little round cavities, into the form of disks or cakes of about five inches in diameter, in which it is usually sold. The moulds are first wetted with cold water, that the wax may be the more easily got out, and the cakes are laid out in the air for two days and two nights, to render them more transparent and dry. This operation of bleaching wax can be per-

formed only in fine weather, as it depends chiefly on the action of the sun; and on account of this inconvenience, it has been a desideratum to discover some other mode of whitening this substance. Chlorine has been found to bleach it much more rapidly; but does not answer completely, the wax being rendered brittle. Steam has also been employed for this purpose; and, by exposing wax to the atmosphere in frosty weather, the bleaching is very soon effected. It is by exposing honey to the frost that the Jews bleach it to such a degree of whiteness as they bring it to in Poland.

569. *In tropical countries, on account of the heat, tallow candles cannot be used*, and therefore wax is much employed. A very simple method of bleaching this substance is made use of there: a vessel containing it is placed within another full of water kept boiling. When the wax fuses, a process for converting it into thin flakes for bleaching is used, that at first sight might appear hazardous. The hands are first dipped into a tub of cold water placed near, and, while wet, plunged into the melted wax; they are instantly and quickly drawn out covered with wax, the heat of which is scarcely at all felt. This wax is stripped off from the hands, and spread out on cloths in the sun, and watered to whiten.

570. *The principal properties of wax are these:* it is insoluble in water and in cold alcohol, but in boiling alcohol a very small portion is dissolved, the greater part of which is deposited on cooling. John, a celebrated chemist, found wax to consist of two substances, one soluble in boiling alcohol, and which he called *cerin*, the other insoluble, which he has named *myricin;* the proportions of each being 75 of the former and 25 of the latter. The first gives brittleness, the last unctuosity, being partly of the nature of a fixed oil. Cerin, when obtained from wax, will form *margaric acid*, a product of saponified fat; but wax itself will not make a soap with the alkalies, a property which distinguishes it from fats, oils, and resins; neither does it contain *elain* nor *stearin*, principles in the latter substances which we shall describe. Wax unites, by the aid of heat, with the fixed and volatile oils, and with resin: with different quantities of oil it constitutes the *cerates* of the apothecaries.

571. *By chemical analysis*, 100 parts of wax are found to consist of carbon 80·4; oxygen 8·3; hydrogen 11·3.

572. *Wax, it has already been stated, cannot be kindled unless it be previously reduced into vapour*, which requires a heat of 300°; in this it resembles tallow and fat oils. Bleached wax burns with a very pure white light, without any offensive smell, and with much less smoke than tallow; and as it is less fusible than the latter substance, it burns well with a smaller wick. It yields in burning the same products as oil. Bleached wax melts at 155°; unbleached at 142°; while tallow melts at 92°, and spermaceti at 133°. White wax is in some degree translucent, but not so much so as spermaceti.

573. *White wax is sometimes adulterated* with white-lead, to increase its weight: this may be detected by melting the wax in water, when the lead will fall to the bottom of the vessel. Adulteration by mixing tallow or suet with it may be known by its greasiness, by a dull opaque white, and its wanting that transparency which pure white wax possesses; as also by its disagreeable odour when melted, and being saponified by alkalies. Potato starch is another ingredient which is sometimes fraudulently mixed with white wax. This may be detected by digesting the wax in oil of turpentine at a gentle heat, which dissolves the wax, leaving the starch. Spermaceti is also employed for adulteration; this mixture has less transparency than pure wax, and it melts more easily; the surface of the cake having likewise a mottled appearance. Wax is also adulterated with resin, which renders it brittle: pea meal and earths are likewise said to be employed. The presence of resin may be suspected when the fracture appears smooth and shining instead of being granular, and it may be detected by putting small pieces into cold alcohol, which will dissolve the resin, and leave the wax untouched. Earth or pea meal may be discovered by remelting and straining the wax, as they will be left behind. When wax is bought, it is proper to break each cake, for it is not unfrequently the case that some impurities are in the centre, the outside only being good.

574. *Besides our large supply at home, a great deal of wax is imported* from Russia, the Netherlands, Barbary, the west coast of Africa, Cuba, and North America; and much more would be imported but for the heavy duty, which is 1*l.* 18*s.* per cwt.

Vegetable wax will be described among the vegetable substances employed for light.

SECT. III.—SPERMACETI.

575. *Spermaceti is an inflammable substance, which occurs* as a spongy, oily mass, in the head of a species of whale (*Physeter macrocephalus* or *cachalot*). It is contained in a large triangular cavity ten or twelve feet long, and four or five feet deep, placed above the fore part of the scull; and an ordinary-sized whale will yield upward of twelve large barrels, or nearly a ton, of this substance in a crude state. While the animal is living, this substance is fluid; and when the whale is killed, a hole is made in the outer and upper part of the head, and the liquid is baled out in buckets; it solidifies to the consistence of fat on cooling. The sperm oil is separated from this by dripping, and pressure in bags: what passes through is the oil, and the residue is the crude spermaceti, which is packed up and brought to England by the South Sea wha-

lers to be refined. The mode of refining it in manufactories is as follows: The crude substance is put into bags of hair or woollen stuff, and subjected to a press till it becomes hard and brittle, and till no more oil can be obtained from it. It is then broken to pieces, and thrown into a vessel with boiling water, when it melts, and the impurities, which rise to the surface or sink to the bottom, are skimmed off and separated by straining. The spermaceti, after becoming solid on cooling, is again thrown into a boiler with water, to which a weak lye of potash has been added to free it from the remainder of the oil. This process is repeated several times if necessary, after which the spermaceti is poured into coolers, where it concretes into a hard white mass, which, when broken, exhibits the beautiful flaky, crystalline appearance seen in the shops.

576. *Pure spermaceti* has very little taste or smell. It is of an almost silvery white, friable, semi-transparent, and unctuous. It is softer and more brilliant than white wax, and it is distinguished from every other species of concrete oil by its superior transparency, high lustre, and crystalline texture. It melts at 112°, and at a higher temperature it evaporates with little alteration. By the assistance of a wick it burns with a clear white flame, superior to that of tallow, and without any disagreeable odour. By long exposure to the air it acquires a yellow tinge, and becomes rancid; but it may again be purified by being washed in a warm lye of potash. It is extensively employed, with wax and olive oil, in making ointment for medical purposes. It possesses, also, the property of softening the skin, and hence it is used by ladies for pastes, washes, &c.; but its chief use at present is in making candles. Some have sold for spermaceti a preparation of oil taken from the tail of the whale instead of that from the head; but this kind soon turns yellow. A small quantity of spermaceti, indeed, is found in all the whale tribe, and is distributed all over their bodies, as also in their fat. The fat of all fishes contains a small quantity of it.

Sect. IV.—tallow.

577. *Tallow is a variety of animal fat melted down and clarified.* There are scarcely any animals but a sort of tallow may be obtained from them. Those which yield the most are the bullock and sheep; but tallow may also be prepared from the horse, hog, goat, deer, and bear. It is employed for a variety of purposes, as for making soap and dressing leather, but chiefly for candles; and large quantities are annually imported from Russia. The fat of animals is usually collected between the skin and muscles, in the interstices between the muscles and between the viscera. It is composed of cellular membrane, enclosing an oily matter of various degrees of consistence, according to the part. Thus, suet, lard, marrow, &c., are varieties of this substance, which is very analogous in its chemical properties to the vegetable fixed oils; but the suet, being the firmest kind, is chosen for making tallow.

578. *Tallow-chandlers melt tallow* by chopping the fat, as it is taken from oxen and sheep, and then boiling it for some time in a large copper, to separate the tallow from the cellular membrane; when the former is chiefly extracted by this means, the remainder is subjected to the operation of a strong iron press, and the cake that is left, after the tallow is expressed from it, is called "*greave:*" with this dogs are fed, and, it is said, many of the ducks and pigs that supply the London markets.

579. *The tallow for mould candles* should be made of half bullocks' and half mutton suet, the former giving firmness, consistence, and gloss. When of the best quality, tallow is white, firm, and brittle: it is then nearly without taste, but has always more or less of an oppressive odour. To be pure, there should be no admixture of oil or grease of any kind, and it is to this species of adulteration that the bad quality of candles is chiefly owing. It is very important that too great a proportion of mutton suet should not be used; for this possesses a peculiar principle called *hirsine*, which has a disagreeable odour that distinguishes it from the fat of other quadrupeds, and which occasions it sometimes to give a disagreeable smell, particularly in hot weather. Hogs' fat causes candles to gutter, smell, and smoke; and the ordinary dipped candles are very often adulterated with kitchen stuff. Tallow is sometimes melted in a vessel heated by a naked fire, which is very liable to injure it; it is much better to employ a vessel surrounded by steam: a little alum is put in with the tallow to harden it.

580. *Foreign tallow has often a yellow tinge, and frequently contains a considerable portion of sebacic acid:* it is generally inferior to the English; but Mr. Parkes informs us, in his Essays, that the former may be purified at a trifling expense by chemical means; and by the proper application of chemical agents brown tallow may be rendered beautifully white, and fit for the best purposes. If tallow is bad, a part soon becomes converted into acid by exposure to the air; and this renders the whole, when melted together, unfit for the making of candles.

581. *The method recommended for separating the sebacic acid from the tallow* is that of melting it in water containing some alkali. But old tallows may, in general, be sufficiently purified from their rancidity by melting them upon lime-water, and giving a considerable agitation to the whole mixture: when the water is again suffered to sub-

side, it will be found to be offensive in smell, and to have subtracted most of the impurities of the tallow. Should it, however, be found not to be sufficiently purified, a repetition of this process will be found effectual.

582. *The late discovery respecting tallow, by which it is shown to consist of two substances, stearin and elain,* will be described in Chapter III., Book IV., under "Composition Candles."

Sect. V.—oil.

Subsect. 1.—*General Observations on Oil.*

583. Of all the substances employed for procuring artificial light, oil is the most extensively used. This substance, in its purest state, *when analyzed by the chemist,* is found to consist of carbon, hydrogen, and a small proportion of oxygen; and its distinctive characters are, that it has always unctuosity, is insoluble in water, not uniting with it by itself.

584. *Oils are divided into two great classes:* fat or fixed oils, and volatile or essential oils.

585. *Fixed oils* are so called because they do not boil or become volatilized, and do not inflame until they are heated to 600°. When they are heated nearly to this point they begin to decompose, and give out a vapour which is very inflammable, and which constitutes carbonated hydrogen or oil gas. The oil does not ignite, indeed, until it is brought into a state of vapour; and on this account, as we have before stated, wicks are necessary, by enabling a small quantity to be successively exposed to a high temperature: it then burns or ignites in atmospheric air, a large quantity of light and heat being given out by its combustion. That this should be complete, free access of air is essential; for if the supply of air be imperfect it burns with a black smoke, which arises from a portion of carbon vapour escaping without being burned, as explained already. It is the fixed oils that are usually employed in procuring artificial light.

586. *Volatile or essential oils* are seldom used for this purpose; they are converted into vapour at a low degree of heat, and their great volatility renders them unsuitable for the ordinary purposes of illumination.

587. *Fluid oil is procured* both from animal and vegetable substances. When obtained from animals in the solid state it is called *fat* and *tallow,* which have been already described; fish oil is generally fluid.

Fixed vegetable oil occurs in plants, associated with mucilage, sometimes in the fruits, as in nuts; occasionally in the pulp surrounding the seeds, as in the olive; but most frequently in the seeds themselves, as linseed, rape-seed, &c. Some vegetable fixed oils, which are fluid in tropical climates, are solid in the usual temperature of this country, such as cocoanut oil; and it may here be observed, that the state of solidity or fluidity of all oleaginous substances depends merely upon the temperature to which they are exposed. All of them assume the solid state at a certain temperature peculiar to them; an oil that is always fluid in India may be generally solid in our climate. Several of the solid vegetable oils have received the name of vegetable tallow or butter. The degree of cold at which oils congeal or become solid varies extremely.

Of all the families of plants the cruciform is the richest in oleiferous seeds; and next to them are the Drupaceæ and Amentaceæ. Nuts contain half their weight of oil. The seeds of the Brassica oleracea and campestris one third; and the variety called colza in France two fifths.

588. We shall treat first of *animal oils* used for light; and afterward of *vegetable oils.*

Subsect. 2.—*Fish Oils.*

589. *The oils most extensively used in Britain for procuring light are the fish oils.* Oil is obtained from several species of fish, and these vary somewhat in their qualities.

590. *The best of these is spermaceti oil,* usually advertised as *sperm oil.* This is, as we stated when describing spermaceti, the oil which drains from the crude spermaceti found in the head of the spermaceti whale, and also from the fat or blubber.

When analyzed it is found to consist of carbon 78·00, hydrogen 11·80, oxygen 10·20. It affords a clear, bright flame, without smell, and it is, on that account, generally burned in Argand lamps in the best apartments in Britain; but several of the finer kinds of whale and seal oil, when purified by forcing them through animal charcoal, are often sold for it. The spermaceti whale does not confine itself to the polar regions, but is found in all latitudes, and abundantly in the equatorial regions, on the coast of Brazil, the Gulf of Guinea, the coasts of Australia, and Van Dieman's Land, and in great numbers on that of Japan. The sperm whale is gregarious, herds of four or five hundred sometimes congregating together; and the taking of them is accompanied with great danger. In 1836, 6083 tons of sperm oil were imported into London. The price having greatly increased of late, the consumption of it is much less, cheaper fish oils being employed, and likewise vegetable oils.

591. *Greenland oil,* or *common train oil,* is the produce of the whale called *Balæna Mysticetus.* The fat or blubber of this animal lies under the skin and over the muscular flesh; it is usually about six inches in thickness, but about the under lip it is two

or three feet thick. The whole quantity yielded by one of these animals ordinarily amounts to forty or fifty, and sometimes to eighty or more hundred weight. Its use in the animal appears to be partly that of poising the body of that enormous creature, and partly to keep its flesh warm in the cold regions which it frequents. Formerly, the boiling down the blubber into train oil was performed where the whales were caught; but of late it has become the practice to pack it up in casks after it is cut off, and to bring it home to extract the oil. In young whales, this fatty matter resembles hog's lard; but in old animals it is of a reddish colour. When the blubber arrives in England, it is generally somewhat rancid, and to separate the oil, it is put into a large reservoir that will hold about twenty tons, in the bottom of which there is a wire grating to suffer the oil to drain through and stop the blubber. The membranous matter that remains is called *finks*, and is burned into animal charcoal. The oil that is run out is led into another vessel, where it is left for two or three days to settle; and after that it is put into a copper and heated to 225°. This causes the mucilaginous matter to settle to the bottom, and destroys the rancidity of the oil. To prevent the adhesion of the mucilage to the bottom of the boiler, some water is poured on the top of the oil when it has cooled by drawing off the fire: the water passes down through the oil to the bottom, and, uniting to the mucilage, prevents its adhesion. The purified oil at the top is then run off into casks for use.

This oil is of a reddish or yellowish colour: when burned in common lamps, it gives out a strong, unpleasant odour, particularly if unpurified, and therefore is seldom employed within doors, but confined to street lamps and other out-door purposes. Burned in an Argand lamp, the oil gives no bad smell, but a quantity of oily matter collects upon the wick, which clogs up the passage for air, and impedes the combustion. By purification, indeed, it may be rendered more limpid, and its odour less offensive; but it is always inferior to spermaceti oil. By recent improvements in lamps, which will be described, it is burned without any bad smell, and without clogging the wicks.

592. *The whale fishery* is of great antiquity; and the Norwegians are supposed to have been the first who attempted the perilous enterprise of killing the whale. The Biscayans engaged in a regular whale fishery in the 12th century; but the whales then caught were of a small size, and were employed as food: whalebone appears to have been then used for the first time. Greenland whales now seldom frequent the Bay of Biscay, confining themselves to the icy seas, where their haunts are eagerly sought for. When the whale fishery was first prosecuted on the coast of Spitzbergen, the whales appeared in great numbers, and, showing no signs of fear, were easily taken; but as the animals began to experience the effects of the stratagems and power of man, they retreated, first to the open sea, and finally under the great banks of ice. Greenland whales are now becoming more scarce, probably on account of the great destruction made of them; and on this account train oil is more difficult to be procured. The polar regions in the southern hemisphere are now resorted to for the whale fishery. The invention of gas light, however, for lighting the streets, has much diminished the demand for whale oil.

593. *There are various other fish oils* used either for giving light, or for various manufacturing purposes.

Iceland whale oil, or fin-fish oil, from the *Balæna nordcaper*, also from the *Balænoptera gibba*. *Sea unicorn oil*, from the *Monodon vulgaris*, finer than any other kind of whale oil. *Porpoise oil*, from the *Delphinus Phocæna*, of a fine quality. *Swordfish oil*, from the *Delphinus gladiator*, of excellent quality. *Sea lion oil*, from the *Phoca leonina*. *Seal oil*, from the *Phoca vitulina*. *Morse oil*, or sea-cow oil, from the *Trichicus rosmarus*. For various manufacturing purposes, there are *shark oil*, from the barking shark; *cod oil*, from the liver of the cod; *herring oil*, obtained by pressing herrings when they are very plentiful; *conger oil*, from the conger eel; *pilchard oil*, by pressing that fish.

594. *Fish oil requires to be purified before it is fit for burning.* At first it is very thick, but, on standing, a whitish mucilaginous matter is deposited, and the oil becomes transparent. It is then of a reddish-brown colour, and has a disagreeable smell.

The modes of purifying it are, in general, kept secret by manufacturers; but the following processes have been practised with some success.

If one or two per cent. of sulphuric acid be added, the mixture assumes instantly a dark green or brown hue, and when allowed to stand quietly for some time, deposites a dark-coloured matter, which consists of a chemical combination of the sulphuric acid with a body thus separated from the oil, which becomes, in consequence, more limpid, and burns with a brighter flame, especially after it is washed with steam, and clarified by repose and filtration. Any remaining moisture may be expelled by the heat of a water bath.

Oil has been purified by agitating it violently with one sixth of spring water, and then letting it rest for 48 hours; the transparent oil will then be found swimming at the top, while all the feculencies will have subsided to the bottom with the water. Rape oil so treated has been found to burn as well as spermaceti. A churn answers the purpose of performing the operation, with a cock to draw off the oil. Some use lime water in preference to that of springs.

Whale oil may also be purified without heat, by filtering several times through charcoal. For this purpose, some employ the long cylindrical bags used by the sugar refiners, which are made of stout canvass and lined with flannel, so as to admit of a thickness of an inch of powdered charcoal, which detains the impurities of the oil. After passing through this filter, the oil is put into a cistern containing water at the bottom to the depth of about six inches, in which blue vitriol is dissolved in the proportion of an ounce to every twenty gallons of water; this divests the oil of any remaining impurities, and likewise of the greater part of its unpleasant smell. It is farther cleaned by a second washing in another cistern of water, where it is allowed to remain for several days, and again it is filtered through charcoal, and lastly through flannel.

A patent has been taken out for clarifying oil by means of heat: the oil is put into a tin kettle, which is fixed within another somewhat larger, and having water in the manner of a glue pot; or steam may be introduced between the two: a close case is fitted on, and openings are made for supplying water and oil, and also for placing a safety valve. By keeping the oil some time in a moderate heat, a portion of the mucilage and other useless ingredients rise to the surface as scum, and another coagulates and sinks to the bottom, the oil remaining pure. One advantage which this method has over that by exposure to the air and sun is, that it can be practised at all times and states of weather.

Dossie's process for purifying fish oil is as follows: Add one ounce of pulverized chalk and half an ounce of slacked lime to a gallon of crude fetid fish oil, then stir in carefully half a pint of water. The stirring is to be repeated after an hour has elapsed, and at other convenient intervals, for two or three successive days: then add an ounce of pearl ashes, dissolved in four ounces of water, and continue the stirring at intervals, for some hours. Next add a solution of two ounces of salt in one pint of water, and agitate the mixture occasionally during the next two days. Now the whole ought to stand still for several days, when the brine will separate from the oil, which will be greatly improved both in smell and colour. Should a greater degree of purity be required, the proportion of pearl ashes ought to be increased, and the period intervening between the addition of the salt water prolonged: lastly, if the same operation be repeated, and the quantity of ingredients reduced one half each time, the oil may be brought to a very light colour, and its smell rendered equally sweet as the common spermaceti. By this treatment, it is said, the coarsest cod or seal oil may be made to burn well.

The following process for purifying fish oil is given in "Brewster's Journal:" Dissolve about one pound of chloride of lime in about one gallon of water, draw off the clear solution, and mix it thoroughly with about one hundred weight of the putrid oil; then add about three ounces of sulphuric acid, previously diluted with sixteen or twenty parts of water, and boil with a gentle heat till the oil begins to drop clear from a spatula. After the ebullition is finished, draw off the oil into a cooler, and allow it to remain at rest for a few days. The quantity of chloride of lime must be varied according to the putridity of the oil. By this the oil will be deprived of its disagreeable odour.

595. *Oil for the purpose of artificial light should be kept from exposure to the air.* Fat oils may be preserved fresh for a long time in vessels perfectly closed; but if exposed to the air, they thicken, and at last become rancid, by the formation of a peculiar acid called the sebacic acid, in which state they are less combustible, and give an offensive smell. This may be removed in a great degree, and the rancidity destroyed, by boiling the oil with a little water and a little magnesia for a quarter of an hour, to neutralize the acid. The boiling must be continued till the oil will no longer redden litmus paper.

[The following method of purifying whale oil may be regarded as a discovery peculiarly American, and is now very generally practised by manufacturers in this country:

First, it is subjected to filtration through a strainer made of linen cánvass, and suspended by a frame over a large trough, by which process what are called "foots," technically, are removed. It is then put into kettles containing from 1 to 300 gallons, and subjected to the process of *bleaching*, by the following recipe, for which the editor is indebted to William A. Swaine, Esq., of the firm of Brooks and Swaine, Front-street, New-York, and is now generally adopted, though once kept profoundly secret, and made a source of emolument to the initiated.

Preparation of the Potash for bleaching Oil.

Take 100 lbs. of the best potash, known as *first sorts*, and dissolve in 15 gallons of pure spring or rain water, which must be boiled down until the quantity is reduced to 9 gallons.

Into a boiler holding 100 gallons of either whale or sperm oil, at the temperature of 60° F., pour 2 gallons of the liquor prepared by the fore-mentioned process, and let the whole be thoroughly stirred for 15 minutes. Then apply heat until the whole is raised to 80 or 90° F.: meanwhile, the gradual stirring of the mass is indispensable, to pre vent any settling, which would defeat the process. So soon as the temperature is at 90°, the fire beneath the boiler should be removed or extinguished, and the stirring be discontinued. In about six hours the whole will be found white and transparent.

In the large manufactories steam is employed for regulating the temperature, which is found to be every way preferable.

Spermaceti oil thus treated is found to be rendered more highly inflammable than in the crude state, besides being thus rendered pure, transparent, and of a beautiful colour.

For the following interesting details in relation to *lard oil,* which is deservedly becoming an object of great attention and interest in the United States at present, the editor is indebted to "Improvements in Agriculture, Arts, &c., of the United States, by Hon. Henry L. Ellsworth, U. S. Commissioner of Patents."]

LARD OIL, ETC.

The subject of the manufacture of OIL from CORN and LARD was introduced to the notice of the public in the report of 1842. As corn oil has heretofore been connected with distillation, although it is easily made and answers a good purpose, less attention has been devoted to it. It has been suggested, on good authority, that it can be gathered from the mash which is prepared for fermentation for feeding swine. If this should be confirmed by farther experiments, as it would not be liable to the same objection urged against the former, the manufacture of spirituous liquors, it may hereafter be carried on to a great extent. No doubt seems to be entertained of its value for burning, and all other purposes to which oil is applied but painting.

Much interest has been felt in the subject of oil from lard, and the almost daily inquiries respecting its process of manufacture, &c., and its close connexion with the question of disposing of our agricultural products, forms a reason for giving it a more extended consideration in these remarks. Complete success has attended the enterprise. Several large factories for the manufacture of this oil have been some time in operation in Cincinnati, and thousands of gallons are daily prepared for home consumption and exportation. It is also carried on at Cleveland, Ohio; Chicago, Illinois; Burlington, Iowa; Hannibal, Missouri; and other places both in the Western and the Atlantic States.

It is considered much superior to olive or sperm oil for machinery, and for the manufacture of woollens, &c. It can be furnished, also, at half the price, and therefore it will doubtless supersede that article of import. As it contains less gelatin than other oils, it is found much better for combing wool, for which purpose a single factory wished to contract for 10,000 gallons from one establishment. It is also undergoing trial in England; and if it succeeds, of which there can scarcely be a doubt, large orders for it may be expected, or, at least, the American lard itself, which pays a less duty, will find a ready market. An order for 600 gallons, with this view, has already been received for the use of a cloth factory in Huddersfield, England. It has also been stated in the journals that a gentleman is about taking out a large quantity, recently ordered from the West, for the purpose of trying it there as an article of trade; and it has lately been stated that 16,000 lbs. have been sent from Cincinnati to England. Repeated experiments, too, have shown that for the purpose of combustion no oil is superior. It is important, in trying it with this view, to obtain a good article, manufactured from good lard, and not from the dark-burned, which creates smoke and clogs the flame. For want of sufficient care in this respect, some have no doubt met with disappointment in their attempts to substitute this oil for sperm oil in the lamps.

The following are given as the relative constituents of lard oil and sperm oil, in 100 parts of either:

	Carbon.	Hydrogen.	Oxygen.
Lard oil	79.03	11.422	9.548
Sperm oil	79.05	11.6	8.9

It will thus be seen that the difference in carbon is only 3.00; about the same in hydrogen; while in oxygen it is about 4.10 in favour of the lard oil. The large quantity of carbon proves that it may be relied on as a material for giving light, as it is well ascertained that whenever carbon predominates in an animal oil, the article is capable of a high degree of luminous power. Experiments have been made by Mr. Campbell Morfit, of Philadelphia, which may be found mentioned on page 155. These resulted in favour of lard oil. About 60 lbs. in 100 of good lard, in tallow only 28 is oil; and the processes of manufacture resorted to show that it may be made a profitable business. Large orders have already been executed at the West for this oil, to be used in the Eastern States. The heat of lard oil for the blow-pipe has been found to be much greater than that of sperm. Lard itself melts at 82° of Fahrenheit; its specific gravity at 60° is 0.938. Lard crystallizes in small globules; sperm in flakes or scales. It is soluble in boiling alcohol. The proportion is 80 gallons of lard to 1 of alcohol. The application of stearin for candles, which was also alluded to in the report of 1842, promises greatly to reduce the price of that article, as will be seen by Mr. Morfit's letter, already alluded to, on page 155. He thinks that the price of such candles, equal to spermaceti, may be eventually reduced to 12½ cents per pound.

As the capillary attraction of lard oil is not so great as that of sperm, it is recommended that the form of the lamp should be such as to bring the bulk of the oil as near to the point of combustion as possible.

It is also recommended that the tube should be filed thinner at the top where the wick is inserted, to prevent the escape of heat. Various lamps have been constructed for burning lard, as well as lard oil, which have been found to answer very well. The solar astral lamp, for this purpose, affords a light unsurpassed by any other for brilliancy and quality of luminous power; and the letter of Mr. Milford, collector of Cleveland, Ohio, which will be found on page 160, shows that the burning of this oil has been introduced with entire success into the lighthouses on Lake Erie. An objection has been made against lard oil, that it is not capable of being preserved in a liquid state in cold weather; but, by a process similar to that by which the winter sperm is prepared, lard oil can be made which will not chill at 30° Fahrenheit.

The importance of this application of lard can scarcely yet be realized. Vast quantities of the oil can be manufactured at the West. Indeed, there is hardly any assignable limit to the power of production of the article, so that, while the demand continues, the business may be conducted profitably. The immense herds of swine which can be suffered to range over the lands adapted to them, and gather their food from mast, as well as the surplus of corn, wheat, potatoes, &c., on which they may be sustained, admit of the manufacture being carried on to almost any extent.

The proportion of lard to the whole hog is about 60 per cent., after taking out the hams and shoulders, or taking out the hams only; the estimate for hogs of the best breeds, and so fed as to produce the greatest quantity of fat, is 70 per cent. As the object is not, in this case, to make pork for food, the objection against those species of nuts, and other modes of feeding which render the animal more gross and oily, is obviated; and it has been proposed to feed out oil-cake to swine, to increase the proportion of oil.

An important letter, in relation to the manufacture of lard oil, &c., will be found, together with Mr. Morfit's account, before mentioned, on pages 155 and 160, the necessity of the publication of which is every day becoming more and more apparent from the continual demand on the Patent Office for copies of the mode of extracting the oil from lard. The specification of one manufacturer, who has patented his process, has also been added for the same reason, as numerous copies are continually requested (p. 161).

By a new process of steaming (a very simple method, a description of which will be found in the letter of Mr. Stafford, on page 160), it appears that the whole of the lard or oily matter in the hog, or of tallow in cattle, may be obtained; while the danger of burning (common in other modes) is avoided, the consumption of fuel lessened, and the degree of pressure required not so great as otherwise. It will be recollected that, while conducting the manufacture of lard, the other parts of the animal, as the hams and shoulders, may be turned to profit. Besides these, also, the hides may be tanned by a cheap process; and the bones, which are worth half a cent per pound, may be calcined and made into animal carbon, for which they are said to be worth, in this calcined state, two and a half cents per pound.

Oil is likewise made of the SUNFLOWER—35 gallons to the acre. The cultivation of the *castor bean* continues to be carried on with increasing success for the manufacture of castor oil, which may also be turned into stearin and oil for burning. A single firm in St. Louis has worked up 18,500 bushels of beans in four months, producing 17,750 gallons of oil, and it is stated that 800 barrels have been sold at $50 the barrel. This oil, likewise, admits of being prepared for machinery, soap, &c., and it is much more soluble in alcohol than lard. A new experiment, too, as to the introduction of *rape seed*, for the same purpose, promises much success, as it is found that rich ground will produce from 25 to 40 bushels to the acre. Ten quarts of oil may be obtained from a bushel of the seed. Oil-cake is worth, per bushel, about the same as oats. This oil sells for from 75 cents to $1 the gallon.

A more beautiful article of lard is now also manufactured, which is of the purest white, and much harder than the ordinary kind, and which thus possesses additional advantages for exportation, as it will bear being sent to the warmer climates, and can be prepared by a rapid process, which costs not over half a cent the pound. The details of this will be found in Mr. Stafford's letter, previously referred to, page 160.

These various articles just mentioned have been brought together, as they are of a kindred character, and constitute a branch of business which is probably destined to become a most important one in our country. It may be well, indeed, to look at this subject a little more closely, and in detail, to ascertain the means we have of future production, as this lard is one of the articles on which the duty in England and France is so low as to bear exportation. In the first place, What are the materials of manufacture at home? The live animals can be raised at little comparative expense; and this business, as we have before said, can be carried on to almost any extent.

Few persons who have not taken the trouble of calculation are aware of the results of an examination into this subject. It would be thought strange, were the assertion made that the export of oil, pork, and lard, were a market opened to us, might be equal to that of our heaviest staples—even to that of cotton; but it is believed that it can be strictly demonstrated that not only this is true, but that it might reach in value beyond all the exports from this country the past year. The calculation is an easy one: pork can be raised in all the states; and wherever there exists mast and wild vegetable roots, the expense is very trifling; for it will be remarked that, for the purpose of making oil, it is immaterial how great is the degree of oleaginous food which is given to swine. Beech, oak, hickory, and walnut, all furnish excellent food. Corn, too, may be raised on the prairies at $3 per acre, standing in the field, where the swine are turned in to feed; making the cost six cents per bushel, allowing (which is a fair estimate) 50 bushels to the acre. If any one doubt the practicability of this, it will only be necessary to consider the fact, that one man can attend to 40 acres, which, beginning early in the season, he can plough with horses at the rate of two acres per day, plant with the corn-planter from five to ten acres a day, and then till it with the cultivator. At $3 per acre, the supposition before mentioned, this would make his receipt for the three and a half or four months employed, $120, or $30 to $35 a month, for wages, expenses, &c. As a farther means of keeping the swine, rye may be sown on the ploughed sod to furnish winter food; and, by taking them off in the spring, a crop of rye may be raised, making a good sustenance for the swine, they being turned in to feed upon it standing after it is ripe. It has likewise been found that, since the animals scatter some of the grain on the field, the same piece of ground will yield two or three seasons without any extra ploughing. It may also be remarked, in passing, that rye pastures are found to be excellent for wintering cattle without injury to the crop of grain, if the stock is taken off early in the spring.

Such, then, are the facilities for raising swine. We can, however, carry the calculation farther. The number of swine reported in the census for 1839 is over 26,300,000. There is reason to believe that the number has very greatly increased in many of the Western States since that time. Thus, it is stated that in Michigan, in 1837, when the state census was taken, the number of hogs reported was 109,096; in 1839, by the United States census, was reported the number of 342,920, being an increase, in only two years, of 232,535, or more than 100,000 in a year. It is supposed, by a writer who appears to be well acquainted with the products of that state, that in 1841 there were not less than 700,000 swine in the state; according to which ratio, there would probably be now over 1,000,000. The whole number in the United States, therefore, estimated simply at an increase of five per cent. the year, would now exceed 30,000,000. Taking this, therefore, as a fair estimate, and allowing that one half of them should be fatted to average 300 lbs.—and for the purpose of lard they would need to weigh 300 or 400 lbs.—we should have the following results, viz., 15,000,000 hogs, weighing 4,500,000,000 lbs. Deducting the two hams, which might be estimated at 20 lbs. each, allowing, also, a loss of one third in curing, is equal to 400,000,000 lbs.; and trying up the remainder, equal to 39,000,000 lbs., on which 60 per cent. of lard might be obtained, gives 2,340,000,000 lbs. of lard; and, since 8 lbs. of lard equal a gallon of oil and stearin combined, this amounts to 292,500,000 gallons, which is equal to 9,285,714 barrels. This is more than twenty-five times the amount of sperm and whale oil annually brought into the United States, including, also, palm and olive oils. Allowing 40 lbs. for the two hams, as we have seen, gives 400,000,000 lbs. Estimating, now, the lard oil and stearin combined at 50 cents per gallon, and the hams at 6 cents per lb., we have the enormous sum-total of $170,250,000. This would probably equal over three times the export value of cotton at the present low price, or perhaps even the whole crop for this year (1843); as the whole crop for 1842, according to the best estimate which a careful examination enables us to make, amounts to 683,333,231 lbs., which, at 6½ cents per lb., is $44,416,650. This, too, is nearly double the whole value of our exports, as appears from the report of the Secretary of the Treasury.

It is, indeed, admitted that we have not, and probably may not for a long time, if ever, have so large a quantity of lard and hams for exportation; but the supposition is only made to show the capabilities of the country in this respect. There is not the slightest difficulty, were the effort made, in doubling the number of swine in the United States, so that the whole surplus above the present number could be thus used for the manufacture of lard and oil. Besides, the articles mentioned in the case supposed above do not require salt, and may be preserved with great ease, as well as allow the animals to be killed earlier, so as to secure a full market; and the former is a consideration of no small importance, especially in portions of the country where salt is high. It will be found more profitable at present, at the price of lard and oil abroad, to use the whole hog for this purpose, the hams and sides excepted. It should be mentioned, too, here, that in the above calculation no account has been taken of a variety of articles which are worth something, and which might aid to defray the expense of the preparation of the lard and hams. Thus, as to the hides, they may be taken off with the hair, at about the same expense as by scalding, and may be tanned at $5 per dozen, or preserved by sprinkling the fresh hides, spread out smooth, with salt, laying one over another, flesh sides together, until there are fifty or sixty together. They can then remain in this state until cured, and may be rolled up and transported to any market. The leather of these hides, when tanned, is used not only for saddles, collars, trunks, but also for binding books—a substitute for Russia leather—and many other purposes. The bristles will pay, in part, for preparing the hides for the market. Hides, when well curried, will bring, it is said, from $15 to $50 per dozen. Hams, too, are said to be better when cured without skins, as the gum of the skin injures the taste of the meat, and retards the salting operation.

It may be remarked here, also, that a demand for oil and candles from lard will, of course, greatly advance the price of pork for consumption, and thus, while a new staple is created, an old one is greatly improved. An increase of only one per cent. per pound on swine slaughtered in the United States will make an aggregate in value of at least $30,000,000. This sum would not, indeed, be actually realized in cash, as little pork, comparatively, is now sent to market, but is consumed by the family where it is raised. *That country which produces beef and pork to most advantage, and especially if wheat is also added, must excel in agricultural profits.*

FOREIGN MARKET.

In looking at the details just given, evidently proving the immense resources our country possesses in these products, as they may properly be termed, of her soil, the question naturally arises, Is there any demand for them abroad? It can be shown, it is believed, that this demand is greater than has been supposed, and that it seems likely to increase. A part of the bearings of this subject will be brought up in connexion with another portion of these remarks; but it may be well here to observe, that from New-Orleans the export of lard for the years 1841 and 1842 to foreign ports was 172,260 kegs, while that to the ports of the United States was over 260,000 kegs.

To Cuba, whose exports to the United States have much exceeded her imports from this country, as appears from the report of the commercial relations of the United States by the Secretary of State, there were shipped, during the year 1838, 5,884,028 lbs., valued at $368,146, at a duty of four cents per lb. The desire to obtain lard from abroad has induced England to admit it into her ports at less than half a cent per lb. duty when taken in American vessels, or, when taken through the Canadas, at less than one eighth of one cent per lb. The duty in France is a little more than two cents per lb., to her colonies not more than one half a cent per lb.; when sent to the Netherlands and Belgium, one mill per lb.; in Texas it is free; in Venezuela, four cents per lb. Large quantities of the olive oil, for which lard can be substituted, are used for making soap. In Marseilles, it is stated, on good authority, that not less than 17,000 lbs. are thus used daily.

Kensington, Philadelphia, January 8, 1843.

Sir—In answer to your inquiries upon the subject of converting lard into oil, and also into concrete forms for the manufacture of candles, I hasten to say that, having been, and still continuing very much engaged in chemical processes upon lard, I am not able, in the short time I can devote to the subject of your letter, to give you the ample information which is desirable, and which, if more at leisure, I could readily furnish. I, however, write off, *currente calamo*, the result of some of my experiments in this branch of inquiry, which perhaps may be serviceable. The article of lard offered for sale in the market for domestic use, and now about to be so much in demand as material for the manufacture of lard oil and candles, is prepared from the adipose matter of the omentum and mesentery of the hog, by freeing it with the hand from the membranous substance connected with it, washing with water until colourless, and melting with moderate heat, continued until the dissipation of all moisture, which fact is known by the transparency of the melted matter, and the absence of *crepitacula*, when small portions are thrown on burning coals.

The chief source of this article is the West, from whence it is brought in kegs of from 40 to 80 pounds each; when fine, it is perfectly white in appearance, and rather inodorous, nearly tasteless, and, at moderate temperature, of a soft consistence, insoluble in water, and but partially so in alcohol. When exposed to the air, it becomes rancid by the absorption of oxygen; this rancidity, engendering a liability to injurious reaction, renders it unfit, in that state, to be used in pharmacy as an ingredient of cerates and ointments, of which it forms the principal part. For this purpose, therefore, it should be kept in close vessels, free from contact of air.

Lard, as well as nearly all other fixed oils and fats, is composed of three proximate principles: two solid, called stearin (from στέαρ, tallow) and margarin (from μαργάριτης, a pearl); and one liquid, of which there are two varieties, called olein (from ελαιον, oil).

Stearin characterizes, for the most part, animal fats. Margarin, vegetable and olein is almost universally present in both. The two fats are essentially different from each other. Margarin is distinguished by its greater fusibility, its being more soluble in cold ethers, and the necessity of evaporation to procure it from such solution, while the stearin drops spontaneously during refrigeration.

Berzelius thinks these principles not identical in different oils, as their points of congelation and liquefaction vary according to the substance from which they are derived. Pelouze and Boudet, however, attribute the variable fusibility of the margarin and stearin of fats to the existence of definite combinations of margarin and stearin, respectively, with olein, and think that each of these principles, in a state of purity, is probably the same, from whatever source obtained; and to prove which, they assert having found the same margarin in palm oil as in human fat. But in oils, and particularly the vegetable, their investigations evinced the presence of two oleins, distinctive in their characters: one more soluble in different menstrua than the other, and with a less proportion of hydrogen, besides other properties inherent in the one not possessed by the other, more than the mention of which would occupy too much space and time.

The ultimate principles of fixed oils are carbon, hydrogen, and oxygen, the hydrogen being in much larger proportions than is necessary to form water. To this predominance of hydrogen is attributed the readiness with which they burn with flame, that property procuring for them all their usefulness as means of illumination or artificial light.

Stearin, the first named of the constituents of oil and fatty matters, is a concrete white substance, insipid and without smell, fusible at 110° Fahrenheit, insoluble in water, and but partially so in alcohol.

Margarin, present in lard and most other fats, and forming by far the greater portion of olive oil, is more fusible than stearin, and, as its name indicates, of a pearly appearance, possessing, also, other properties different from stearin, mention of which has been made above. Olein, the oily principle formerly called elain, when pure, is quite colourless, and in some degree has the appearance of vegetable oil, liquid at 60° and congealing at 32° Fahrenheit, and, though not becoming rancid by exposure, acquires viscidity. The relative proportions of all these three principles are different in different fats.

Nearly all kinds of fat, under proper circumstances, are capable of combination with alkali, by which union the principles thereof are changed. By this reaction, they undergo *saponification*, and are transmuted, not by the absorption of any foreign substance, but by the union of the elements of a small portion of water into three peculiar acids, *stearic*, *margaric*, and *oleic*, which unite with the salifiable base and into a peculiar sweet principle, glycerin (from γλυκυς, sweet), which, in remaining behind, is not saponified. Of this sweet principle, there are formed about three during the saponification of every one hundred parts of lard or tallow.

Hog's lard, in its natural state, Chevreul says, has not the property of combining with alkalies, but acquires it by experiencing some change in the proportion of its elements. This change being induced by the action of the alkali, it follows that the bodies of the new formation must have a decided affinity for that species of body which has determined it. These acids, generated during saponification by the action of the alkali, called adipose or saponic acids, are, when *solid*, in appearance like wax or spermaceti; when *liquid*, they appear as their oils, mostly fusible at temperatures below 212° Fahrenheit.

The oleic, being generally mixed with that portion of margaric which is liquid at the time and temperature of its preparation, is used sometimes as lamp oil, but mostly for the manufacture of soaps; while the remaining small portion of margaric, being of a consistence sufficient to retain it with the stearic, is allowed to remain with that body, which, when used for candles, experiences no great disadvantage by its presence. Stearic, the most important, and by far the most characteristic product of the saponification of lard, tallow, and other not easily fusible fats, is the one of which, at your request, I am to speak in detail; an article the use of which for making candles bids fair to be in this country most extensive. The consequence which this branch of manufacture is about to assume is no greater than its merits should obtain for it. Independent of all other advantages, the great reduction which it will occasion in the price of an article of such general and necessary use in domestic economy is alone sufficient to procure the attention which the subject does and will receive. Inferior in no degree to sperm, both as regards quality and appearance, the stearin candles have the advantage of greater cheapness, as they can be made, even by the English mode, hereafter given, at a cost of at least 20 per cent. less than sperm. The increasing importance of this subject induced my attention to it some eight or ten months previous, since which period my whole time has been devoted to its examination. The result of my investigation is a process entirely different from all others, to be executed with so much facility, and with so little cost of time, money, and labour, that I expect to make by it candles, in appearance and quality, as perfect and good, if not better, than sperm, and which, when *retailed*, even at as low a price as 18¾ cents per pound, will afford a remunerating profit to the manufacturers, and a profitable commission to the vender. I mention this price in consideration of the present rates of lard, the supply of which, owing to the unexpected requisition for this purpose, is at present totally inadequate. When, however, this is removed by the increased supply which the producers will see it is their interest to furnish, the price of the material will be in a few years much lower: this, and the improvements which by that time I shall have made in my mode, will, I expect, enable me to manufacture candles at a price so reduced as to entitle them, when these superior properties are considered, to the substitution for the much-used but unpleasant mould and dipped candles.

I would willingly communicate fully the manner of conducting the process, but, having been at a great expense of time, money, and anxiety, I have determined to remunerate myself by carrying it into practice; and, for this purpose, I am now arranging apartments in my laboratory, and hope, by the coming spring, to have for sale, in quantities, candles as good, or better, than the sample I sent you some weeks since.

I have spoken of lard, because this article will, without doubt, be the material from which to make these candles, both on account of the facility with which it can be produced in quantities, its comparative cheapness, and the profit on its oil, yielded in a preparatory stage of the process for manufacturing the stearic acid, of the substance of which the candles are made. This oil, now largely in use, under the name of lard oil, is nearly pure oleic, its only admixture being small portions of margaric and stearin, with which it becomes connected during preparation.

Its great superiority over sperm oil has caused it to be extensively substituted for that article, for lubricating the joints of machinery, and for manufacturing purposes generally. As a burning fluid, it has proved itself equally good; and in corroboration of this is my experiment with lamps of eight ounces' capacity, previously cleaned and new wicked for the purpose. This experiment was frequently repeated, with the same results. In one lamp was pure sperm; in the other lard oil, of only a fair quality, burned under the same circumstances. The consumption of oil in both was equal; the quantity of light equal; the flame was different, that of the lard oil being of a reddish hue, and not so transparent as sperm. The lamps were of glass, and such as are ordinarily used for burning common oils. There is an erroneous idea abroad that it requires lamps of a peculiar construction to consume this oil. It is not so, for I use in the laboratory lamps of the commonest make. If, however, the notion will be persisted in, instead of purchasing an expensive burner, all that is necessary is to have substituted, by any coppersmith, for your tin tubes in the lamps you may have those of copper, filed off quite thin at the top, where the wick projects through, so as to prevent the passing off of too much heat; then the lamp will answer to burn lard as well as oil. The price of lard oil being at all times about 25 cents less per gallan than fair sperm, and being equally good, preference should therefore be given to it, both because of its economy, and of being a domestic production. It may be as well to mention that there are lard oils of various qualities; that prepared from dark-burned lard is not so good for *burning*, because of its causing, after several hours' burning, a crust on the wick; and, as there has been a quantity of this kind of lard in market, and bought for manufacturing the oil, it is not surprising that there should be a slight prejudice against it as a burning fluid. This prejudice, however, is always removed by the use of that made from pure white lard.

It may be as well to say here some few words in relation to the burning of the lard. To further the consumption of this article, there has been introduced, by persons having at heart their own more than the interest of the community, an expensive lamp, which they advertise as being peculiarly adapted for this purpose. The substitute of lard for *its* oil possesses no advantage, either as regards price or convenience; the use of the latter being so economical, and much more cleanly, besides its not requiring additional expense for a peculiar kind of lamp. The liability of these burners to smoke, and other disadvantages, will, upon trial, convince any one of their inconvenience; and if any other fact or corroboration is requisite, it is only necessary to say that, notwithstanding the grand display of the article in full flame at the last exhibition of the Franklin Institute, and the ample opportunity thereby afforded to judge of their deserts, so destitute were they of merit, as not to have elicited even a passing notice or mention from the committee. If, however, lard is preferred to its oil, why go to the unnecessary expense of a new lamp, when any one you may have will answer fully as well, with the tubes altered as above directed? Farther still, in proof of my assertions about the false economy of burning lard in preference to the lard oil (the lard oil, as my experiment before mentioned proves, being equal to sperm), I here insert the result of Harris & Co.'s experiments, cut from a Boston paper last week:

To the Public.

As much has been said, of late, respecting lamps, oil, and lard, the subscribers have caused a very accurate experiment to be made, whereby the economy of oils and lard, producing light in the solar and carcel lamps, might be tested. These two descriptions of lamps were selected for the purpose, as they may be fairly deemed superior to all others in points of economy and safety. Wishing to satisfy all interested in the subject, and who may not have the conveniences necessary for the test, we shall give particulars of the experiment made November 10, 1842.

The solar lamps, of the same size and construction, and one French carcel lamp, were used.

Time of burning, four hours.

No. 1 denotes a solar lamp filled with whale oil.
No. 2 " solar " " " sperm oil.
No. 3 " carcel " " " sperm oil.
No. 4 " solar " " " hog's lard.
Weight of whale oil, 124 ounces per gallon, quality indifferent.
Weight of sperm oil, 120 ounces per gallon, quality good.

Lard of best quality, fresh and sweet.

Nos.	Length of Shadow.	Square Inch.	Quantity burned.	Cost per Gallon.	Cost of Quantity burned.	Equal to
No. 1 . . .	37.2 inch.	1383.84	8.5 oz.	50 cts.	3.42 cts.	3 42.100 cts.
No. 2 . . .	38.3 "	1466.89	9.5 "	80 "	6.33 "	6 33.100 "
No. 3 . . .	32.6 "	1062.76	8.25 "	80 "	5.50 "	5 50.100 "
No. 4 . . .	33.2 "	922.40	9.25 "	8 "	4.62 "	4 62.100 "
	27.25 "					

Each lamp was made to give as much light as possible at the commencement of the experiment, and the strength of shadows then measured. Nos. 1, 2, and 3 maintained the same degree of light during the whole time of burning. The light from No. 4 had perceptibly decreased in two hours, and, at the close of the experiment, had receded upward of 16 per cent. Consequently, the mean quantity of light given during the four hours is taken in estimating their relative powers.

No. 1 (whale oil), compared with No. 4 (lard), gave 105 per cent. more light in proportion to its cost.

No. 1 (whale oil), compared with No. 3 (sperm oil), gave 111½ per cent. more light in proportion to its cost.

No. 1 (whale oil), compared with No. 2 (sperm oil), gave 75 per cent. more light in proportion to its cost.

The following table shows the expense of burning each of the above lamps one hour, omitting fractions of mills, and stating the comparative quantities of light in whole numbers:

No. 1, 8 mills; light equal to 13.
No. 2, 15 " " 14.
No. 3, 13 " " 10.
No. 4, 11 " " 9.

The results stated in round numbers, showing the cost of each burning a given time, estimating the amount of light and cost of materials, are as follows:

Whale oil, in solar lamp, Argand burner, 100.
Sperm oil, " " " 175.
Hog's lard, " " " 205.
Sperm oil, in carcel, " " 211.

Much care was taken in weight and measure of the materials, and the judgment of several persons accustomed to such experiments was taken in adjusting the shadows, and the calculations we believe to be correct. This any one can verify, as the elements are all stated above.

We feel justified in recommending *the use of the best winter-bleached whale oil in the solar Argand lamp,* whereby the best artificial light now in use will be produced.

Harris, Stanwood, & Co.

29 Tremont Row, Boston, December, 1842.

The mode now adopted for the preparation of this oil is that of graining the lard in a suitable and well-known manner, by which process the separation of the olein from the stearin is rendered more easy. This separation is effected by pressing the grained matter, enclosed in canvass bags, by means of a powerful press of proper construction. In this way, all the olein or lard oil is driven out, together with a small portion of margarin and stearin, not, however, in sufficient quantity to injure the oil. What remains in the bags (the stuff of which, after proper preparation, the candles are made) is the white constituent of the lard—stearin, with small portions of margarin and olein, remaining with it—the removal of which (the press not being able to effect) must, in order to procure good candle material, be produced in some other way. To effect this, I have (as before stated), after much trouble and patient investigation, discovered an economical mode, and which (as I intend carrying it into practice immediately) I shall not make known, but will substitute therefor that practised in England, and which is found to answer admirably, the product thereof having so handsome an appearance, and being of so good a quality, as to cause it difficult to distinguish it from the most refined wax. This fact of their handsome appearance is confirmed by the following paragraph, cut from a paper some days since:

"ACCIDENTAL POISONING.—It is well known that a salve, for the cure of chaps and wounds, is often made of virgin wax and oil; and some families, who live at a distance from an apothecary, make this medicine, at the moment it is wanted, by taking a wax candle and melting it into oil. In employing this remedy, made of a candle, a person is said to have been recently poisoned in France. The reason of it is this: candles are now no longer made of wax, but of suet, from which oil has been extracted to grease wools. This suet, in order to form candles, is combined with a great quantity of arsenic. It is, therefore, not astonishing that arsenic, which penetrates even by friction, can have a poisonous effect when applied to the raw flesh."

The advantage which my mode possesses over this is its greater economy, both in cost and time, of preparation, while the product is equally good as that by the English, which is as follows: Tallow lard, or the solid part of lard, after the separation of its oil or any fat, is boiled with quicklime and water in a large vat, by means of perforated steam pipes distributed over its bottom. After several hours' active boiling, the combination becomes sufficiently complete. The stearate thus formed is allowed to cool, until it becomes a concrete mass. It is then to be dug out, transferred to a suitable vessel, and decomposed by a sufficient quantity of sulphuric acid. This decomposition of the soap, says the patentee, should be made in a large quantity of water, kept well stirred during the operation, and warmed by steam introduced in any convenient way. When the mixture has stood sufficiently long, the acid of the fat or tallow will rise to the surface, and the water, being drawn off, will carry the *alkaline* or saline matter with it; but if the acids or tallow should retain any portion of the salts, repeated portions of fresh water must be added to it, and the whole well agitated, until the acids have become entirely freed from alkaline matter.

The washed mixture of the three acids—stearic, margaric, and oleic—is next drawn off into tin or other suitable pans, and allowed to cool, and then reduced to thin shreds by a tallow-cutter—an instrument used by tallow-chandlers. The next step is to incase the crushed mass in canvass or caya bags, and then submit it to the action of a powerful hydraulic or the stearic cold process—a machine made for the purpose. By this means a large quantity of the oleic acid is expelled, carrying with it some little of the margaric. The cakes, after considerable pressure, are then taken out, and again subjected to the action of steam and water; after which, the supernatant stearic acid is run off into pans, and cooled. The cakes are then reduced to a coarse mealy powder by a rotary rasping machine, put into strong canvass bags, and submitted to the joint action of steam and pressure, in a hydraulic press of appropriate construction, called Maudlay's stearin cold press.

By these means, the stearic acid is entirely freed from oleic acid. It is then subjected to a final cleansing in a tub with steam, melted, and cooled in clean vessels. These cooled masses, owing to their crystalline texture, are unfit to be made into candles. It is therefore necessary, in some way, to remedy this. The French do so by crushing the masses, and pressing with them small portions of arsenious acid. This, however, is an injurious and reprehensible admixture, not only on account of the liability of such accidents mentioned in a previous paragraph, but because of the volatility of the arsenious acid, causing the atmosphere, in a room where these candles have been burned, after a short time, to be not only disagreeable, but deleterious to inhale.

This assumption of crystalline form I prevent without the use of this poisonous substance, merely by a proper and peculiar arrangement in the concluding part of the process. The wick to be used in the manufacture of these improved candles is to be made of cotton yarn, twisted rather hard, and laid in the same manner as wire is sometimes coiled round the bass strings of musical instruments. For this purpose, straight rods or wires are to be procured, of suitable lengths and diameters, according to the intended size of the candle about to be made; and these wires, having been covered with cotton, coiled around them as described, are to be inserted in the candle-moulds as common wicks are; and, when the candle is made and perfectly hard, the wire is to be withdrawn, leaving a hollow cylindrical aperture entirely through the middle of the candle.

I have now given you what information my leisure has allowed to prepare. I could extend my remarks, but have not now the time.

With the hope that this summary will answer your purpose, I remain yours respectfully,

CAMPBELL MORFIT, *Manufacturing Analytic Chemist.*

Washington, January 18, 1843.

SIR—In answer to your commun cation of yesterday, I beg leave to say that, in obedience to instructions received from the general superintendent of lighthouses on the akes, I procured, in the month of November last, a sample of lard oil manufactured in Cleveland, which was used in the lighthouse at Cleveland as an experiment. It had a fair trial, being placed in the centre lamp; the others were filled with sperm oil. The lard oil was found to give as brilliant a light, and burn equally well with the sperm. During the night, the lamps containing the sperm oil were trimmed twice; the one containing the lard oil was not trimmed. On examining the lights in the morning, at the time for extinguishing the same, the lamp containing the lard oil was found burning equal to those containing the sperm oil.

I have no hesitation in saying that I believe winter-pressed lard oil will burn equal to winter sperm oil.

I have the honour to be, very respectfully, your obedient servant,

WILLIAM MILFORD, *Collector of the Customs, Cleveland, Ohio.*

Hon. H. L. ELLSWORTH, *Commissioner of Patents.*

Cleveland, December 29, 1842.

DEAR SIR—Yours of the 21st is just received. In answer to your first query, viz., How much lard will a hog make weighing 300 lbs., very fat, after taking out the hams and shoulders?

I would state that there is a great difference in hogs as to their frame and the kind of food they have been fatted upon. The average Ohio hogs (common breeds) will produce, when tried by steam, 50 per centum lard, after deducting the hams and shoulders. The plan now generally adopted is, not to take out the shoulders; the sale for them is limited, and price low; the covering of fat will produce more in lard than the expense of curing would warrant. The mixture of the China and Berkshires, fed upon potatoes or any other vegetable containing starch as a principal food, would produce, when very fat, at least 70 per centum, after taking out *only* the hams.

The steam apparatus is merely a tub with a false bottom, perforated with holes, lying about two inches above the bottom. The steam is introduced between the two bottoms, and so entirely separates the fat from the cells in which it is enclosed, that no pressing of scraps is necessary. The bones, lean, and scraps are left on the false bottom, and the lard floats on the surface. With steam, at a pressure of 5 lbs. to the inch, it will require from 18 to 20 hours to try off a tubful of any given quantity, steam in proportion, of course; 60 lbs. pressure would do it in one third the time. The great advantage of steam is, the whole of the lard or tallow is produced, and there is no danger of burning either.

The quality of the lard is good, but not equal to leaf lard or suet; the carcass fat does not contain as much of the concrete principle (stearin). Whole hog lard cannot be refined and made hard without a portion of the oil is extracted. I take from 20 to 40 per centum of the oil; then the balance goes through several washings in pure *rain water* by steam, after which it is refined lard. The expense is not more than one quarter of a cent per pound, but it is of more value to us than common lard, as we have a great deal of trouble and expense with it; and in only extracting a portion of the oil, we would lose by it, did it not command a better price in the market, which it should from its purity.

I cannot give you any information about the quantity of tallow from beeves, as none have been slaughtered in this section for tallow; they (beeves) must also vary very much in the amount produced, depending upon their feed, &c. The bones are worth at least half a cent per pound to calcine. From them ivory black is made (worth 2½ cents per pound), by charring them in close iron vessels.

I used to decompose the lard in acid and neutral salts. When the affinity between the parts is destroyed, I separate them by means of canvass bags placed in powerful screw presses. If I wish to make candles of the residue, the pressure is continued until all the oil, by this means, is forced out. The contents of the bags are then subjected to the action of a powerful hydraulic press, and the stearin pressed to dryness.

To produce the winter oil, we have to expose the decomposed lard to the cold, in the same manner that the crude sperm oil is exposed to produce the winter-strained oil. Upon analysis, it is found that lard oil contains 79 2.10 carbon, and pure sperm oil 79 5.10, making three tenths of one per centum difference; the other equivalent of hydrogen and oxygen are the same, excepting the difference of the three tenths. For all uses (except painting) lard oil has no equal. It burns with a strong white light, and is entirely free from either smoke or smell. It does not contain any gelatin, which makes it a preferable article for all kinds of machinery; for wool it answers better than the olive oil, which it has superseded entirely. The oil of tallow is also well adapted for machinery; for burning it is not preferable to other oil, on account of its odour. Tallow only contains about 28 per centum of oil, whereas lard contains, on the average, 62. The stearin of both lard and tallow makes a better and harder candle than sperm, and the same amount in weight produces a great deal more light.

Since you were here, the works of this company have been increased, and are now running 2000 pounds per day. Lard is coming in freely; we are paying five cents cash per pound. The oil sells readily at seventy-five cents by the cask, and one dollar at retail per gallon, in competition with some oil from Cincinnati, which is offered at $33\frac{1}{3}$ per centum lower.

My process is so entirely different, and the ingredients I use are so effective, that I find no difficulty in purifying the oil and lard after it is manufactured, and in producing a superior article to any other. Yours respectfully,

J. R. STAFFORD, *Agent Cleveland Lard Oil and Candle Co.*

Hon. H. L. ELLSWORTH.

Mode of manufacturing Elain and Stearin from Lard, &c., patented by John H. Smith, No. 122 Front-street, New-York City.

To all whom it may concern.—Be it known that I, John H. Smith, of the city of Brooklyn, in the county of Kings, and State of New-York, have invented a new and useful improvement in the manner of separating from each other the elain and stearin which are contained in lard; by means of which improved process the operation is much facilitated, and the products are obtained in a high degree of purity; and I do hereby declare that the following is a full and exact description thereof:

The first process to be performed upon the lard is that of boiling, which may be effected either by direct application of fire to the kettle, or by means of steam; when the latter is employed, I cause a steam tube to descend from a steam boiler into the vessel containing the lard; this tube may descend to the bottom of the vessel, and be coiled round on said bottom, so as to present a large heating surface to the lard, provision being made for carrying off the water and waste steam, in a manner well known; but I usually perforate this tube with numerous small holes along the whole of that portion of it which is submersed below the lard, thus allowing the whole of the steam to pass into and through the lard. To operate with advantage, the vessel in which the boiling is effected should be of considerable capacity, holding say from ten to a hundred barrels. The length of time required for boiling will vary much, according to the quality of the lard; that which is fresh may not require to be boiled for more than four or five hours, while that which has been long kept may require twelve hours; it is of great importance to the perfecting of the separation of the stearin and elain, that the boiling should be continued for a considerable period, as above indicated.

My most important improvement in the within-described process consists in the employment of alcohol, which I mix with the lard in the kettle or boiler at the commencement of the operation. When the lard has become sufficiently fluid, I gradually pour, and stir into it, about one gallon of alcohol to every eighty gallons of lard, taking care to incorporate the two as intimately as possible; and this has the effect of causing a very perfect separation of the stearin and elain from each other by the spontaneous granulation of the former, which takes place when the boiled lard is allowed to cool in a state of rest.

I sometimes combine camphor with the alcohol, dissolving about one fourth of a pound in each gallon of alcohol, which not only gives an agreeable odour to the products, but appears to co-operate with the alcohol to effect the object in view; the camphor, however, is not an essential ingredient, and may be omitted. Spirit of lower proof than alcohol may be used, but not with equal benefit.

After the boiling of the lard, with the alcohol, has been continued for a sufficient length of time, the fire is withdrawn, or the supply of steam cut off, and the mass is allowed to cool sufficiently to admit of its being laded, or drawn off, into hogsheads, or other suitable coolers, where it is to be left at perfect rest until it has cooled down, and acquired the ordinary temperature of the atmosphere; as the cooling proceeds, the granulation consequent upon the separation of the stearin and elain will take place and become perfect. The material is then to be put into bags, and pressed moderately, under a press of any suitable kind, which will cause the elain to flow out in a great state of purity, there not being contained within it any appreciable portion of the stearin; this pressure is to be continued until the stearin is as dry as it can be made in this way.

The masses of the solid material thus obtained are to be remelted, and in this state to be poured into boxes or pans, of a capacity of ten or twelve gallons, and allowed to form lumps, which I denominate blocks; these, when removed from the vessels, are piled or stacked up for a week or ten days, more or less; the room containing it should be at a temperature of nearly eighty, which will cause a sweating or oozing from the blocks, and they will improve in quality; the blocks are then to be rolled in clothes or put into bags, and these placed between plates and submitted to very heavy pressure by means of a hydraulic press. After this pressure it is brought again into the form of blocks, and these are to be cut up by means of revolving or other knives or cutters. The pieces thus obtained are to be put into bags, and subjected to the action of hot water or steam, in a press, until it becomes hard enough to be manufactured into candles, or put up for other purposes to which it may be desired to apply it.

The manner of subjecting it to the action of heated water or of steam, is to place the bags containing the stearin in a box or chest, into which heated water or steam may be introduced, but not to such extent as to fuse the stearin. A follower is then to be forced against the bags contained in the box or chest, and moderate pressure made upon them; the material will now be found to have acquired all the required hardness, and to possess a wax-like consistence, such as would generally cause it to be mistaken for wax.

I am aware that alcohol has been used for the purpose of separating elain and stearin from each other in analytical chemistry; but the lard, or other fatty matter consisting of these substances, has, in this case, been dissolved in the heated alcohol, and the whole has been suffered to cool together; this process would be altogether inapplicable to manufacturing purposes, as the cost would exceed the value of the product. In my manufacturing process, instead of dissolving the lard in alcohol, I add a small proportionate quantity of the latter to the former, the whole of which is driven off at an early period of the ebullition, but by its presence, or catalytically, disposes the elain or stearin to separate from each other, which they do after long boiling and subsequent cooling. I do not, therefore, claim the use of alcohol in separating elain and stearin from each other, by dissolving the fatty matter in heated alcohol, and by subsequently cooling the solution; but what I do claim as my invention, and wish to secure by letters patent, is the within-described method of promoting their separation, or by incorporating alcohol, or highly-rectified spirits, with the lard in small proportionate quantities, say one gallon, more or less, of such alcohol or spirit, to eighty gallons of lard, and then boiling the mixture for several hours, by which boiling the whole of the alcohol will be driven off, but will have left the elain and stearin with a disposition to separate from each other, on subsequent cooling, as herein described and made known.

John H. Smith.

Witness, { T. H. Patterson,
H. S. Fitch.]

Subsect. 3.—*Vegetable Oils used for Light.*

596. On the Continent lamps are chiefly supplied with these; and since sperm oil has become so dear with us, they are much employed here. Some of these are cheaper than the fish oils, but require the consumption of a greater quantity to give the same light.

597. *Olive oil* is too costly in Britain to be generally used in lamps; but in France and Italy, where it is much cheaper, it is extensively employed in this way. It burns with a beautiful white light equal to wax, is not apt to clog the wick, and gives no offensive smell in burning. (See a more particular description of olive oil in Book VII., "On Food," Sect. 10, Chapter VII.)

598. *Rape oil* is made from the seeds of *Brassica napus*, Linn., chiefly in Flanders. The oil is expressed by a mill constructed on purpose. It has a yellow colour, and a peculiar smell. It is much used on the Continent.

599. *The oil of tobacco seeds and of belladonna seeds* are perfectly mild, and are burned in lamps in Germany, though the oil cakes of both are poisonous.

600. *Oil of plum stones* is used at Wirtemberg for lamps.

601. *Colza oil.* In France and the Netherlands they extract from the seeds of a species of cabbage, *Brassica arvensis oliefera*, an oil called *colza*, which they use in lamps, or for the fabrication of soft soap. The seed is beaten out like grain, and the oil is procured by pressure; but to prepare it for burning it is purified, or deprived of its mucilage and colouring matter. To effect this, two parts of concentrated sulphuric acid are mixed with 100 parts of oil, and well stirred until the acid combines with the mucilage and colouring matter, which are gradually precipitated in flakes of a blackish-green colour; after which, in order to separate the acid, a quantity of water equal to double that of the oil is added; the whole is agitated, and left to settle for ten days, at the end of which time the oil which is upon the water is decanted into tubs, in the bottom of which are holes filled with cotton, through which the oil filters in a purified state. The same method of purification is applicable to all oils expressed from seeds. The oil of colza is of a pale yellow colour, has very little odour, and an agreeable, sweetish taste. It is analogous to rape oil, but superior.

602. *Cocoanut oil.* This oil is extracted from the fruit of the *Cocos nucifera*. When it was first imported into this country from America, it was of very limited utility, since it was not sufficiently fluid in our climate to burn in lamps, except in those of a particular construction. A piece of metal which was heated by the flame communicated with oil, and thus kept it fluid; but this was an inelegant contrivance, and the oil did not come much into use. The lamp used for burning is described in Section 14, Chapter IV. Lately, the discoveries of Chevreuil and Bracconot have been applied to this substance; and it has been separated into its stearin and elain, the former being employed in the manufacture of candles, while the elain is used for other purposes. (See "Cocoanut Candles.")

603. *Palm oil.* This is a vegetable oil which is solid in the usual temperature of this

climate, and is now extensively imported from Africa, and employed in the manufacture of candles and soap. The stately palm-tree from which it is obtained, the *Cocos butyracea*, grows abundantly on the coast of Africa and Brazil. The fruit consists of a thick-shelled stone of a dark colour, covered by a succulent pulp, and it grows in clusters at the base of the leaves. It affords two kinds of oil; one of which is yellow, obtained from the pulp by expression; the other, a white oil, procured in a similar manner from the kernel within the stone. It is the yellow oil which has been chiefly brought here. It is had in immense quantities in Guinea and Sierra Leone. In its natural state in that climate it is always fluid, and the negroes use it to eat with their rice, or to fry fish in; and it seems to be as important to them as butter to us, or as olive oil in Italy. It melts at 84°. The white oil is in smaller quantity, and is always solid, even in Africa. The negroes employ it to oil their skins with, and it preserves them nice and soft; while, at the same time, it prevents too great an excretion of perspirable matter. The kernel of the fruit is of an agreeable flavour when eaten.

Stearin is likewise procured from this palm oil for candles by the following process: The thick oil, called "butter of palm," is kept for two hours, with the addition of a little water, in a Papin's digester, having the valve loaded with the pressure of two or three atmospheres. After this process it is subjected to a hydraulic press, which forces out the elain or fluid oil, leaving the stearin behind. Both products are then bleached to deprive them of their yellow colour. Stearin is likewise procured from the oil that is extracted from the kernels.

In the account of a late voyage up the River Niger in Africa, we are informed that palm oil is produced in immense quantities by the negroes about the town of Eboa, and is collected in small gourds, from which it is emptied into puncheons; and that it may be purchased there for about four shillings per ton. In 1808, the import did not exceed one or two hundred tons per annum: it is now nearly 14,000 tons, having been trebled in the last eight years. The increase in the quantity of palm oil procured by the negroes for exportation proves their industrious dispositions.

604. *Vegetable wax.* A species of wax exists ready formed in many vegetables. The varnish on the leaves of some trees consists of it, as also that on the skins of plums and other fruits. It is found likewise in the juices of many trees, which yield it so abundantly that wax is thus collected and employed for making candles.

605. *Myrtle-berry wax* is a vegetable substance, intermediate between wax and fixed oil, which becomes concrete at the ordinary temperature of this climate, and is used for making candles in Louisiana, and other parts of North America. It is the produce of the *Myrica cerifera*, known familiarly by the name of the *candle-berry myrtle.* The tree grows to the height of from four to twelve or eighteen feet, being tallest in the warmer regions: it has a considerable resemblance to the common myrtle. The seeds, which are of the size of a pepper-corn, grow in large bunches, and are coated with wax that approaches to the nature of bees' wax, though a distinct substance. The fruit ripens in November or December; and being stripped from the branches, it is thrown into large iron pots containing water, which is boiled as long as any waxy matter continues to rise. The melted wax, or vegetable tallow, is then skimmed off, and is remelted and clarified. Its appearance, when cold, is much like that of bees' wax; but its colour is a dirty green. When formed into candles, it is generally mixed with about one fourth of its weight of tallow. It gives a clear and steady light, nearly equal to wax candles: it never gutters, and, while it is burning, produces an extremely pleasant balsamic odour. This substance is prepared for commerce along the Canadian lakes. One of the best of these shrubs will yield near seven pounds of berries; and four pounds of these will produce one pound of wax. The candles are dearer than tallow, but cheaper than wax. They can be bleached quite white by chlorine, and an agreeable soap is also made from the wax.

606. *The Piney*, or *tallow-tree of India and China* (*Croton sebiferum*), has supplied for ages the inhabitants of these countries with a material for candles. The tree much resembles the pear-tree; and it is the fruit that affords a combustible substance, which partakes of the nature of wax and of oil, and, from its appearance, may not be inaptly termed a tallow. The method of preparing this material is simply to boil the fruit in water, when the tallow is soon found to rise to the surface in a melted state, and on cooling forms a solid cake. Thus obtained, the piney tallow (piney is the native name of the tree that produces it) is generally white, sometimes yellow, greasy to the touch, with some degree of waxiness, almost tasteless, and has a rather agreeable odour. It melts at a temperature of 97½°, and, consequently, remains solid in the climate of India, in which respect it differs from palm or cocoanut oil. Wrapped up in folds of blotting paper, and submitted to strong pressure, scarcely any oil or elain is expressed to imbue the inmost fold. Its tenacity and solidity are such, that when cast in a rounded form of nine pounds' weight, the force of two strong men was not sufficient to cut it asunder with a fine iron wire; and even with a saw, there was considerable difficulty in effecting a division. When manufactured into candles, it comes with facility from the moulds, thus differing from wax, which does not readily admit of being cast. It gives as bright

a light as tallow, and has an advantage over that material in being free from unpleasant smell, and in not emitting a disagreeable odour when extinguished. It unites in all proportions with wax, spermaceti, and with tallow, and forms compounds with the two former, intermediate in their melting points.

It may be imported into this country at less than one fourth the price of wax; and, although it does not possess all the advantages of that substance, it is considerably superior to animal tallow. It is in use only in the town of Mangalore (province of Canara), and is there employed medicinally as an external application for bruises and rheumatic pains; and likewise, when melted with the resin of the same tree, it is used as a substitute for tar in paying the bottoms of boats.

607. *A light green vegetable wax* is common on the Malabar coast, which is easily blanched, and gives a beautiful light; and it is thought it might be imported with advantage.

608. *A mineral wax*, called *ozocerite*, found at the foot of the Carpathian mountains, is stated to be used in Moldavia for making candles; but it is inferior to bees' wax, and is of a brown colour, but may be bleached.

609. *The turpentine of fir-trees* is used for burning in lamps in countries where it is plentiful, and where the people are unacquainted with the manufacture of candles, as is the case in the Landes in the south of France; but it gives a great deal of smoke.

610. *The essential oil of turpentine* gives, also, too much smoke and smell to be used in lamps by itself, and is likewise too inflammable and volatile; but *a mixture of turpentine and alcohol* gives a dense and brilliant light, although alcohol by itself yields a feeble flame. This mixture has likewise been used for lamps under teakettles and tea urns, with incombustible wicks of asbestos, or fine wire, or cotton; it is cheaper than spirit of wine alone, and gives no stains; but it is not altogether free from smell.

611. *Large splinters of resinous wood* are used in many countries, and have been used, no doubt, from the earliest periods, among the lower classes, instead of candles. This is frequently done in Ireland, where, in the bogs, large quantities of pine are found deeply buried, and which have lain there for many ages: when dug up, these are rended like laths, and dried, when they burn readily, giving a good deal of flame and light, and are used in their dwellings by multitudes of the peasantry, particularly in the province of Ulster. Similar slips of resinous wood are used also in North America, and in the Highlands of Scotland.

SECT. VI.—BITUMINOUS SUBSTANCES USED FOR LIGHT.

612. *Bitumen is a very inflammable substance*, and is extensively employed in some countries for procuring light by burning it in lamps. It is a natural substance found in two states, *petroleum* and *naphtha*. These issue from the earth in springs, and are collected in wells. *Petroleum* is blackish brown, about the consistence of common tar, and has a strong, disagreeable odour. Naphtha, when pure, is colourless, and thin as water, but having the same bituminous odour as petroleum. It is more rare than petroleum; and the latter is supposed to proceed from the naphtha having imbibed oxygen from the air. Pure naphtha consists of only hydrogen and carbon, without any oxygen; but the latter element is one of the constituents of petroleum. *Naphtha* is highly volatile and inflammable; it may be procured from petroleum by distillation, and appears to have the same relation to it as the essential oil of turpentine has to the crude turpentine as it comes from the tree. Both these fluids are found in vast abundance in Persia and the Birman Empire, where they are the only substances burned in lamps for light. They are likewise met with in some parts of Italy, and are employed for this purpose in the city of Genoa, Modena, &c. The wells of petroleum in the Birman Empire are said to yield 400,000 hogsheads annually. Naphtha affords a bright white flame, but the bituminous odour is unpleasant.

613. *Lately a liquid has been procured by distillation from coal tar, having most of the properties of naphtha*, and which is, indeed, nearly identical with that substance: it is employed as the solvent of caoutchouc, and it is likewise used for burning in a peculiar lamp; but it has a disagreeable, bituminous odour. This coal naphtha must not be confounded with the true naphtha mentioned above.

Another substance is frequently sold under the name of naphtha, which is procured by the distillation of wood, in the process of making acetic acid or wood vinegar, and is known to chemists by the name of *pyroligneous ether*, and sometimes by that of *pyroxilic spirit*. It is highly inflammable, more volatile than spirits of wine, and burns very well in a spirit lamp: being cheaper than spirits of wine, it is sometimes used instead of it for lamps; but what is advertised as naphtha, at 7*s*. 6*d*. a gallon, is said to be a mixture of this with oil of turpentine. It affords a flame clear and brilliant, and has the advantage of not giving any smoke, nor causing greasy stains by dropping.

CHAPTER III.

CANDLES.

614. Candles, from their portability and other qualities, supply, upon the whole, the most convenient and the most general mode of obtaining artificial light for domestic purposes. Until lately, two substances only, wax and tallow, were known as materials for candles; spermaceti was next introduced, and, at present, various substances, as stearin, &c., are added.

Sect. I.—wax candles.

615. *The making of wax candles is seldom attempted in domestic economy in this country. There are three methods of making them:* 1. By hand; 2. by the ladle; and, 3. by drawing.

616. *In the first method,* the wax is first softened and worked well by hand in a kettle of warm water; it is then taken out in pieces, and gradually, bit by bit, disposed round a cotton wick slightly twisted, which is hung upon a hook in the wall, beginning at the bottom, and proceeding to the upper part. To prevent the wax from adhering to the hands, they are rubbed over with olive oil or lard. When the candles have acquired a sufficient size, they are made perfectly round and smooth by rolling them upon a table of hard wood, with a board made of box, that is kept constantly moistened with hot water, to prevent the adhesion of the wax. This method is employed in domestic establishments in warm climates, where people often make their own candles.

617. *In making wax candles by the ladle,* the wicks are suspended from a short rod, or a circle of iron over a tinned copper vessel, containing melted wax; a large ladleful of this is poured gently and repeatedly on the tops of the wicks, till the candles have acquired a proper size: they are then rounded and smoothed by rolling on a table as before mentioned.

618. *The third method, by drawing,* is usually employed when candles are manufactured upon a great scale. The wicks, in great lengths, are made to go through a vessel of wax kept melted, and as they come out of the wax, they pass through holes in a plate of metal in the way that wire is drawn, only instead of passing them through holes each one smaller than the other, they are passed through holes successively larger, the candles increasing in size by being drawn again and again through the melted wax. These long cylinders are afterward cut into the proper length for candles.

619. *In France* the wax candle is termed *bougie,* to distinguish it from the tallow candle, called *chandelle.* Spermaceti candles are *bougies diaphanes.* The best wax candles are made at Le Mans, and have hence been named *Bougies de Mans.*

620. *Wax tapers* are of two kinds. The first are larger than a candle, and used in church solemnities, funeral processions, &c. The use of lights in religious ceremonies is of long standing. The ancients used them in their sacrifices; and they were introduced into Christian churches probably from the necessity of procuring artificial light where the windows were very small, and before glass came into general use. They are still much employed in Roman Catholic churches. The wicks of tapers are made of half cotton and half flax, and the wax is poured on them by a ladle, repeatedly, until they have acquired sufficient thickness. They are then rolled, while a little soft, upon a smooth table. Small *wax tapers* are drawn in the same manner as wax candles, and afterward made up into coils, for various domestic purposes.

Sect. II.—spermaceti candles.

21. *Spermaceti candles are of modern manufacture.* The nature of the substance has been already described. They nearly resemble those of wax in their qualities: they are smooth, with a fine gloss, almost semi-transparent, and of a silvery white, while those of wax have always a slight tint of yellow. When genuine, drops of spermaceti leave no stain. They are cheaper than the best wax.

Sect. III.—tallow candles.

For the nature of tallow, see Sect. 4, Chap. II.

622. *Tallow candles are of two kinds:* the one dipped, the other moulded. The manufacture of these is very different, excepting what relates to the melting of the tallow, and making the wick, which is nearly the same in both. The wicks are made of spun cotton, loosely twisted, and prepared in large balls. The manufacturer puts three or four or more threads together, according to the intended size of the wick, and cuts them off to the proposed length of the candle.

Subsect. 1.—*Dipped Candles.*

623. *In making dipped candles,* the cotton wick is pulled, made straight and smooth, and

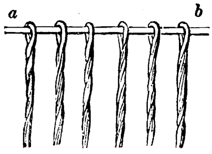


Fig. 99.

freed from all knots and imperfections; then put on the broaches, *a b, fig.* 99, which are rods about half an inch in diameter, and about three feet long. The different kinds of tallow being weighed and mixed in their due proportion, are cut or hacked into pieces, and, to be melted, are thrown into a pot or boiler, having a cavity of some depth running round the top, to prevent the accident of its boiling over, which would be dangerous from its catching fire. Being melted and skimmed, a certain quantity of water is thrown in, proportioned to that of the tallow, for the purpose of precipitating to the bottom the impurities that escaped the skimmer. The tallow, however, intended for the first three dips must have no water, because water imbibed by the dry wick would make the candles spit and crackle in the burning. The tallow, thus prepared, may be used after it has stood three hours. It is then drawn off through a sieve into a vat or cistern, supported upon a stand, having a small fire beneath to keep it melted. The workman next takes two or three broaches with wicks, and immerses them carefully in the tallow, holding them over the vessel to drain, and hangs them on a rack till the tallow gets hard. They are then dipped a second time, hung up again; and the same a third time, repeating the operation till the candles are of the required thickness. During the process, the vat must be supplied with fresh tallow kept at the proper temperature. When the candles are finished, their peaked ends or bottoms are taken off; not with a cutting instrument, but by passing them over a flat brazen plate heated to a proper pitch by a fire underneath, which melts down as much as is requisite. In manufactories where candles are made on a large scale, they have a contrivance by which a great number of broaches are lowered at once into the tallow, and raised again. If the wicks of candles are badly made, and contain loose projecting threads, the candles will be liable to have wasters, will gutter, and the light will be variable and unsteady. Waxing the wicks is sometimes used as an improvement, and the light is thus more equal and steady: it costs a little more; the wick is thus necessarily thinner, and the candles scarcely give so good a light as the common dipped candles, if well made. They are, however, more elegant, and approach nearer to a wax candle.

SUBSECT. 2.—*Mould Candles.*

624. *Mould candles are made thus:* The moulds are cylinders of pewter, having the inside diameter the size of the candles required; and one end, that on which the candle is to be lighted, is contracted into the form of a cone, *c, fig.* 100, having an aperture only large enough to admit the wick. The cotton wick, properly prepared, is then passed into the mould, and a piece of stiff wire is used to assist in getting it through. The wick is doubled, and in the loop there is run a small piece of wood, *d*, which is laid across the open end of the mould. By pulling the wick tight at the conical end, it may be adjusted, so as to be placed exactly in the centre of the mould; and, still holding the wick tight, a peg is driven into the middle of it, at the conical aperture, to secure it in its place, and stop up the bottom of the mould. When the wicks are exactly adjusted, the moulds are placed in the frame *e*, and the melted tallow is poured into them, and allowed to get quite cold and hard: as the tallow gets cold, it shrinks, and leaves a hollow at the top of the mould, which requires filling up with more melted tallow. The pegs at the bottom are now taken out, and the candles are drawn from the moulds. If they do not draw readily, plunge the mould for an instant into hot water, and the candles will come out easily. Some bleach or whiten their candles, by hanging them out in the dew, or earliest rays of the sun, for eight or ten days, care being taken to screen them in the daytime from the heat, and in the night from rain, by waxed cloths. Upon the whole, many persons find it less trouble to make mould than dipped candles.

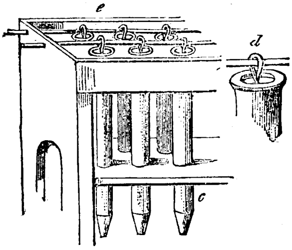


Fig. 100.

625. *Tallow candles, when well made, of good tallow, resist decomposition for a long time,* and will keep for two years. When laid up for store, they should be preserved from the atmosphere; and it is found a good practice to keep them covered up with bran. Light turns them yellow, though it whitens wax. The storeroom should be cool, and free from damp, as this mildews them, and causes them to gutter. They are better for being kept for six or eight months.

Rush-lights are made in the same way as dipped candles, only having the pith of a rush for a wick instead of cotton; they require no snuffing, as the burned wick falls off as the tallow consumes: hence they are used to burn all night in bedchambers. Very small cotton wicks will answer the purpose, and are less liable to go out, owing to the smallness of the wick causing it to bend as in a wax candle.

SECT. IV.—COMPOSITION CANDLES.

626. *Composition candles are a kind lately introduced,* and which originated chiefly in consequence of the researches made about twenty-five years ago by the French chemists, Chevreuil and Bracconot, respecting the nature of tallow and other fatty substances. Tallow was formerly regarded simply as fat, or a uniform and solid oil; but it has been shown (as we have stated already) to consist of two substances: a solid fat, which is called *stearin*, from the Greek word for suet; and a liquid fat, named *elain*, from the Greek word for oil, the former being in the largest proportion.

627. *Stearin is the chief ingredient in* suet, lard, and butter, and is the cause of their solidity; whereas oils contain a much larger proportion of elain, and hence they are fluid. These two principles may be easily separated from each other, and a simple experiment will exhibit the truth of this statement. If fat be exposed to a considerable degree of cold, and then pressed between some folds of unsized paper, the latter will absorb the elain, and the stearin will remain. Having thus collected a quantity, press the paper under water, and the elain will float on the surface as an oil. The stearin, by proper management, from its beautiful colour and consistence, was found to be a very elegant material, and better adapted for making candles than tallow. The elain is admirably suited for oiling the wheels of watches, or other delicate machinery, since it does not thicken or become rancid by exposure to the air, and requires a cold of 20° Fah. to freeze it.

But, notwithstanding the superiority of stearin to tallow for making candles, the expense of separating it by mechanical means alone was found to be too considerable.

628. *In* 1825, *M. Gay Lussac, a French chemist, took out a patent* in England for an improvement in candles from the above principle, combined with the following: When tallow is mixed with an alkali, as potash, soda, or lime, it is saponified, or made to form soaps; and when, by the action of an acid, such as the sulphuric or muriatic, these new combinations are decomposed, the fats reappear in the altered form of stearic, margaric, and oleic acids; the first being harder than tallow, and of a texture resembling spermaceti, the latter being fluid like oil.

By certain chemical management, and the action of a powerful press, Gay Lussac was enabled to separate the oleic acid from the stearic and margaric; and the two latter were found to be an admirable material for candles, which were accordingly made and known by the name of *stearin candles*, the only objection to which was their expense, though less than wax. Another advantage in these candles was, that, by making the cotton wick hollow, the current of air ascending them caused the wick to be consumed without the necessity of snuffing.

629. *To diminish the expense of the stearin candles*, other manufacturers employed lime as an alkali, instead of the potash or soda used by Gay Lussac, by which stearic acid is procured, but not in a state quite so fit for candles. Accordingly, some process to harden it had been employed by them, and candles made of stearin and certain other ingredients, with which the public was not well acquainted, had been in use for several years.

630. *Fortunately, however, of late, a discovery has been made by Mr. Everitt, that arsenic had been employed* in the manufacture of some of the candles known by the name of "composition;" and this subject has been investigated by the Medico-botanical Society. They have proved, by experiments, the highly deleterious nature of the arsenical vapours which are given off by the combustion of such candles, and put the public upon its guard against their use. Considering how generally the poisonous nature of arsenic is known, it seems difficult to imagine how any manufacturer could venture upon such a practice, the danger of which required so little chemical knowledge to perceive, were it not certain that the art of adulteration regards not the destruction of health, nor of life itself. Now that the danger of using arsenic has been so completely and publicly pointed out, it is to be hoped that no manufacturer will be so rash and unprincipled as to employ it in candles.

631. *It has also been stated by Chevreuil and others, that arsenic is not necessary* for the purpose to which it was applied, and that a small quantity of wax, and, some say, of magnesia or chalk, will answer the purpose of hardening the stearin.

632. *Candles of stearin, or, rather, stearic acid, and a small quantity of wax*, are accordingly made in London, and are found to burn nearly, if not quite, equal to wax, though considerably cheaper. They are called in the shops *stearin wax*, and also *ceratin*.

633. *Other composition* candles, some of which appear in their properties to be intermediate between wax and tallow, have received a variety of names by the different makers, all of which are evidently calculated to mislead, as *German wax, pearl wax, imperial wax, Venitian, adamantine, moulded, tropical,* &c. Of the exact composition of these it is impossible to speak with certainty, as it is kept secret by the makers. Their colour is generally an opaque white; but some have an artificial tint of pale yellow, to make them resemble wax candles. They have the advantage of burning without snuffing, and, supposing them to have no deleterious ingredient, they are useful, being about half the price of the best wax.

SECT. V.—COCOANUT CANDLES.

634. In Subsection III. we gave an account of cocoanut oil, which is not fluid enough in our climate to burn in lamps without a particular contrivance; and it is not solid enough to be formed into candles.

635. *Advantage was taken of the discovery of Chevreuil, and a patent was taken out, in* 1829, *by Mr. Soames, for separating the stearin from the oily principle of the cocoanut without saponification*, for the purpose of manufacturing candles. The following is the method employed: the oil is imported of the consistence of lard; is made up into pieces two feet long, three or four inches wide, and an inch and a half thick: these are wrapped up, first in linen and then in sail cloth. These packages are then laid side by side, and subjected to a hydraulic press, in the temperature of about 50° or 55°, but not exceeding 60°. The oil or elain will come through the cloth, and the stearin will remain. This solid portion is now taken out of the bags in the press, and is next to be purified from the other vegetable principles with which it is usually combined, such as fibre, mucilage, &c. For this purpose it is put into a covered boiler, placed in a water bath to prevent burning. There is then added to it two per cent. by weight of sulphuric acid, diluted with six parts of water. When this is boiled, the impurities are coagulated and precipitated; and they are separated by skimming, straining, and filtering, while warm in the fluid state, and by allowing them to settle in the cold state. The substance thus obtained is of firm consistence, and form an excellent material for candles. The candles are made in moulds in the usual way. They burn with a flame nearly equal to that of wax, certainly giving more light than the same sized candles made of tallow; nor is there any disagreeable odour. They are not, however, equal to the stearin wax.

636. *The elain, or liquid cocoanut oil*, which has been pressed through, is purified by mixing with it from one to two per cent. of common sulphuric acid, and agitating it in a vessel like a barrel churn. When drawn off, it has a dirty whitish appearance; but when allowed to rest, a scum rises to the surface, which is removed, as well as a sediment which falls to the bottom, leaving the oil nearly clear, and fit for burning in ordinary lamps, and other purposes.

SECT. VI.—PALMER'S CANDLES.

637. These are altogether a very ingenious invention, not requiring to be snuffed. *The candles are made of tallow. To form them*, to a portion of the strands, about a tenth part of them, is applied a portion of bismuth in a finely divided metallic state, or else the nitrate, or any other similar preparation of bismuth. The portion of the wick thus prepared is surrounded by more strands, till it becomes half the thickness required for the wick, which is the ordinary thickness of a tallow candle. This prepared wick is then cut into lengths twice as great as that of the proposed candle. The wick is next twisted spirally round a thick steel wire, in contrary directions. A notch is made in the lower end of the wire to receive the middle of the wick, and the upper end is bent into a rectangular loop to retain the two ends of the wicks together, and to facilitate its removal, when the making of the candle is completed, which is to be effected either by moulding or dipping, in the usual manner. The consequence of this construction of the wick is, that the two halves curl over to different sides, as is seen at *a*, *fig.* 101, each half pro-

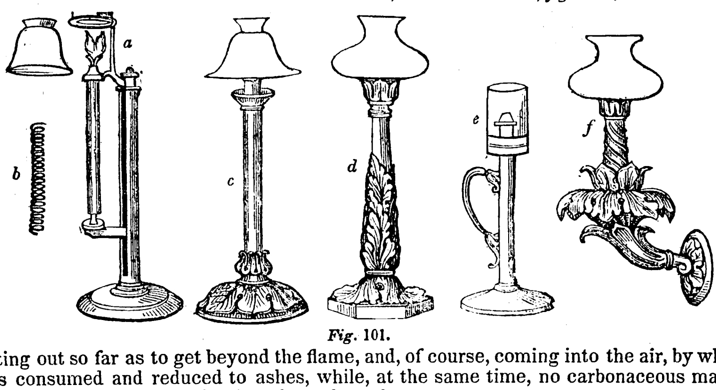


Fig. 101.

jecting out so far as to get beyond the flame, and, of course, coming into the air, by which it is consumed and reduced to ashes, while, at the same time, no carbonaceous matter settles upon it. Snuffing is, therefore, altogether unnecessary.

638. *These candles give a remarkably clear, steady light*, and always of the same brightness. From the wick being double, it gives almost the effect of two flames united, and the air having access to the centre, has the effect of consuming the smoke.

639. *It is to be observed that Palmer's patent* is for the candles just described, but not for the candlestick in which it is used: this is made by various persons. In order

that the flame may always be at the same height, the candle is pressed upward by a spiral spring *b*, in the manner of a coach lamp. In these candlesticks the spring is usually concealed in a brass tube, as at *c* and *d*, and the candle is also put into the same tube, which is the most elegant arrangement: but an inconvenience sometimes attends those; the tallow is apt to run down and clog the spring, and the servants seldom know how to clean it out. In the arrangement as at *a*, the candle being outside, this accident cannot happen; but it is much less elegant.

640. *Some add a cylindrical glass round the flame*, and over that a ground glass shade This prevents the flickering of the flame, which is so troublesome, and conceals the light from the eye. The candlesticks are made of very elegant patterns; *e* is a candlestick of this kind adapted for carrying about; and *f* is a bracket candlestick. They are likewise made with double lights, and for suspending. This invention is, perhaps, on the whole, the most convenient and elegant apparatus we have for giving light in reading, or for lighting a small room.

641. *Mr. Palmer has also made candles of this construction, of a much larger size*, which he calls *magnum candle lamps*, *fig.* 102. These are calculated, in many cases, to supersede the table lamp, as one of them is sufficient to light a moderately-sized room. They save a great deal of trouble in trimming, and have an advantage in point of cleanliness. Of magnum candles some have four wicks, and these are said to last eight hours, giving a light equal to Argand's lamp. There are also shorter candles with three wicks, that give half the light, and last the same time. His common metallic single wicks, *e*, *fig.* 101, are eight to the pound, last eight hours, and give the light of an ordinary mould candle; with double wicks, six to the pound, *a*, *c*, and *d*, the light of two candles, and last five hours and a half. The price is eleven pence per pound. He likewise makes other varieties; and some of these candles are of stearin, which are proper for a warm atmosphere.

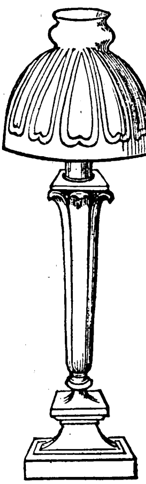


Fig. 102.

642. *The Soho candle lamp*, invented by Crosse and Blackwall, *fig.* 103, is made hollow, and a wick is contrived to move up or down through the candle, so as to make that part of the wick above the surface of the tallow higher or lower, thus increasing or lessening the consumption of tallow, and, consequently, the light. The candle is contained in a hollow stem with a spiral spring, in the same manner as Palmer's, which keeps it always at the same height; and the wick is elevated or depressed by means of a rack and pinion at the bottom, moved by the nut *a*; by bringing the wick down enough, the light can be extinguished. With candles four or two to the pound, it is said that more light is given than by the same weight of candles burned in the common way. The smoke is also destroyed by the form of the glass cylinder put over the flame; by means of the contraction of the glass at the lower part, the air is made to impinge upon the flame, and thus cause the combustion of what would otherwise escape as smoke. Besides this cylinder, there may be a ground glass moon. The Soho candle lamp is an admirable "table lamp."

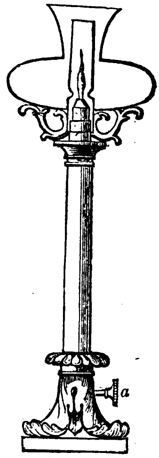


Fig. 103.

Sect. VII.—other varieties of candles.

643. *The Chinese have a kind of candle* about half an inch in diameter, which, in Canton, is called a "lobstock." The wick is of cotton, wrapped round a small stick or branch of the bamboo. The body of the candle is of white tallow; but the external part, to the thickness of one thirtieth of an inch, consists of waxy matter, coloured red. This covering of wax gives a considerable degree of solidity to the candle, and prevents guttering, because it is less fusible than the tallow itself, and therefore a cup is formed, which holds the melted tallow.

644. *Similar candles have been made at Munich*, with wicks of light wood, covered neatly with unspun cotton; these have been found to burn very steadily, and not to run: but they are troublesome to snuff, which must be done with sharp scissors, and they do not appear to possess advantages to counterbalance so great an inconvenience.

645. *Candles with hollow wicks* have been tried, which appear to promise the advantage of giving more light by a supply of air to the centre of the flame, in the same way as in Argand's lamp, but they are little used.

646. *Cobler's candles* are made with double wicks. It was suggested by Dr. Franklin that the flames of two candles, brought almost into contact, gave more light than when both were separate. Upon this principle, double-wicked candles give a great deal of light.

647. *Perfumed candles are made in Paris.* The tallow, purified, is run into buckets of water distilled from aromatic herbs, as lavender, thyme, rosemary, &c. The tallow and water are then beaten together, and, after forty-eight hours, they are separated by means of a water-bath, when the tallow will be found to have imbibed the perfumes. The wicks are first coated with wax and spermaceti, and a small quantity of gum Arabic; wax and alum are incorporated with the tallow before it is poured into the moulds. Effectually to prevent them from greasing the fingers in handling them, they are covered over with a varnish of glover's size, gum, and alum. Candles made in this manner are nearly equal to wax.

648. *Before the duty on candles* was repealed in 1831, tallow chandlers were obliged to take out an annual license; they were likewise subject to a variety of revenue regulations, and private persons were not allowed to make candles, which checked experiments; but at present every one may make his own candles.

649. *The flambeau* differs from the taper in having several wicks, generally four, which are covered with wax. These are first made into small tapers, which, being laid together, more wax is poured round them to unite them together. They are afterward smoothed by rolling.

650. *Torches* are also used for similar purposes, but are lights of an inferior kind. The ancient torch appears to have been formed of wooden slips, or straight branches bound together by rope, the inside being filled with flax, tow, or other fibres, impregnated with pitch, rosin, wax, oil, or other inflammable substances. Some modification of a construction of this kind is still used in different countries.

Sect. VIII. — Management of Candles, and Comparison between those of Wax and Tallow.

651. *To understand this well*, it is necessary to enter rather minutely into the subject of the qualities of the several materials, and some circumstances respecting the combustion of candles. The difference between the burning of wax and tallow candles depends, in a great measure, upon the different degrees of fusibility of these two substances; tallow being fusible with less heat than wax. If we observe a candle when it is burning, we find that a cup is formed round the wick, the rim of which is owing to the wax or tallow being farther from the flame at that place than close to the wick, and therefore being less exposed to heat. This cup is filled, or nearly so, with the melted material, which is thus ready to be drawn up by the capillary attraction of the wick.

652. *A candle, therefore, though apparently very simple*, is so far curious, that it is, in fact, a kind of lamp that continually keeps melting its own combustible. If the flame should melt more than it can consume, it is evident that the melted matter would accumulate, and at last overflow the cup, which does take place in what is termed the *guttering* of the candles. Now the thinner the wick the less fluid it will draw up: and it is also evident that, the more fusible a substance, the more will be melted at the same distance from the flame. If, therefore, a wax candle and one of tallow were both made with wicks of the same size, and if the wick of the wax-light were properly proportioned to the consumption, that of the tallow-candle would not be able to draw up and consume all the melted tallow, which would exceed the melted wax, from the greater fusibility of the former.

653. *It is necessary, therefore, to make the wick of the tallow-candle thicker than that of the wax candle*, to enable it to consume a sufficiency without the cup overflowing. But we have explained, when describing flame and the burning of lamps, that a thick wick occasions a good deal of smoke, from the escape of the unburned carbon vapour in the interior of the flame. The great size of the wick has another bad effect; for, as it does not bend on one side, like the wick of a wax candle, a deposition of this unburned carbon takes place upon it as it lengthens, and, of course, projects into the hollow of the flame; and at last it becomes covered with a great quantity of soot, in a sort of fungus or mushroom form, that still farther increases the evil; a candle in this state does not give above one tenth of the light of one newly snuffed. It is necessary, therefore, to take off this accumulation, together with the upper part of the wick, now lengthened by the diminution of the tallow, which process constitutes the *snuffing* of the candle. If the progress of the candle be observed, this is easily to be understood. It burns with a bright light when it is first snuffed of a proper length, because there is very little smoke, the flame being able to consume nearly all the fluid that is drawn up; but, as the wick lengthens, more fluid is drawn up than can be consumed, and therefore a large portion escapes through the top of the flame in the form of smoke. If the wick is snuffed too short, it is not able to draw up and consume so much tallow as is melted, and therefore the latter accumulates till it almost extinguishes the light, except it be relieved by the margin of the cup breaking down, which is generally the case. then the candle immediately burns with unusual brightness. It is, therefore, of the utmost importance, in tallow candles, that the size of the wick and the thickness of the candle should be accurately proportioned to each other.

654. *The wax candle admits of a smaller wick than the tallow candle, from the less fusibility of the wax;* for a large wick is not necessary in order to consume the melted contents of the cup: but we showed, when treating on the subject of lamps, that the smaller the flame the brighter it is, there being least unconsumed vapour in the centre, and the smallest flame gives likewise the least smoke. The superiority of the wax candle, therefore, consists in this: that, from the smaller degree of fusibility of wax than of tallow, we can afford to make the wick of a wax candle thinner in proportion than that of a tallow candle, the flame being, at the same time, more brilliant. This thinness of the wick also causes it to bend of itself, till its extremity comes outside the flame, and then the part which projects is burned to ashes by its contact with the air: wax candles, therefore, require no snuffing, there being no accumulation on the wick, which is kept short by being burned as we have mentioned.

655. *The following degrees of fusibility* of different substances will point out their relative advantages. Palm oil melts at 84°; tallow at 92°; spermaceti at 133°; and wax at 155°.

656. *The goodness of candles depending upon* the inferior degree of fusibility of the material, it is obvious why the employment of too much mutton fat, or kitchen stuff, deteriorates them, independently of the bad smell of the latter; and that one of the modes of improving candles is to discover a material of the least fusibility compared to its price.

657. *The disagreeable smell of a candle or lamp carelessly blown out* is caused by the vapour of the tallow or oil rising, for a few moments, from the red-hot wick, and escaping into the air of the room unburned. The extinguisher, by fitting close on to the cup of the candle, confines this vapour, and prevents the annoying smell.

658. *Candles have a great advantage over every other kind of light, in their great portability and cleanliness;* and they are free from the great trouble of cleaning and trimming of lamps. Small oil lamps are now made very portable; but, if of the simple kind, they always give smoke and smell, except the oil is particularly pure. The solar lamp, to be afterward described, is made conveniently small. It has not been found practicable to construct the Argand lamp, so as to have no greater flame than that of a single candle, nor to burn so little oil as to be as economical. Upon the whole, therefore, for economical and ordinary domestic purposes, no other light is found so convenient as candles: well-made dipped candles give the most light in proportion to their expense, and are preferable where economy is considered: mould candles, though having a better appearance, and being less liable to run, do not give quite so good a light.

659. *The wicks of candles* are usually made of cotton, which is found to be the best material; other materials have been tried, but without producing any improvement.

Some have thought it advantageous to steep the cotton previously in lime-water, in which there has been dissolved a considerable quantity of saltpetre. They should be well dried after this before the tallow is put to them. Candles so prepared are said to afford a clearer flame, and give a more brilliant light; the combustion of the wick is so complete as to render the snuffing of them nearly superfluous; and they do not run or gutter.

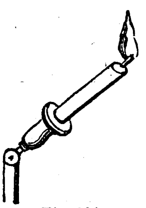


Fig 104.

660. *If a candle be kept inclining at an angle of* 45°, *fig.* 104, it will require no snuffing, because the upper extremity of the wick, coming into contact with the atmosphere, as in the case of a wax candle, is burned to ashes. But an objection to this is, that the candle is apt to run and drop, except very well managed, and the unsightly appearance will prevent it from being adopted, except on particular occasions, when the fact may be made useful.

661. *Snuffers,* so essential a domestic implement for cleanliness and safety, in all classes of society, are, in the present day, of great variety of forms and prices. Some ancient snuffers, made of brass of very clumsy construction, have been preserved; a figure of one of which may be seen in Hone's "Every Day Book," and another in Hutchin's "History of Dorsetshire." At present, snuffers are made of brass, and of wrought iron; immense numbers are also cast immediately from the pig-metal, which, being subsequently annealed to render them softer, are filed, polished with emery, or burnished, so as to look very well; and as the cutting edge does not soon wear away, they are not ill adapted for use. The best polished snuffers are made of cast steel, which has been decarbonated, that it may bear being worked with the hammer, and thus, at the same time, retain that compactness of grain which enables steel to take so beautiful a polish. Snuffers are, in reality, a kind of scissors, constructed to cut off the excrescence which accumulates on the wick of the candle during combustion, retaining the snuff in a box or cavity. In the very cheap snuffers made of cast iron, there is no contrivance to prevent them from opening, and letting the snuff fall out; but all the best sorts have a coiled spring fixed in a cell in the shanks where the rivet is placed, to keep the box closed by the cutter when it is not in use. This spring, however, is sometimes so unpleasantly powerful as to cause the snuffers to open with difficulty, or it becomes too weak to

answer its purpose. There are many contrivances invented to obviate these inconveniences.

Hobday's patent snuffers, by the rising and falling of a steel slide or cutter, hides and retains the snuff in the box. The only objection to this ingenious method is the disagreeable snap of the machinery whenever it is used : it, however, effectually answers the intended purpose.

662. *Snuffer trays* are made of various materials. The cheapest are japanned. They are also of silver, and plated, and of papier-machée. Some are made of polished steel, having various ornaments etched upon them.

SECT. IX.—RELATIVE QUANTITIES OF LIGHT FROM VARIOUS CANDLES AND LAMPS.

663. Various experiments have been made, with a view to determine *the relative quantities of light* afforded by the combustion of different materials in candles and in lamps. In these experiments economy has been chiefly considered ; but in choosing between candles and lamps, many other circumstances present themselves to our notice: such as the great portability of the former, and their small heating power, as well as the small expense and variety of candlesticks compared with that of lamps. Lamps that burn the oil with smoke are intolerable in good apartments ; and Argand's lamps, which consume their smoke, are too expensive for ordinary purposes. On the other hand, where much light is required, and portability is not an object, Argand's lamps have a decided advantage in giving no smoke ; and their light is then economical.

664. *It was observed by Count Rumford* that the relative weight of the undermentioned inflammable substances, required to produce an equal degree of light, is as follows :

A good wax candle, kept well snuffed, and burning with a clear bright flame	100
A good tallow candle, kept well snuffed, and burning with a bright flame	101
The same tallow candle, burning very dim for want of snuffing	229
Olive oil burned in an Argand's lamp	110
The same burned in a common lamp, with a clear bright flame	129
Rape oil, burned in the same manner	125
Linseed oil, burned in the same manner	120

Whale oil was not tried, as it was not to be had in Bavaria, where the count then resided.

665. *The following table gives the result of experiments made by Dr. Ure, to determine the relative intensity of the light, and the duration of several sorts of tallow candles :*

Number in a Pound.	Duration of a Candle.	Weight in Grains.	Consumption per hour in Grains.	Proportions of Light.	Economy of Light.	Candles equal to one Argand.
10 mould	5h. 9m.	682	132	12¼	68	5·7
10 dipped	4 36	672	150	13	65½	5 25
8 mould	6 31	856	132	10½	59½	6·6
6 do.	7 2½	1160	163	14⅔	66	5·0
4 do.	9 36	1787	186	20¼	80	3·5
Argand oil flame	....	....	512	69·4	100	

Dr. Ure farther observes that a Scotch mutchkin, or one eighth of a gallon of good seal oil, weighs 6010 grs., or $13\frac{1}{10}$ oz. advoirdupois, and lasts in a bright Argand's lamp 11 hours and 44 minutes. The weight of oil it consumes per hour is equal to four times the weight of tallow in candles, 8 to the pound, and 3¼ times the weight of tallow in candles, 6 to the pound. But its light being equal to that of 5 of the tallow candles, it is a much cheaper illuminating power than tallow candles; the exact proportion will depend upon the materials at the time.

666. *It is often required to determine the relative proportions of the light* given by two illuminating bodies ; for instance, to compare the degree of light afforded by an Argand's lamp and candles ; or to compare the light of two different kinds of candles with each other. We can judge pretty well by the eye whether two lights be equal or not ; but when they are unequal, it is not possible to determine, by the eye alone, in what proportion one light is more intense than the other. Instruments, however, capable of effecting this have been invented, and these are called *photometers*. The simplest of these is that invented by Count Rumford, and which is described in the Philosophical Transactions for 1794, though one invented by Prof. Leslie is still more delicate ; but Rumford's is more simple, not requiring the purchase of any instrument ; and, by experiments of Mr. Nicholson, it has been shown that by it the degree of illumination can be easily ascertained within an 80th or 90th of the whole, a degree of accuracy sufficient for all ordinary purposes.

667. *We therefore describe the Rumford photometer* as that which is the most convenient for common use. Place the two lights that are to be compared at exactly equal heights upon two small tables or stands in a room that is darkened, and let a flat sheet of white paper, or a white cloth, be hung up at six or eight feet from the lights ; if the wall be made use of for the paper, then the lights must be six or eight feet from the wall. Take now a small cylinder of wood, or any other substance, about half an inch

in diameter (for the exact size is not material), and hold it up between the lights and the paper, and about three inches distant from the latter. It is evident that by this two shadows will fall upon the paper, occasioned by the two lights. If the lights be exactly equal, the two shadows will be of the same degree of intensity or darkness; but if one light be greater than the other, then the shadows will differ in their degree of intensity; that is, one will appear darker than the other. By moving the cylinder farther from and nearer to the paper this difference will be better perceived. It will be found that the light which is the strongest has produced the darkest shadow, and it is necessary to bring both the shadows of the same degree of shade or darkness: to effect this, move the light that casts the strongest shadow farther from the paper, and it will seem that its shadow will grow fainter, and if moved too far, it will be fainter than the other: keep moving it backward and forward until both shadows are exactly of the same colour or intensity. When both shadows are exactly equal, which will be best judged of by keeping them quite close together, measure the distances which the lights now are from the paper. Suppose, for instance, that the weakest light should be 4 feet from the paper, and it had been found necessary to remove the stronger one to 8 feet from the paper to get the shadows equal; square the two distances, that is, multiply 4 by 4, which will give 16, and 8 by 8, which will give 64: then the real intensity of the stronger light will be to that of the weaker light in the proportion of 64 to 16, or as 4 to 1. Instead of a cylinder of wood, any object held up will do; and this method of measuring two lights is so simple, that it may be practised by any person, and in any place. It may be necessary to explain the cause of the difference in the intensity of the shadows produced by two unequal lights. To understand this, it must be observed that, though we speak of a body *casting* a shadow, yet a shadow is not anything real, but merely the part that is deprived of light. If only one candle or lamp had been used, there would have been a single shadow, and that shadow would be simply the part of the paper which was deprived of the light of the luminous body which illuminated distinctly all the rest of the paper. If a more powerful luminous body should be substituted instead of this, the paper would be more strongly illuminated, and the shadow would appear darker; but this increased intensity of shadow would be the effect of the contrast between the light and the shadow, the shadow would be really the same in both cases, but would appear darker, because opposed to a stronger light. In all cases, therefore, of this kind, the stronger the light the darker the shadow will *appear* to be. This simple contrivance, which is not, in fact, an instrument, is exceedingly useful for ascertaining the comparative illuminating powers of lamps or candles. For instance, to determine how many candles any lamp may be equivalent to, place the lamp opposite to the paper at 8 feet distance, and then put candles quite close together, a little way off, but at the same distance from the paper, adding to their number till the shadows cast by them and the shadow cast by the lamp are of equal intensity, then the number of candles used will show the power of the lamp.

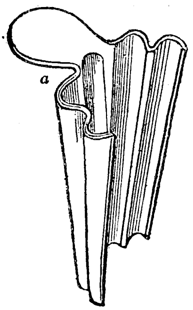
Sect. X.—CANDLESTICKS.

668. *Candlesticks are made in a great variety of forms*, according to the several uses for which they are wanted, or the materials of which they are composed. Those of the richest kind are of gold or silver: they are also silver plated, of brass, bronze, or other alloys, of tinware japanned, or plain; and sometimes of porcelain, and other earthenwares, or of glass.

669. *Candlesticks are no doubt as ancient as the use of candles;* and, like them, were first made for churches, in which many ancient specimens may be seen, some of extraordinary richness. It would be impossible to enumerate all the varieties of this very useful article of furniture, of which fashion is continually producing new forms, or restoring some which have been long laid aside. Of these our shops exhibit great variety, many of which have much merit. We must confine ourselves to presenting a few specimens of the principal varieties, and to pointing out some things of importance in their general construction, as far as regards utility.

670. *An inconvenience often attends the candlesticks in common use*, which is, that the same socket does not fit any sized candle; and the consequence is, that candles are generally procured rather smaller than the socket, and must be made tight by papering in some way or other, an operation troublesome and unsightly, and which becomes more inconvenient when the candle burns down near to the socket, as the paper often takes fire.

671. *To remedy this*, in appearance at least, coloured papers are used, stamped as ornaments; or cut glass is employed as an additional socket. But a superior construction is to have loose sockets, with a cylindrical plate of metal within, slit so as to form a spring that gives way to the pressure of the candle, and holds it fast without any papering. Candles are never suffered to burn quite to the socket in the best candlesticks; before they burn down so far, the pieces are taken out, and are used either in bedchamber candlesticks or other places. In ordinary candlesticks the bottoms of the sockets are made to rise up to burn the last portion of the candle. And here we may



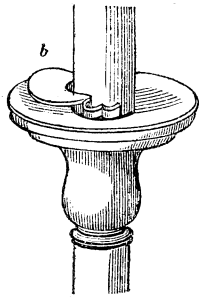


Fig. 105.

mention a little contrivance that has just made its appearance, and is sold in the streets for a halfpenny, as a useful substitute for papering candles. *a, fig.* 105, is a piece of sheet brass pressed into the form represented, with a little handle bent back. This is put into the socket of the candlestick, and then the candle is pressed down. It holds the candle firmly, cannot take fire, and is easily taken out by means of the handle, after raising up the bottom of the socket; *b* shows this contrivance when in the socket.

672. *Telescopic candlesticks* are made with tubes to slide within one another in the manner of a telescope, to heighten it as the candle burns down, so as to preserve the flame at the same actual height. This construction is only used in plated or silver candlesticks, as it is expensive.

673. *Fig.* 105* *exhibits* some of the best table candlesticks now in fashion. A and B

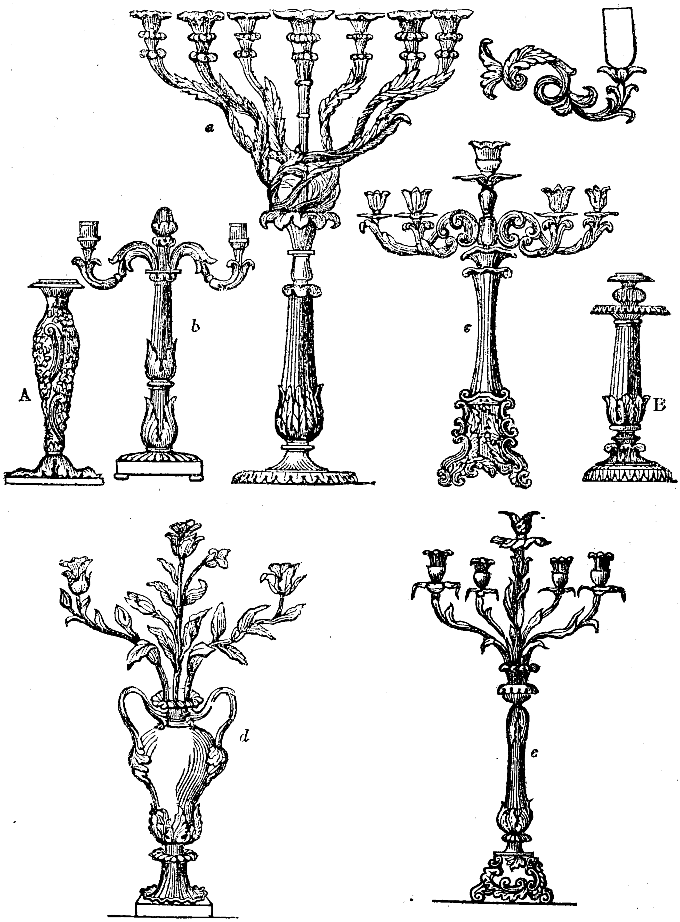


Fig. 105*.

are small candlesticks. *a, b, c, d, e,* are branched candlesticks or girandoles of silver, plated, or brass gilt. *d* is a girandole of coloured porcelain and or-moulu.

674. *Chandeliers* are suspended candlesticks, and magnificent examples are to be seen

in churches, and in large and elegant apartments. Those in churches are usually of brass or bronze, but in private houses and public rooms they are now also made of cut glass: and nothing can exceed the richness and splendour of these when ornamented,

Fig. 106.

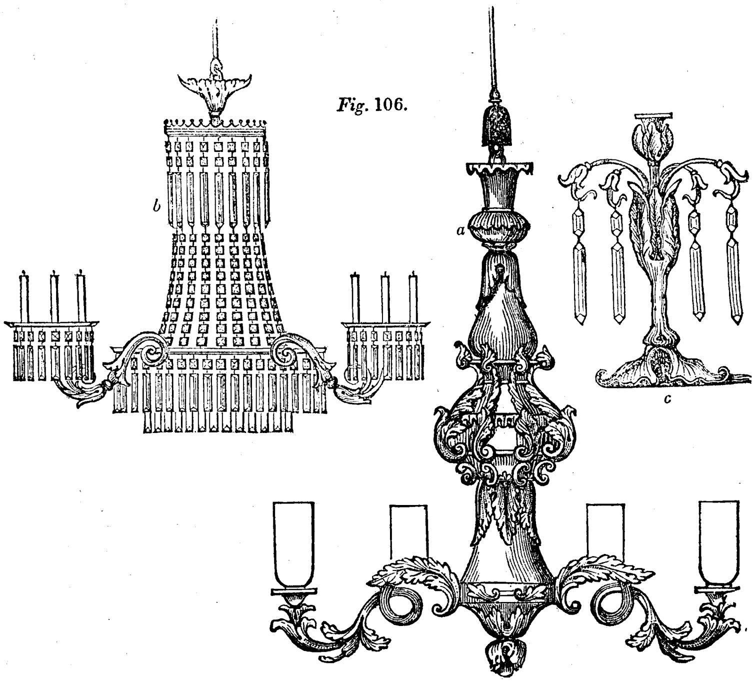
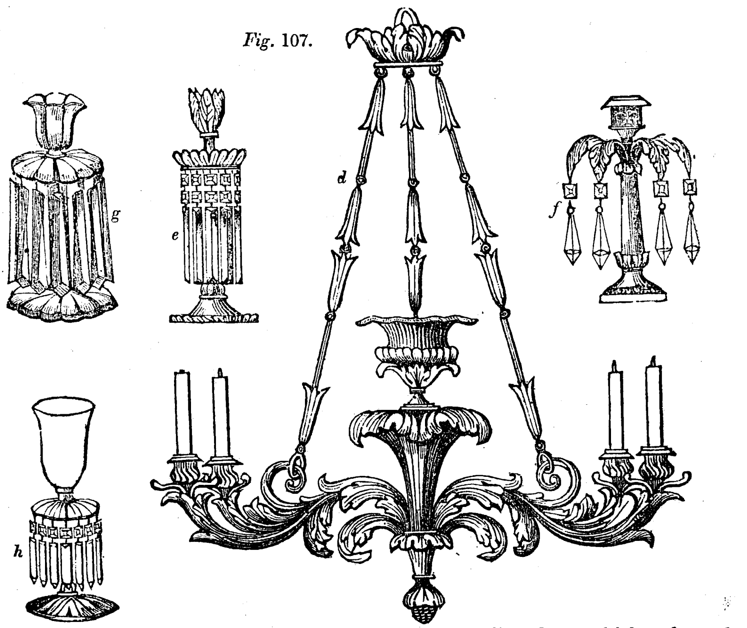


Fig. 107.

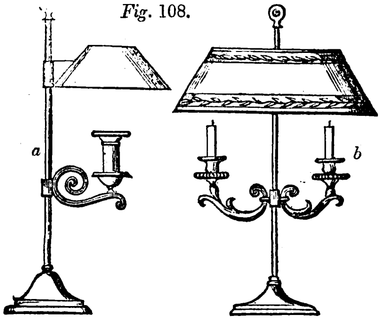


as they generally are, with a multitude of drops of cut flint-glass, which refract the light like so many gems. Instead of candles, frequently gas light is burned in chandeliers of the same forms. *a*, *fig*. 106, represents a chandelier of coloured porcelain and or-moulu; and *d*, *fig*. 107, one of brass gilt, such as are used in the best houses; the number of lights may be varied at pleasure by altering the design a little. *b*, *fig.* 106, is a chandelier of cut glass.

675. *Lustres* are candlesticks of cut glass, ornamented with drops, and usually placed on the mantel-piece, or some other convenient place in the drawing-room. Instead of the forms, with many facets, into which these drops were formerly cut, glass, cut into the shape of triangular prisms, are now generally used, being more easily made, and refracting the light as much or more than any other shape. *e*, *f*, *g*, *fig.* 107, and *c*, *fig.* 106, represent various patterns of such lustres. In *h*, *fig.* 107, the candle is concealed by a ground glass-shade.

676. *Cheap candlesticks for reading or writing* are made, with one or two candles, to rise or fall, in order to keep the light always at the same height, with conical shades to reflect the light down, and to conceal the flame from the eyes. These are not only beneficial to the eyesight, but economical, one candle giving as much light on the paper as two without shades. The shades are japanned, white within, to reflect the light strongly ; *a*, *fig.* 108, may be for one candle, or, by repeating the branch on the opposite side, for two. In *b*, *fig.* 108, the shade is oval, and concentrates the light best.

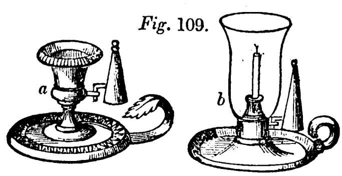
Fig. 108.



677. *The best reading candlesticks* at present in use are Palmer's, and the Soho, already mentioned.

678. *Bedchamber candlesticks*, *a* and *b*, *fig.* 109, are always made low, with an extinguisher, and sometimes a pair of snuffers attached. In *b* the light is protected by a glass, which is useful in carrying. *Fig.* 110 is intended for the light to be raised or lowered ; and by being made to swing, it is very useful on board of ships. Japanned candlesticks for bedchambers usually have the bottom of the socket to slide up by means of a slit and a projecting piece on the side ; and this permits the candle to be burned to the last bit. This construction is also generally applied to the common brass candlesticks ; but in these, a wire is made to come down from the moveable bottom through the middle of the stem to the foot, so as to be invisible on the outside ; and the candle is pushed up by pressing upon a knob on the end of the wire. The same construction cannot be applied to plated candlesticks, nor to those of earthenware. Bedchamber candlesticks are made of silver, brown, plated, and tin japanned ; the last are remarkably cheap, and are very generally used. They exhibit a remarkable instance of what may be done in manufactures on the score of economy ; a candlestick of this kind, japanned and painted, with snuffers and extinguisher complete, may be bought in the retail shops in London for 6*d.*, and though not so strong nor so well finished as more expensive ones, yet is neat, and will answer very well for ordinary purposes.

Fig. 109.



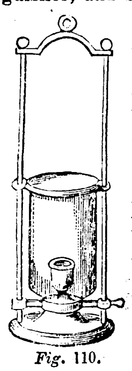


Fig. 110.

679. *Tin is the best material for kitchen candlesticks :* those which are japanned brown save some trouble in cleaning, but require much care to prevent the varnish from coming off; these should never be put near to the fire to clean, but should have the tallow melted off by hot water. *Office candlesticks* are best of the latter kind ; and it is very important that these and kitchen ones should always be furnished with snuffers and extinguishers, fixed to them by a piece of chain ; many accidents by fire having occurred through neglect in putting candles out, when there is no extinguisher.

680. *Candlestick stands* are occasionally used to raise the candlesticks on the dining-table. They should, if possible, correspond in style to the candlesticks ; and should be made heavy at the bottom.

681. *Economical housewives use*, for burning their ends of candles, a little apparatus called a *save-all*, which deserves much more patronage than it meets with. It is usually made with a socket to fit into the candlestick, on which is a circular cup, with three projecting wires to fix the piece of candle between. These wires bend, and are soon out

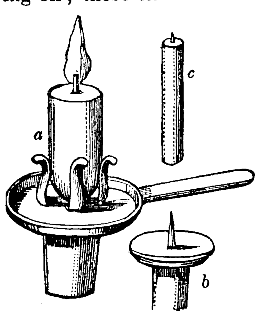


Fig. 111.

of order, which may be one reason why this is not a favourite; but, instead of wires, pieces of tin plate may be substituted, as in *a*, *fig.* 111, which last much longer; and also the save-all may be furnished with a handle, a construction which is very much superior. Some are made with a single-pointed wire to fix the candle upon, as in *b*; and others are made of earthenware, to imitate a candle, as in *c*, by which, when the piece is put on, it looks like a whole candle.

CHAPTER IV.

LAMPS.

SECT. I.—THE SIMPLEST KINDS OF LAMPS.

682. *The most simple lamp* consists in a vessel of any shape, filled with oil, or other inflammable liquid, and having a short depression or spout on one side, on which lies a wick composed of any fibrous substance capable of imbibing the oil by its capillary attraction. The oil thus raised and diffused through the wick, when set fire to, admits of being heated to such a degree of temperature as is capable of volatilizing the oil; the vapour of which, in a state of combustion, constituting the flame of the lamp.

683. *The wick of a lamp* serves only for the purpose of raising up the oil, and thus giving a constant supply of just the necessary quantity to the flame.

It furnishes no part of the light by the combustion of its own substance; for the quantity consumed is too small to deserve notice, and it is usually coated over with a hard deposite of carbonaceous matter, which cannot burn for want of the access of air; the flame, in fact, keeping the wick from it.

684. *Fig.* 112 *represents a lamp of the simplest kind* made of hammered iron, still used in the Orkney and Shetland islands for burning fish oil, procured by melting the livers of a small fish caught there in abundance. The wick is of peeled rush. The upper vessel holds the oil, and the lower one is to catch the drippings. The lamp is fixed in the walls of the cottages by the bent top. The Esquimaux make their lamps of a kind of pot stone, and use them not only for getting light during the long, dark, and dreary winter months, but also for boiling their kettles. Their wicks consist of moss laid in the oil.

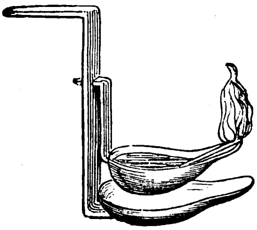


Fig. 112.

685. *Fig.* 113 *is an example of the common Greek and Roman lamp* made of terra cotta. Such are found in great numbers in Herculaneum and Pompeii.

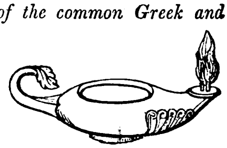


Fig. 113.

686. *Several improvements have been made in the simple lamp.* The size of the wick is a circumstance very important to attend to. We have already shown how essential it is that the air shall have access to every part of the flame, in order to ensure complete combustion: if the wick be large, a great deal of carbon vapour remains unburned in the interior of the flame, and breaks out at the top in the form of smoke; and the flame appears yellow, or even brownish. This is the case with torches, which always give a great deal of smoke. The smaller the wick, the clearer and whiter will be the flame; because, from what has just been said, it is obvious that there will be less unconsumed carbon in the interior of the flame: but a very small wick cannot give much light, as it diminishes with the superficies of the flame. The inconvenience of thick wicks has been long observed, and many attempts have been made to remove it.

687. *It was first noticed by Dr. Franklin that two small wicks, placed close together, gave more light than one equal in quantity to both:* the air being admitted between them, there is more surface of flame than in one only; see *fig.* 114, *a*. Three wicks, *b*, for the same reason, give still more light, but consume oil in proportion; but it is rather difficult to keep several wicks always at the same height, and there is a good deal of trouble in adjusting and trimming them.

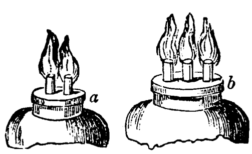


Fig. 114.

688. *A flat wick* is found to obviate this inconvenience, and to give a much better and clearer light, with less smoke, than a round one that consumes the same quantity of oil. These are, consequently, now much used.

By making the lamp of metal, and attaching an upright cylinder to the cistern, which is covered, and causing the wick to rise vertically through small tubes, greater cleanliness is ensured: this lamp is sometimes used as a common passage lamp to hang on a wall. *Fig.* 115.

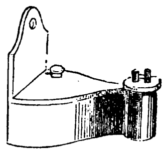


Fig. 115.

689. *a and b, fig.* 116, *represent lamps made in the form of candlesticks*, with the wick vertical. These require the wicks to be very nicely trimmed; for it is to be observed that the wick, when in this position, is more apt to contract a hard crust than when nearly horizontal. The upper part is often made and sold separate, so as to fit into any candlestick, either japanned or of brass. They form cheap lights for kitchens and other places where economy is much an object; and, indeed, if properly managed, give as good a light as small candles. *c, fig.* 116, is one of a more ornamental kind, with a glass to keep the flame steady; and, if a common cylindrical glass, with a plate, such as is afterward described, be added, these common lamps will give no smoke. These candlestick lamps require replenishing with oil pretty often, as the capillary attraction of the wick cannot raise it to any great height.

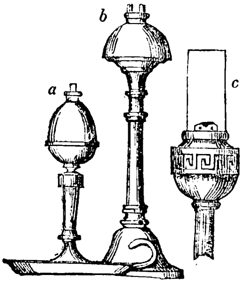


Fig. 116.

a, fig. 117, is a very economical working lamp, made for the light to be raised or lowered. The oil is contained in the conical reservoir, which slides on the stem only by the latter passing through a cork attached to the top of the reservoir.

b is also a very economical lamp, made to raise and lower, such as is used by watchmakers. The wick is made flat, and it has a shade to throw the light down, and also a cylindrical glass to keep it steady. When this is well trimmed, and the oil good, it gives very little smoke, and may be used as an excellent economical reading lamp. The oil is contained in a reservoir, and this lamp does not consume half so much as an Argand. It costs only six or seven shillings, and the addition of the oxydator, to be afterward described, completely destroys the smoke, making it thus a good and cheap reading lamp.

Fig. 118 exhibits small lamps made portable by a glass added to protect the flame from the wind. They are useful and safe as *bedchamber lamps:* an extinguisher is attached.

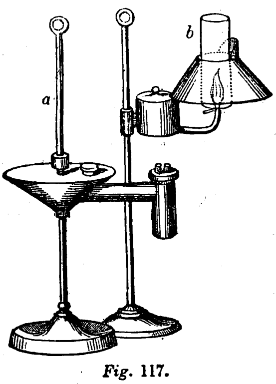
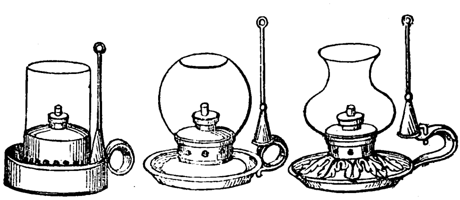


Fig. 117.

Fig. 118.



690. *Float lights, fig.* 119, are short wicks fixed into some substance that floats on oil, as a round slice of cork, or a hollow flattened sphere of glass or tin. Elegant glasses are sold for holding the oil, but any glass, as a tumbler or wine glass, will do. They are very useful for burning to give a light all night, being safe; and, by making the wick small, they may be made to give as little light as is required. The best sperm oil should be used; and it is well to put a teaspoon-full of water into the bottom of the vessel before the oil is poured in, that, when the oil is burned out, the wick may be extinguished. An inch in depth of an ordinary tumbler will burn twenty-four hours.

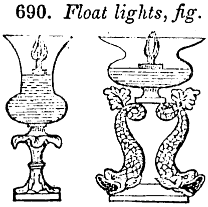


Fig. 119.

691. *Fountain lamps, fig.* 120, are those where the reservoir is above the level of the wicks, and which, consequently, burn with the same brilliancy as long as there is any oil in the reservoir.

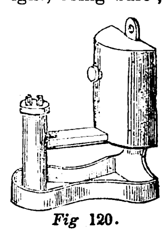


Fig 120.

Sect. II.—Argand's Lamp.

692. The smoke and disagreeable smell arising from the burning of oil in common lamps, and the unsightly appearance of the whole process, had long banished the lamp

from the apartments of the wealthy, and they had been universally superseded by candles.

693. *An invention, however, made,* 1780, *by M. Argand,* a native of Geneva, by which the smoke of lamps is entirely consumed, at the same time that the brilliancy of the light is greatly increased, even with economy, brought this instrument again into general use, and made it a successful rival to the best wax candles. The numerous advantages of the Argand lamp are not confined to affording a very brilliant and economical light, but it extends its usefulness in producing a convenient and great degree of heat for the chemist, which renders it one of the greatest improvements in the useful arts. Argand, reflecting upon the cause of the imperfect combustion in the interior of the flame of a candle or lamp, and correctly supposing that it was for want of the access of oxygen, conceived the idea of admitting air into the centre of the flame. To accomplish this, he made the wick in the form of a hollow cylinder, instead of a solid one as before; and he contrived that a current of air should pass up through this hollow cylinder where the wick was burning, thus admitting air into the middle of the flame. This was found to succeed perfectly on trial: the combustion was more complete, the smoke was diminished, and the brilliancy of the light increased. But, to improve the effect still farther, he also added a glass cylinder or chimney, open at bottom, surrounding the flame at a small distance, by which another current of air was made to pass upward on the exterior part of the flame, and between it and the glass. Thus every part of the thin circular flame is between two currents of air, which supply the combustion with oxygen so much as to create a heat that is sufficient to consume the smoke and convert it into heat and light.

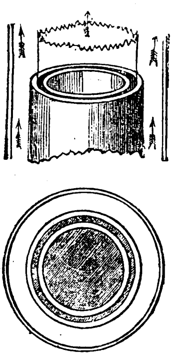


Fig. 121.

This is the simple principle of the lamp invented by Argand; and it will be easily understood by examining *fig.* 121, where the dark circle in the centre of A, the place of the burner, represents the interior of the hollow cylinder through which the air ascends. The thin, dark line outside being the wick itself, and the double external line being the glass. B represents a view of the burner with the wick; and the arrows show the direction of the current of air between the wick and the glass.

A few improvements have been made upon the original construction. The glass chimney does more than cause a current on the outside of the flame; it considerably increases that in the inside of the circular wick also: without the glass there would be a current, but it would be weak. It is of consequence to regulate the quantity of air admitted to the flame: too much air will diminish the temperature so much as to impede the desired effects, and too little will leave the combustion languid. In the common lamp the wick is fed with oil by capillary attraction, the surface of the oil being below the level of the flame; but in the Argand lamp the reservoir of oil is kept above the level of the flame.

Fig. 122 *represents the general appearance of an Argand lamp,* such as is used for reading or similar purposes. *a* is the reservoir for the oil; *b* is the cistern supplied from the reservoir, and from which the oil flows to the burner, *c*, through the branch *d*.

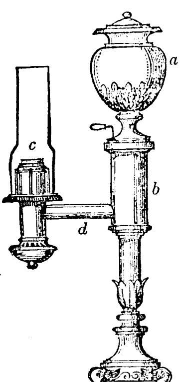


Fig. 122.

Fig. 123 is a section of the reservoir on a larger scale, together with the tubes of the burner. The vase *e*, which holds the oil, terminates below in a hollow neck, *f*, which screws into the cistern *g*. This neck has a circular hole in the side, which can be closed, when required, by a sliding piece of brass, *h*, moveable by a handle, *i*. To fill the reservoir with oil, it

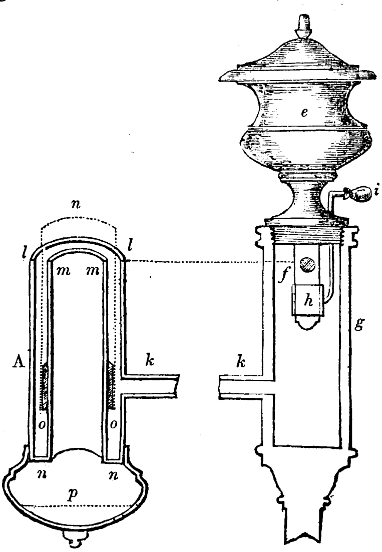


Fig. 123.

is unscrewed and laid on its side; and the oil is poured in through the circular hole in the neck. When enough oil is put in, this hole is covered by drawing up the short tube *h* over it by means of the handle *i;* the reservoir is then screwed into its place, and the hole is opened by pushing down the handle *i;* the oil then coming out through the cistern *g*, from which it passes through the branch *k*, to supply the burner. The burner part A consists of two tubes, *l l* and *m m*, one within the other, the space between to hold the oil coming from the branch *k* being closed at bottom, *n n*, but open at top. The circular wick *n*, expressed by the dotted line, is kept in the oil in this space between the two tubes by drawing it on a short cylinder of brass, *o o*, that slides upon the inner tube *m m*. At first, this wick was raised and lowered by means of a rack and pinion, but now a much neater method is employed: a spiral groove is cut on the outside of the tube *m m*, in which a pin on the inside of the short tube *o o* works, and causes it to rise or fall when it is carried round: the motion of the tube *o o* is effected in an ingenious manner by means of the shelf which carries the chimney glass. The lower portion of this burner part terminates in a cup, *p*, which receives what oil may happen to drop from the burner; and apertures are made in the upper part of the cup, by which air can have access to the inside of the inner tube, and, consequently, to that of the wick and flame. There are likewise apertures in the shelf on which the chimney-glass stands, to supply air to the space between the glass and the flame. As the reservoir acts upon the principle of the *bird fountain*, the height of the oil in the cistern must always be at the level of the wick, which is, therefore, supplied as long as there is oil in the reservoir; and, by this means, the light is always equal.

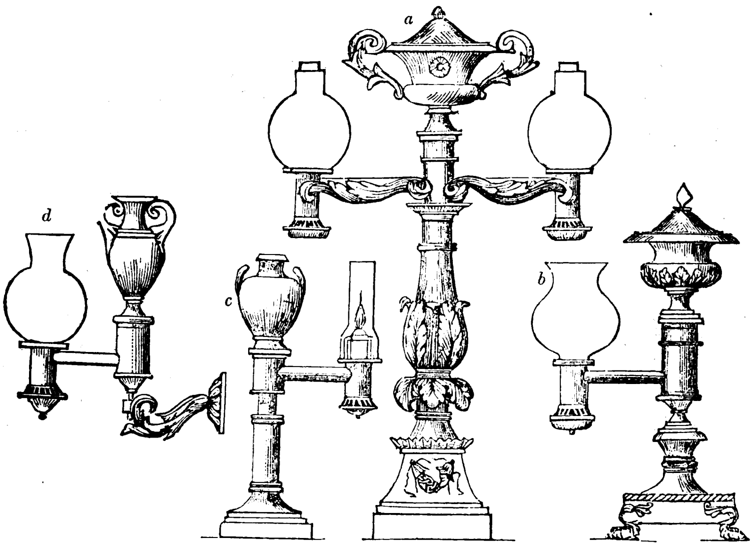


Fig. 124.

It is essential in this lamp that the flame should be at a certain distance from the reservoir of oil; otherwise the air in the upper part of the reservoir being much more expansible than the oil, it would cause the latter to flow over: this inconvenience is apt to occur in consequence of the air being expanded in a warm room.

694. *In the original construction of Argand's lamp there was an imperfection in the glass chimney*, which has been removed by subsequent improvements. The glass was at first made simply cylindrical, and then the air within rose quite vertically between it and the flame, striking upon it imperfectly; on which account the lamps could burn only the best oil. But by a French alteration of the shape of the glass, made some years ago, the lamp burns with a clearer light. Instead of being of equal width throughout, it is contracted at the level of the flame, as at *c*, *fig*. 122, by which the current of ascending air is made to turn out of its course when it arrives at this shoulder, and is propelled against the top of the flame just where the smoke is beginning to part, which, in consequence, is destroyed almost entirely; and this has been still farther improved upon by the contrivance called "oxydators," and a contraction of the glasses, which will be described afterward.

695. *a*, *fig*. 124, *represents a two-light Argand's lamp for the table.* *b* is one for the side-board or similar situations. *c* is one with a telescopic or sliding stem, to raise or lower the light, which is useful in some cases, particularly for reading or writing: but such

light should always be used with a shade to defend the eyes from the strong glare. *d* is a bracket lamp for fixing to the wall.

696. *Fig.* 125. *e is a two-light suspended Argand lamp,* of the cheapest kind. *f* is a suspended lamp of a more elegant kind, with a cut glass basin, to prevent accident from

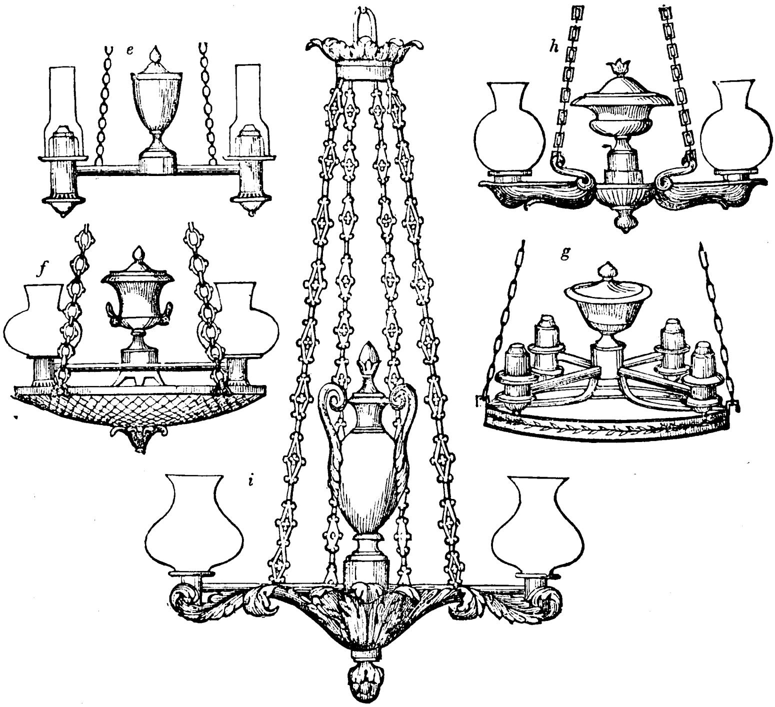


Fig. 125.

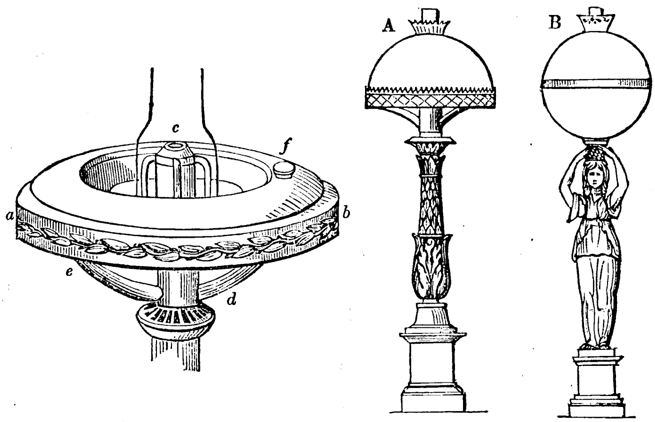
the oil dropping: it has also *moons*, or ground glass shades, over the lights. *g* is a four-light lamp with a basin of plate glass below. *h* is one of those called by the manufacturers *boat lamps*, from the arms being concealed by ornamental brass work having a slight resemblance to a boat, with three or four lights. In these lamps, although only two chains are represented, there must be three or four chains. *i* is a large lamp with the chains very ornamental, and the branches concealed by very rich brass work.

697. *Shades of ground glass* are not only agreeable in concealing the flame, and preventing the disagreeable dazzling effect of a strong light, but they appear to increase the light by dispersing it and softening the shadows. They should be cleaned once a fortnight with soap or pearlash: the latter will not injure them. For some lamps white paper, not too thick, makes an excellent shade, and particularly for an economical reading lamp. Transparent envelopes, or shades for some purposes, as lanterns for passages, may be made very elegantly of chintz of agreeable patterns; and some have cut out the flowers or other ornaments of chintz and pasted them on varnished paper. Chinese lanterns are frequently made of paper painted.

Sect. III.—Annular French Lamp.

698. This lamp has been for many years very generally used in England as a *table lamp*. In the original construction of Argand's lamp, the reservoir for the oil was placed on one side of the flame; and, consequently, the light being obstructed by it, there was a strong and inconvenient shadow on that side. To obviate this imperfection, the annular lamp, *fig.* 126, has been contrived. The ring of metal, *a b*, *fig.* 126, contains the oil, which descends below the burner *c* by the tubes *d e*; a construction which is extremely simple, and, consequently, not liable to be out of order. *f* is a cap, by unscrewing which, the oil may be poured into the reservoir. The construction of the burner is on Argand's principle. This lamp was placed upon an elegant stand, as at A, and the flame was concealed by a hemisphere of ground glass; or by a complete sphere, as at B.

It is worth while observing that the French employed this construction also in lamps



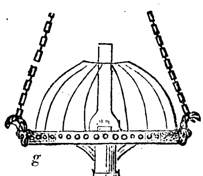


Fig. 127.

of a cheap kind for suspending, which, though not used here, yet may be useful, as they might easily be executed where Argand's lamps cannot be procured. The oil was contained in an annular reservoir of tin, japanned or painted, *g*, *fig*. 127; and, instead of Argand's burners, the wicks were of the common flat kind, but surrounded by glasses. To reflect the light down, a skeleton of wire, such as is used for bonnets, was raised over them in a hemispherical form, and on that was fixed thin silk, which being partly transparent, had a very pretty effect. Below was suspended a small glass basin to catch the droppings of oil.

Sect. IV.—parker's sinumbra lamp.

699. Although the object of the French lamp was to do away the shadow cast by the reservoir of the Argand lamp, this was not completely effected: for still a slight shadow was projected by the thickness of the annular reservoir, which, coming just about the level of the eyes of those at table, had an unpleasant effect. This fault was corrected by an improvement made by Mr. Parker, for which he took a patent in 1820. In his lamp, called the *Sinumbra*, or shadowless lamp, *fig*. 128, the reservoir is sloped away from the light, by reducing the breadth of the ring in front, in the manner shown in the section at *a* and *b*. The burner is on the Argand principle, with the usual glass chimney; but the form of the ground glass shade assists the dispersion of the rays of light, so as to obliterate all shadow entirely. *c* is a little metallic conical speculum fixed on the glass chimney, to reflect some rays from the flame, immediately downward. A represents this lamp complete. It is to be observed that the ground glass shade is continued below the light, as at *d* and *e*. This lamp, though obviously an improvement, is no longer made, being superseded by others to be afterward described.

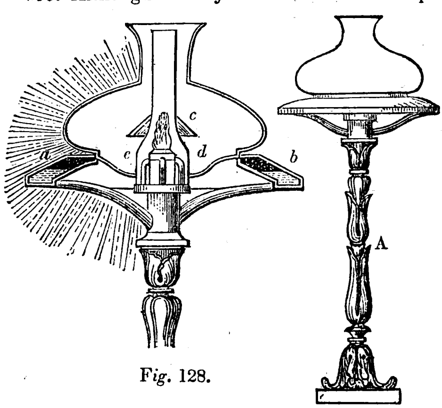


Fig. 128.

Sect. V.—quarrell's sinumbra lamp.

700. *Fig*. 129 is another construction for effecting the same object as Mr. Parker's. In this the bevelling or sloping of the reservoir is on the under side of the reservoir, and the ground glass distributed over the light is brought to the outside edge of the reservoir, as in the French lamp, thereby concealing it more completely. The ground glass shade, instead of being made in one piece, as in Parker's, is divided into two, one above the light, and the other, in form of a circular basin with an aperture in the middle, below the light, as *a b*. In other respects, it is like the French lamp. The little speculum, *c*, is often omitted.

SECT. VI.—ISIS LAMP.

701. The last improvement upon the French lamp appears to be what has been called by the manufacturers the *Isis lamp, fig.* 130, and which is now most generally

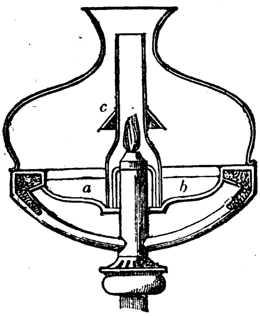


Fig. 129.

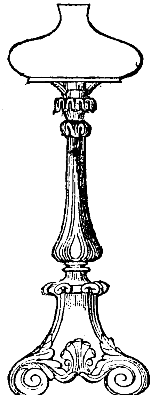


Fig. 130.

seen in the shops. In this the external appearance of the reservoir is reduced to a mere brass bead, and the ground glass distributor being brought quite to the front, no shadow is projected, and this part appears as perfect as this lamp can be. They are now frequently used as table lamps, and are manufactured in an almost infinite variety of patterns, of various prices and degrees of ornament and elegance, of brass, bronze, or part porcelain and part brass. *a, fig.* 131, represents a two-light table lamp; *c* is a

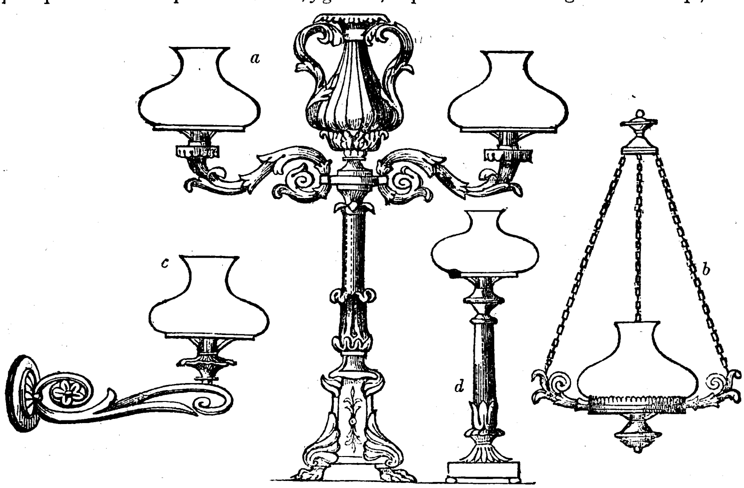


Fig. 131.

bracket lamp; *b* is one suspended. Parts of the stand are now frequently made of coloured porcelain, while the ornaments are of or-moulu, and brass, chased.

SECT. VII.—QUARRELL'S ALBION LAMP.

702. This is represented in *fig.* 132, A, B, C. The oil is contained in a circular reservoir like that of the French lamp; but instead of its being below the level of the flame, and to be raised by the capillary attraction of the wick, it is considerably above the flame, in the manner of a fountain lamp, as may be seen at A C, which is a view of the lamp without the glass shade and stand, and in A, which is a section of the same. B represents the lamp complete; the whole of what is exhibited in the other figures being included within the ground glass shade, and concealed by it. To fill the reservoir, the oil is poured in through the hollow two-valve cock, *b*, which at that time must have the valve, *c*, open, and the other valve, *d*, shut; there are marks on the top of the valve for setting the valves by means of the little handle, *o*. When the reservoir

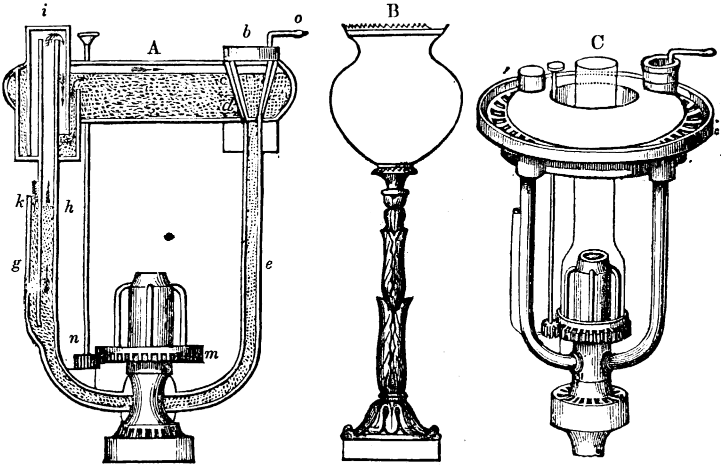


Fig. 132.

is full, the valve, *d*, is opened, and the oil flows out of the reservoir into the descending tube, *e*, which communicates with the burner, *f*; but it passes farther on, and rises above the level of the burner, through the tube, on the opposite side, *g*, as far as *h*; compressing the air in the upper part, which, being open, is covered and surrounded by a short outer tube, *i*, one half of which is open, and communicates with the reservoir, while the other half is closed. The lamp is now ready to be lighted: when this is done, the oil begins to be consumed, and the burner is supplied by the tube *e*, which takes it from the reservoir; but no more can come from the latter, except some air enters to supply its place; and this is admitted by a very ingenious contrivance. A smaller tube, *k*, is attached to the side of the tube, *h*, and communicates with it at the lower part, the upper part being open to the atmosphere. When, therefore, the combustion of the flame draws the oil from the reservoir by the tube *e*, the atmosphere passes into the upper part of the tube *k*, and air passes downward in minute bubbles, according to the direction of the arrows, to the top, and down again through the short external tube *i*, until it arrives in the reservoir, and ascends to the upper part of it, to fill the vacuum that otherwise would be formed; and this effect proceeds as long as there is any oil in the reservoir, or until the whole is consumed by the flame. One of the advantages of this lamp, therefore, is, that the supply of oil, not depending merely upon capillary attraction, as in the original French lamp, will burn with an undiminished flame as long as there is oil in the reservoir. In the French lamp the flame becomes weak some time before the oil is exhausted; and it requires more frequent supply. This lamp likewise obviates a defect which attends the Argand lamp when the flame is near the reservoir; the heat expands the air in it, and sometimes forces the oil over the burner. By the construction just described, the air which enters at *k*, and passes up the tube *h* into the reservoir, being surrounded by the oil in the latter, which is warmed by the flame, is heated to the same degree of temperature as the oil, and, in consequence, so much rarefied, that its pressure upon the surface of the fluid is considerably diminished, and therefore is not so liable to occasion an overflow at the burner. Another peculiarity belongs to the patent. The wick is raised or depressed by means of a rack, *m*, cut upon the shelf for the glass chimney, into which a pinion, *n*, works, and this is turned by a rod that rises above the cistern, and is accessible without lifting off the glass shade, as was necessary in former constructions. It is easy to perceive that this lamp can cast no shadow downward on the table.

Sect. VIII.—Parker's hot oil lamp.

703. This is a late invention, chiefly founded on the advantage of heating oil previously to its combustion. The cistern, *a* (see the section A, *fig.* 133), is composed of two cylinders, one within the other, the oil being contained in the space between both, expressed by dots; and through the inner cylinder, the chimney of the flame, *b*, passes up to heat the oil in the cistern. The lower part of the chimney is of glass, but the upper part, *c*, is of iron, for the purpose of radiating the heat more strongly against the sides of the cistern, or reservoir, which is assisted by the top of the chimney being notched and bent back. From the cistern, a pipe, *d*, descends to supply the wick with oil, and on it is a stop-cock, to turn off the supply when the cistern is to be charged with oil.

Instead of raising or lowering the wick to regulate the height of the flame, as in the

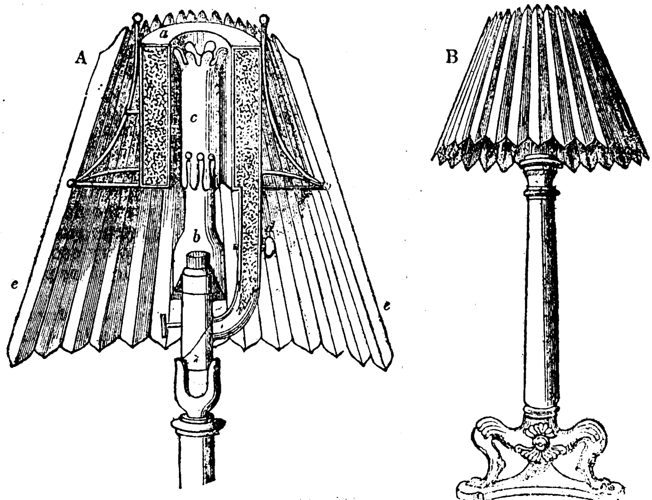


Fig. 133.

Argand's lamp, the effect is produced by raising or lowering the bell-mouthed glass chimney, which rests on three slips of metal moved by rack-work. The cistern contains an imperial pint of oil, and should be made quite full before lighting the lamp, so as to have no air in it, as that, by expansion with the heat, would cause an overflow of the oil. A shade of a conical form, *e e*, made of paper plaited, and plain white, pierced, or painted, is placed round the light, and to conceal the cistern: it is suspended on a circle of wire, *f f*. The nature of this paper shade is seen better in the external view of the lamp at B. The cylindrical cotton wick, which, we have observed, is stationary, is very short, as a new one is to be put on every day with a cotton stick, that it may burn clear, and prevent the usual clogging of the wick, which takes place when it is suffered to remain in the oil for several days, as is usually the case. That the flame may be more regular, the wicks, as sold, are cut quite true by machinery. More particular directions for managing this lamp are given in a printed paper to purchasers. We must observe that this lamp is calculated to burn the common oils, even the coarse fish oils, without smoke or smell, and thus the inventor considers the common Southern whale oil as preferable for burning in it to the best sperm oil. By using the contrivance called an oxydator, or, what is better, the glass contracted in the lower part, described afterward, the light is made still brighter. We can safely recommend this lamp as throwing down a most agreeable light upon the table. The stand is made of various forms.

Sect. IX.—The solar lamp.

704. This is a late improvement of considerable importance, by means of which a simple wicked lamp is made to burn with increased light, and no smoke. *Fig.* 134, *a*,

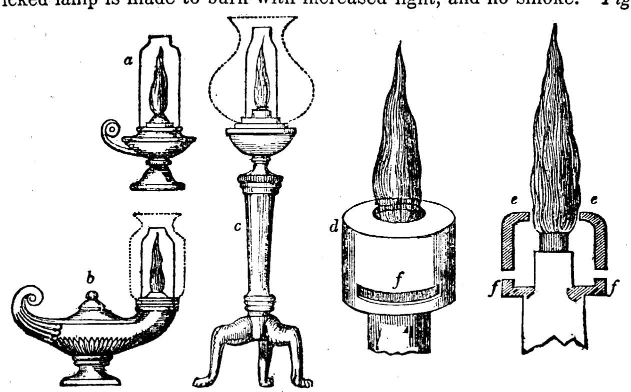


Fig. 134.

b, *c*, represents forms in which they are frequently executed, either for carrying about, or to stand on a table. To the wick must be applied a cap, as represented at *d* on a larger scale, of which *e e* is the section; this has apertures on the side at *f f*, and one at the top, through which the flame issues: by this contrivance a current of air enters at these apertures, and being deflected by the top of the metal cap, is brought into close contact with the flame, impinging upon it nearly at right angles, forcing its way into the flame, and thus supplying it with so much more oxygen than in the usual manner, that the combustion is complete, and the whole of the oil burned, thus entirely preventing the formation of smoke. It is essential that the lower part of the flame should be a little below the aperture of the cap. It is to be observed that there is no current through the centre of the flame, as in Argand's lamp, yet the flame is exceedingly bright. Lamps on this construction, with simple wicks, give no smoke when the best oil is burned, and very little with common oil; they are very economical and agreeable when used in many situations, as in a hall or passage, or other places where the smoke and smell of a common lamp would be objectionable.

705. *But the advantage of this construction is greatest when applied to Argand's lamp.* In the usual construction of this lamp, the current of air on the outside of the wick is made to ascend nearly parallel to the surface of the flame, without being made to strike against it so much as in the solar lamp. The application of the deflector of the solar lamp to the flame of the Argand's lamp produces, therefore, an increased brilliancy of the light. But a still greater advantage in the application of this principle is, that by its means the Argand's lamp can be made to burn the coarse oils without either smoke or smell, equally with the best spermaceti oil. The price of the latter has lately advanced considerably, and at the present time amounts to from six or eight to ten shillings per gallon: whereas the Southern whale oil, when purified, which answers equally well with this new lamp, is sold from three shillings to three and sixpence. The saving is therefore considerable when much oil is used; it is true, the greater consumption is to be considered, but even then the balance is in favour of the solar lamp, both as to economy and light. But to effect this combustion of the common fish oils, a peculiar kind of wick is necessary: it must be more loosely woven than those which are employed for the common Argand's lamp, and somewhat larger; the wicks, as formerly made, would very soon become clogged; the tubes, also, containing the new wick, must be made on purpose for it, and this may be added to the old stem, or other supports of the lamp; an alteration which generally costs from fifteen to twenty-five shilings for each light. By this means any of the ordinary lamps, as the French, or others, may be made to burn the coarse oils. The present high price of sperm oil has given rise to numerous inventions in lamps, to enable them to burn the common fish oils, or the vegetable oils; and these have led to some permanent improvements.

The most usual form in which this improvement of the Argand's lamp has been executed is what is termed the *vase solar lamp*, of which A, *fig.* 135, shows the upper part,

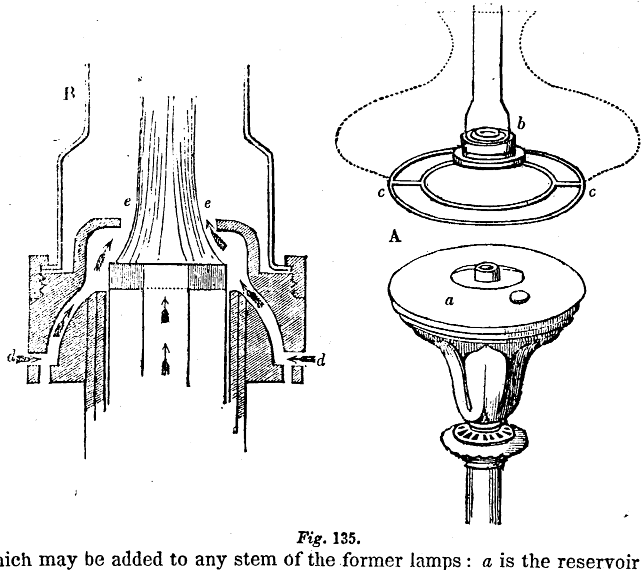


Fig. 135.

and which may be added to any stem of the former lamps: *a* is the reservoir for holding the oil; *b* is the cap with the deflector, and the ring, *c c*, holding the ground glass shade, fits on the edge of the reservoir *a*. B, *fig.* 135, shows the deflector on a large scale. The air enters through the apertures, *d d*, goes towards the flame of the circular wick in the direction of the arrows, and impinges on the flame at *e e*, the current within the circular wick being, as usual, at *f*.

706. *A still farther improvement* in the solar lamp, as applied to Argand's, has been made by Quarrell, *fig.* 136. By this, besides the usual deflected current shown by the arrows, a second current is produced by air entering at apertures *g g*, which, rising within the glass chimney, keeps it cool, and prevents the breakage it is very liable to by great heat. He also makes this chimney conical, without the usual shoulder.

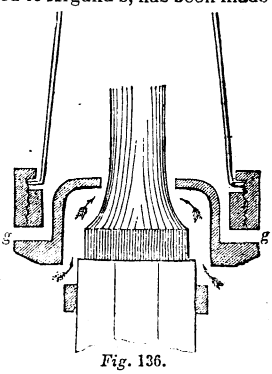


Fig. 136.

707. *Various contrivances, called oxydators,* have been produced in consequence of perceiving the advantage of causing the external current of air to impinge upon the flame of the Argand lamp. Some of them consist of small caps of brass, with a wide hole on the top, to admit of the flame of the lamp, similar to that of *fig.* 133, but so that the current of air is obliged to pass upward in close contact with the flame. Making the glass a little wider at bottom, to admit of a flat loose ring of brass, with an aperture for the flame, to rest on the shoulder of the contracted part, as shown by the shaded ring in *a*, answered the same purpose, and has been the subject of a patent. Even so simple a contrivance as a circle of thin mica, *b*, *c*, *fig.* 137, fixed in the inside of a cylindrical glass, with a hole in it a little larger than the flame, has been found sufficient to destroy the smoke of a common lamp, burning common oil.

But almost all these contrivances are now superseded by contracting the lower part of the glass itself, in the manner shown at *c*, *fig.* 137, which has the effect of obliging the external current of air in the Argand lamp so to impinge upon the flame that every particle of smoke is destroyed, and coarse cheap oil can be burned. We must observe that this form of glass, which is certainly a very great improvement upon the former cylindrical glass of Argand's, requires very great care, otherwise they are apt to break. For common purposes, the plate of mica, described above, answers very well with those who have sufficient ingenuity to fit them in. A circle of tin plate would do.

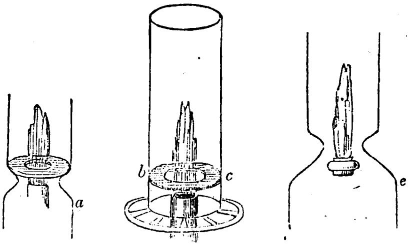


Fig. 137.

Sect. X.—keir's fountain lamp.

708. *Many attempts have been made to construct lamps to stand on the table with an upright stem,* having the plane on the top in form of a large candlestick or candelabrum, so as to do away entirely with all shadow, or visible reservoir for the oil. The great difficulty is in the supply of the oil for a long time: in the common small candlestick lamp, where the wick is supplied simply by capillary attraction, the lamp burns dim as soon as the oil falls much below the flame; and some means are required for keeping the oil always at the same height. This is effected completely in the Argand's lamp, where the supply cistern is on one side; but the shadow which this casts renders it unfit for the centre of a table; and what is desirable is to have a lamp burning constantly with an equal and strong light, but without any shadow like a candle. To effect this, two methods have been resorted to: one is on a hydrostatic principle, in the manner of Hiero's fountain, where the oil is placed in the body of the stem, and is raised to the wick, as it is wanted, by the pressure of a column of some fluid. In the other method, the oil is forced by clock-work mechanism, as in the lamp by Carcel of Paris. The first successful attempt of this kind, in England, was the lamp invented by Mr. Keir, about 40 years ago, upon a hydrostatical principle; and though it is not used at present, being superseded by contrivances of a similar kind by other manufacturers, yet it will serve to illustrate the general nature of these lamps, of which several varieties have been brought partially into use.

Fig. 138 represents the usual form in which Mr. Keir's lamp was made; but it is to be observed that the form might have been varied to infinity with the same construction, which will be understood from B, which is a section. The vase and its pedestal were both hollow, and two tubes, *a* and *b*, passed down through the middle, one of them only reaching to the top to supply an Argand burner. A heavy fluid, consisting of brine, or a strong solution of salt in water, so as to be three times the specific grav-

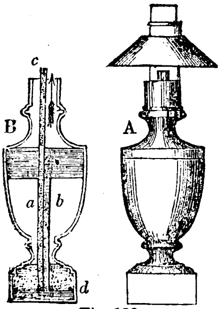


Fig. 138.

ity of oil, was poured in at the side of the burner, marked *c*; this descends down through the tube *b* into the lower vessel or pedestal *d*, and rises up the tube *a*, standing at the same altitude in both tubes. The oil is next poured in at *c*, and this falling upon the surface of the salt liquor, and swimming on it, by its weight forces up the tube, *b*, into the vase part: the oil and salt liquor balance each other when no more oil can be poured in. Both fluids being now in a state of equilibrium, they will remain in that state until the oil is diminished by the consumption occasioned by burning. The liquor in the vase then presses downward, and communicates an upward pressure to that below the oil in the pedestal, and causes it to rise in the tube *a*. As this pressure of the salt liquor is constant, it keeps the oil at the height of the burner, until it is all consumed. This lamp, therefore, requires no more attention than an ordinary lamp, and is merely to be filled with oil when necessary, the brine remaining always the same. Several other lamps have been constructed on the same principle, as King's, Barber's, &c., though varied in appearance; but these are difficult to manage, except by those who understand the philosophy of them, and when in the least deranged, it is generally necessary to take them to the makers. They are, therefore, not calculated for general use, although some of them have a very elegant appearance as table lamps.

Sect. XI.—Parker's Fountain Lamp.

709. Parker's fountain lamp is another of this kind, which has been reported on by the Academy of Sciences in Paris. A, *fig.* 139, represents its external appearance; but it is executed in various other patterns. Having no ring reservoir like the French lamp, it is obvious that there can be no shadow whatever. The external part, *a*, is in the form of a column, usually bronzed or japanned, to imitate some dark-coloured stone, as porphyry, basalt, &c. Within this is an internal cylinder, the top of which appears at *b*, and which is taken out when the lamp is to be filled with oil. B, *fig.* 139, represents a section of this lamp, the description of which we shall give in the words of the inventor. "Like Hiero's fountain, the interior of the lamp is divided into three distinct compartments: an upper chamber or reservoir, *x*; a middle chamber, *y*; and a lower chamber, *z*. Through the centre of the whole there passes a tube, *c d*, open at its upper end, *c*, and opening at its lower end, *d*, into the chamber, *z*. *e e* are opposite sides of the burner tubes of the lamp, between which is placed the cotton wick, *f*. *g* is the open space in the interior tube for the current of air that supplies the flame, and supports the combustion. If it is now recollected that the proper action of every lamp depends on the constant and uniform supply of oil to the burner, the action of this lamp will be clearly understood by attentively examining the intercommunications between the three chambers and this tube. The upper chamber, *x*, communicates with the tube, *c d*, by a lateral aperture at *h*. The tube, *c d*, opens into the lower chamber, *z*, by a lateral opening, *d*, at its lower extremity. The lower chamber, *z*, opens into the middle chamber, *y*, by an ascending passage, *i k*, the upper end of which is covered (but not closed) by the cap, *l*. The middle chamber, *y*, is in direct communication with the burner tube, *e e*, by the passage, *m n*; the lower end, *m*, of which opens into the chamber, and its upper end, *n*, into the lower part of the burner tube. Now, to consider the action of this arrangement, it will be evident that, if a liquid, as oil, be poured into the tube *c d* at the opening *o*, it will endeavour to fill the chamber *z* by escape at the lateral opening *d*; but this chamber is already occupied by atmospheric air, which must, therefore, be driven off as the oil enters; or, if the construction of the vessel prevents its escape, then, by the known properties of atmospheric air, and the laws of hydrostatic pressure, it will be condensed by the pressure of the superincumbent column of the invading liquid, until its resistance, or the power of its counteraction, becomes equal to the weight of a column of the liquid, of diameter equal to that of the vessel into which it is forced, namely, *z*, and of height equal to that of the column of supply, namely, *c d*. Now, imagine the oil to be thus poured into the chamber *z*, until it be filled; the air it contains will then be driven into the chamber *y* by the

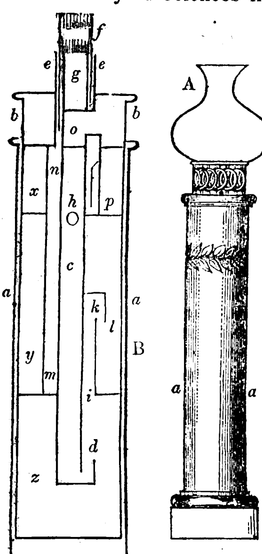


Fig. 139.

passage $i\ k$, and by the tube $m\ n$. Now, if the lamp be placed in an inverted position, the contents of z will run through $i\ k$ into the chamber y. During the passage of the oil from z into y, atmosphere again enters z by the passage $c\ d$; and now, if we again fill $c\ d$ with oil as before, the air that z contains will be condensed, and its counteraction will drive out the oil contained in y by the passage $i\ k$, through the only exit it finds, namely, the mouth of the passage $m\ n$, which, as already described, supplies the wick. It now only remains to say that the operation last mentioned, of pouring in oil at the tube $c\ d$, also fills the upper chamber x by the aperture h, the air it contained escaping through a small tube, p. The contents of this chamber sustain the supply of the tube $c\ d$. It now appears that the action of the lamp depends simply on the tube of supply, $m\ n$, delivering to the wick uniformly enough oil, and with sufficient rapidity, to support combustion, and not so much or so rapidly as to encumber it. This is done by ensuring a just equilibrium between the altitude of the maintaining column, $c\ d$, and the column maintained, $m\ n$." When these lamps are sent to India, a contrivance is added to prevent the flame from being blown out by the action of the puncha, an apparatus for producing currents of air for ventilation, and likewise to prevent the light being extinguished by swarms of moschetoes, as frequently happens. For this purpose a plate of metal, pierced full of very small holes, surrounds the aperture by which the air enters to feed the flame. In the ordinary lamps to be used in this country this plate is perforated, so as to form an ornament having wide openings.

Sect. XII.—Carcel lamp.

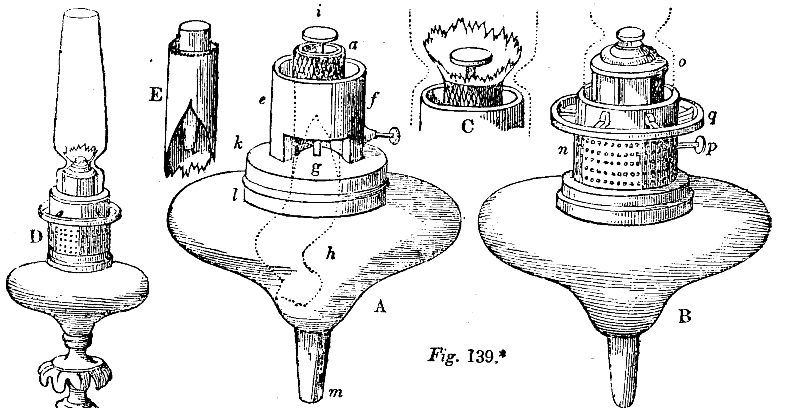
710. The Carcel lamp gives, perhaps, the most beautiful light of any for domestic purposes, and is generally used by the opulent families in Paris. The following opinion respecting it is that given by Dr. Ure. In this lamp the oil is raised through tubes by clock-work, so as continually to overflow at the bottom of the burning wick; thus keeping it thoroughly soaked, while the excess of the oil drops back into the cistern below. Its light, when furnished with an appropriate tall glass chimney, is very brilliant, though not perfectly uniform, since it fluctuates a little, but always perceptible to a nice observer, with the alternating action of the pump-work; becoming dimmer after every jet of oil, and brighter just before its return. The flame, moreover, always flickers more or less, owing to the powerful draught, and rectangular reverberatory shoulder of the chimney. This mechanical lamp is, however, remarkable for continuing to burn, not only with unabated, but with increasing splendour, for seven or eight hours; the vivacity of the combustion increasing evidently with the increased temperature and fluency of the oil, which, by its ceaseless circulation through the ignited wick, gets eventually pretty warm; besides, it emits very different quantities of light, according to the differences in the nature and supply of oil, as well as variations in the form and position of the chimney. It is little used in England; nor can it hardly be trusted in the hands of ordinary servants, for, when it gets deranged, it must be sent to its constructor in Paris to be repaired.

Sect. XII.*—Young's vesta lamp.

710 *a*. The lamp is an instrument of such great and general utility, that it is not surprising numerous attempts are now making to improve it. For many years the lamp of Argand was considered so perfect, that scarcely anything more was thought desirable, and, of course, little or no improvement was made upon it. The French glasses described in p. 180, *c*, *fig.* 122, where the glass was contracted at the level of the flame by a shoulder, was the first improvement on the original construction by Argand, whose glass was simply cylindrical; but by this new form, the air, instead of rising by the side of the flame as before, was made to impinge upon it, thus causing the combustion to be more complete. This effect is still better attained in the solar lamp, invented by Mr. Bynner: his cap of brass (see *figs.* 134, 135, 136) had the advantage of being more durable than the glasses, which are very apt to break. But, as the principle was not new, the patent for the solar lamp could not be maintained, notwithstanding it was the first lamp by which the common fish oil could be burned without smoke. The idea of causing the air to impinge upon the flame in the manner just mentioned was a happy thought that has given rise to other improvements, of which the solar lamp, and the oxydators mentioned in p. 187, are examples; and the glasses have been still farther improved by being contracted in the manner shown at *e*, *fig.* 137, which, indeed, answers all the purpose of the oxydators, except not being so durable.

710 *b*. *Young's patent Vestal lamp*, usually known by the name of the *Camphen lamp*, has advanced nearer to perfection in several respects than any that has yet appeared; and it was only while this article was passing through the press that our attention was directed to this, the latest improvement in lamps. To render the nature of this lamp quite evident, it is necessary that we enter previously into a few details.

All constructions of the Argand lamp, where the oil is made to rise simply by the capillary attraction of the wick, are found to be imperfect, requiring that the oil shall be replenished very frequently, which rendered it necessary to have the oil in a reservoir on one side, that it might be on a level with the flame; but the inconvenience of this reservoir, in causing a shadow, has been already mentioned in our description of that lamp, and gave rise to the French annular lamp, and others of that class. The solar lamp, having the oil altogether below the flame, is liable to the objection that it will not burn long clear without being replenished with oil. In all oil lamps there is an accumulation of carbonaceous matter upon the wick, less or more according to the purity of the oil and completeness of the combustion. These circumstances, together with the high price of oil, and particularly of sperm oil, the only one fit for the ordinary Argand lamp, have led to several attempts to burn other liquids, as naphtha and turpentine. The disagreeable odour of the former rendered it inadmissible into apartments, and neither it nor turpentine could be employed in the Argand lamp of the usual construction, since their great inflammability rendered them unsafe, when the liquid was at all heated by any metallic part of the lamp coming into contact with it in the reservoir. To avoid this danger, Mr. Young enclosed his liquid in a glass reservoir, and prevented its being in the least heated, by permitting the cotton wick only to pass into it; and the liquid being thinner than oil, easily rose in the wick by mere capillary attraction. After trying several combustible liquids, he found that rectified turpentine was the best adapted for burning in his lamp, which is now frequently known to the public by the name of the *Camphen lamp*, from the name given to this liquid by Mr. English, who had taken out a patent for its preparation.



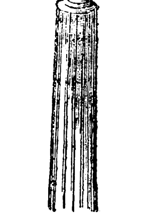


Fig. 139.*

710 *c*. Young employs a cylindric wick of cotton, but this has a slit at about an inch and a half from the top, represented at E, *fig*. 139,* as upon the mandrel ready to put into the lamp. The lower part of this wick hangs down into the camphine. Instead of this wick being cylindrical, it may consist of two, three, or more flat slips of cotton arranged in a circular form, and held together at the top, where they burn, by a ring of metal.

A, *fig*. 139,* represents the upper part of this lamp, displaying its internal structure. *a* is the cylindrical wick put over a brass tube by means of a mandrel, and *e f* is another brass tube of larger diameter, leaving a space between it and the wick. In the side of *e f* there is an opening, *g*, through which the air is admitted to ascend between the two tubes, to supply the outside of the flame of the wick when it is lighted; and by the same means the air is admitted through the slit in the wick in the inside of the flame. The dotted lines show this wick hanging down into the camphen in the glass reservoir, *h*. The flame at *a* is made to strike on a metal button, *i*, by which it diverges outward like the petals of a flower, which is shown more at large at C, where the dotted line represents the glass with its contraction. The brass cap, *k*, carrying what has been described, screws on to another brass cap, *l*, fixed to the glass reservoir, *h*; and to prevent all communication of heat to the camphen, a piece of wood is interposed between the two caps, as being a bad conductor. The whole of this apparatus may be fitted into the stand of an ordinary lamp by means of the glass foot, *m*.

B represents the same upper part as completed by some additions; *n* is a perforated cylindrical tube to conceal the aperture by which the air is admitted to the flame; *o* is the part necessary for inserting the bottom of the glass represented by the dotted line; and *p* is a screw by which the height of the wick is adjusted; *q* is a stage on which rests a ground-glass moon to soften and distribute the intense light of the flame.

D represents the lamp complete on a stand, but without the ground-glass moon, or conical paper shade, which is sometimes also used, as is represented in Parker's hot oil lamp, which throws down a strong light round the foot of the lamp.

710 *d*. One of the great advantages of the Vesta lamp is, that there is no deposition of carbonaceous matter upon the wick, provided the camphen is used quite fresh; and from the simplicity of its construction, the management of it is easy, the wick requiring merely to be cut even every time it is used; nor is this even always necessary, as there can be no overflowing of the liquid, a defect to which the Argand lamp is liable, and which demands the addition of a cup to catch the oil that may drop; here no cup is required, nor is the turpentine liable to damage the carpets and other furniture in the same manner as oil. But it is proper to observe that the camphen must be kept quite

close from the air in a tin can, and no more poured into the reservoir than is required for one burning, or at most two, because the rectified turpentine attracts oxygen from air rapidly, and what has been exposed for a day or two in the reservoir is not fit for combustion, as it will give smoke. The proper rectification of the turpentine appears to be essential to the success of this lamp. Another precaution must be mentioned, which is, that the liquid, being highly inflammable, the greatest care must be taken that it does not take fire by any accident in filling the reservoir, or pouring it out in any way; since, in case of such accident, the flame is violent and difficult to extinguish; but it is to be observed that the turpentine is not very easily inflamed, except when heated, which it is not liable to be in the glass reservoir on the construction above mentioned; but this effect would happen were it used in a common Argand lamp, or any other lamp having a metal tube going into the liquid. The total absence of such a tube is one of the peculiarities of the Vesta lamp.

710 *c*. *The printed report by Dr. Ure* is subjoined, not only as stating some properties of this lamp, but because it affords information respecting combustible liquids:

"The Vesta lamp, burning with its utmost brilliancy, without smoke, emits a light equal very nearly to twelve wax or sperm candles of three or four to the pound; and in so doing it consumes exactly one imperial pint of spirits of turpentine (value sixpence, retail) in ten hours; hence the cost per hour for a light equal to ten such candles is one halfpenny, whereas that from wax candles would be nearly sixpence; from spermaceti ditto, fivepence; from stearin ditto, fourpence; from Palmer's spreading wick, ditto, nearly threepence; from tallow moulds, 2½*d*.; from sperm oil in Carcel's mechanical French lamp, 1½*d*. One peculiar advantage of the Vestal lamp is the snowy whiteness of its light, which is such as to display the more delicate colours of natural and artificial objects, flowers, paintings, &c., in their true tints, instead of the degraded hues visible by the light of candles, and ordinary oil lamps.

"The size of the flame from which so much light is emitted in the Vesta lamp is greatly smaller than that of oil or gas Argand flames of equal intensity; a circumstance to be accounted for from the difference in chemical composition between spirits of turpentine and fat oils. The spirits consist entirely of carbon and hydrogen, in the proportion of 88½ of the former element and 11½ of the latter, in 100 parts, and they consume 328 of oxygen; whereas sperm and other unctuous oils consist of 78 carbon, 11½ of hydrogen, and 10½ of oxygen, in 100 parts; and these consume only 287·2 of oxygen in being burned, because the oxygen already present neutralizes 2·6 parts of the carbon, and 0·4 of the hydrogen, thus leaving only 85½ parts of the combustible elements of the atmosphere to burn, for this reason: 87½ parts by weight of spirits of turpentine will consume as much oxygen as 100 parts of sperm oil, and will afford, moreover, a more vivid light, because they contain no oxyde, as fat oils do, which serve to damp the combustion. In the spirits of turpentine the affinity of its elements for oxygen is entire, whereas, in fat oil, the affinity is partially neutralized by the oxydes it contains, somewhat as the flame of spirits of wine is weakened by their dilution with water."

Mr. Young has also prepared lamps upon similar principles, but on a smaller scale, in several forms, for giving light in chambers of various sizes. To this we may add that the principle of Mr. Young's lamp, by which air is admitted to the interior of the flame by a slit in the wick, is applicable also to the solar lamp burning oil, with a ring flame, to the interior of which hitherto the air has been admitted only from below, by a tube passing down through the reservoir.

Sect. XIII.—Lamps for Reading.

711. *A lamp for reading, writing,* or *drawing* should have the light thrown immediately upon the most convenient part of the table.

An Argand's lamp, with a conical shade, forms an excellent lamp for these purposes; but they consume more oil than is usually required, and, consequently, give too much heat. If the hollow wick is made very small, it is difficult to get the lamp to burn well. A flat wick, well trimmed, with a glass chimney, and the best oil, such as watchmakers use, make a good economical lamp for these purposes.

712 *Fig.* 140 *is another lamp on a superior construction* for the same purpose. *a* is a tin cylinder, containing the oil, which has a valve at the bottom, made to open by a wire in the same manner as the fountain lamp. In this lamp the wick is flat, or it may be circular, upon the plan of Argand's. It is made of tin, japanned, and is much used by engravers: though not so elegant as some others, it forms a powerful reading lamp, price ten shillings.

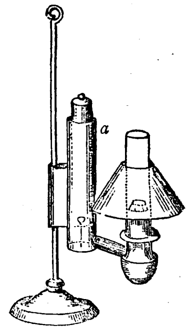


Fig. 140.

713. *The Rumford lamp*, A, *fig.* 141, was first made with a flat wick, and, though not elegant, is a good reading lamp. It may be used with an Argand burner. B, *fig.* 141, is a reading lamp with a reservoir for oil, on the principle of the French circular lamp.

714. *The University lamp*, A, *fig.* 142, is much used as a reading lamp: it is on the Argand principle, with a small wick; but as the reservoir is not above the light, it does not burn many hours without replenishing.

715. B, *fig.* 142, *represents a reading lamp of an uncommon construction.* The shade is double, and serves also as the reservoir for the oil between the two thicknesses; the lamp is Argand, and being supplied from a higher source than the flame, has the advantage of burning long. The inside of the shade is japanned white; and the whole outside is gilt. This lamp will be peculiarly useful where it is required to have a very strong light on the table.

716. *A globe of glass filled with water*, with a light placed before it, is used by the French peasants who make lace; by this means the light of a single lamp is thrown with extraordinary vividness along a whole range of these industrious workers.

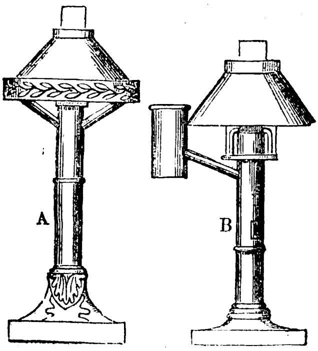


Fig. 141.

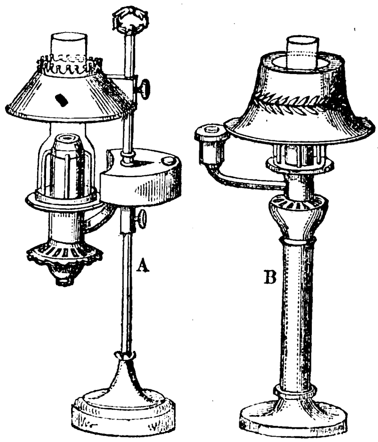


Fig. 142.

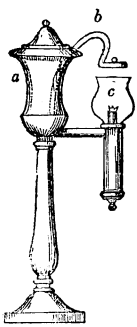


Fig. 143.

Sect. XIV.—lamps to burn solid oils.

717. *Lamps to burn oils that are not sufficiently solid to make into candles, and yet too thick to burn well in common lamps,* as palm oil, tallow, hogs' lard, &c., require a particular contrivance. A piece of metal is made to come over the flame, so as to be heated by it, and then this piece communicates with the oil in the reservoir, which is, by the heated metal, kept always in a liquid state. The Hon. E. Cochrane took out a patent for a lamp of this kind. *a, fig.* 143, is the reservoir in which the material is to be burned; *b* is a bent metal rod, one end of which comes over the flame *c*, and the other passes into the interior of the reservoir, among the solid matter, which is thus melted by its heat, and enabled to flow to the wick.

Sect. XV.—wax lamps.

718. These are found more convenient for some purposes than wax candles, as, the flame being always at the same height, anything may be boiled or warmed over it with more ease. Travellers have found them useful in this way for keeping coffee warm, or water for shaving; and they have this advantage, that the wax very soon gets solid after the flame goes out, so that the lamp with its wax may be packed away among the luggage without danger; whereas it is almost impossible to keep an oil lamp from doing some kind of damage. A cup is sufficient for holding the wax; and the burner, of tin plate, may stand in the middle of it. The wick should be of cotton thread, dipped in wax, and cut into short pieces; when one is consumed, it is sufficient to pierce the wax with a large pin down to the burner, and introduce a fresh one. The best way of extinguishing wax lamps, so as to preserve the wick for re-lighting, is to overcharge it with wax, by holding a piece of wax over it till it melts and falls on the wick, reducing the flame, which may be then put out by a gentle puff.

Sect. XVI.—lamp without flame.

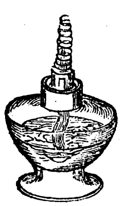


Fig. 144.

719. *A curious night lamp, without flame,* is made, *fig.* 144, from a philosophical principle discovered by Sir Humphrey Davy. If a cylindrical coil of very thin platina wire be placed partly round the wick of a lamp with spirits of wine, and partly above the wick, and the lamp be lighted so as to heat the wire to redness; on the flame being blown out, the mere heated vapour rising from the spirits of wine will be sufficient to keep the upper part of the wire red hot for any length of time that the spirit remains. This beautiful and simple contrivance will give sufficient light to see the hour of the night by a watch, or to do anything that requires very little light, and will not be liable, as a flame, to disturb persons not accustomed to burn a light. It has also the convenience of being always the same, requiring no trimming, and being peculiarly safe, as it can give no sparks. Its heat is sufficient to kindle German tinder, or paper prepared with nitre, and thus to light a sulphur match. The size of the platina should not exceed one hundredth of an inch. A coil of twelve turns is sufficient. When the wire collects a crust round it, it

may be brightened, and made to act as well as at first, by uncoiling and rubbing it with fine glass paper.

This curious effect is produced by the heat of the wire being sufficient to cause the invisible vapour of the spirit to combine with the oxygen of the atmosphere, and thus to burn, although the heat is not great enough to occasion that kind of combination which gives rise to the emission of light. It is, in fact, an *invisible* combustion of the vapour of the spirit which continues to rise, and which, being extremely inflammable, was set fire to by the red-hot wire in the first instance; the constant production of vapour, through evaporation, causes its invisible combustion to maintain the wire in a state of red heat as long as it is immersed in it. As the decomposition of the alcohol, and the union of its hydrogen and oxygen, give rise to acetic acid, which has an unpleasant odour, it has been proposed to use *eau de Cologne* instead of spirits of wine, which would diffuse an agreeable fragrance. With respect to this lamp, it must be observed that it is to be considered rather as curious, and illustrating some chemical principles, than as particularly useful.

SECT. XVII.—CARRIAGE LAMPS.

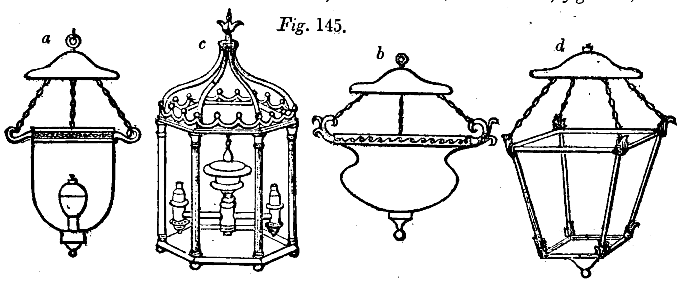
720. In ordinary carriages for travelling, the light is an oil lamp of the common kind, with either a round or flat wick. Attempts have been made to use Argand's lamps, but hitherto without success, as they are liable to be extinguished by a violent draught of wind. In carriages of the best kind, wax candles are used for the light, on account of their superior cleanliness, although their light is inferior to oil.

The wax candles are contained in tin tubes, through a hole in the upper part of which the wick passes, the candle being pressed upward as it is consumed, by a spiral spring. In dress carriages the lamps are more ornamental, consisting of circular boxes of glass, in which are burned wax candles. The lamps of travelling carriages are square, and have wooden slides to shut before the glass in the day: sometimes they have reflectors.

SECT. XVIII.—HALL LAMPS.

721. These are either of the vase kind, when small, as *a* and *b*, *fig*. 145, or consist

Fig. 145.



of panes of glass in frames, as *c* and *d*; and the lights may be, in the first case, simple lamps with one or more wicks, or Argand lamps, when a stronger light is required. Of course, it is essential that a supply of air shall be given to the light by proper openings in the containing vessel. A glass is suspended over the lamps, when they are not Argand's, to collect the smoke, which otherwise would blacken the ceiling.

SECT. XIX.—CANDELABRA.

722. *Candelabra are elegant stands*, or supports, to place lamps upon, or they are stands terminated at the top by branches for candles. Such stands were in common use among the ancients, from whom we have adopted them. Of antique candelabra, great numbers have been found in Italy, and form some of the finest examples of exquisite taste in design and execution. They are of two kinds: those of a large size in marble, as *a*, *fig*. 146, which were used in temples or in large halls, and sometimes contained braziers, or basins on the top, for holding combustibles. Some of these bear a resemblance to altars, and were perhaps used for burning incense. A very fine antique marble candelabrum may be seen in the Townley Collection in the British Museum. The other kind was of bronze or other metals, as *b*, *c*, of a more slender form, and were chiefly employed in domestic edifices. Great numbers of them have been found in the excavations in Herculaneum and Pompeii, and are to be seen in the museum of Portici. In many of these the shafts represent a knotted cane, or a spiry branch, with truncated shoots and leaf stalks. They may be cited as instances of the taste with which the ancients adapted ornaments to things of common use, at the same time preserving the type of the objects which gave rise to any useful invention. Cicero informs us that, in Sicily, no great house was without some of these utensils, made of silver. In modern times, the invention of candles occasioned this kind of elegant furniture to

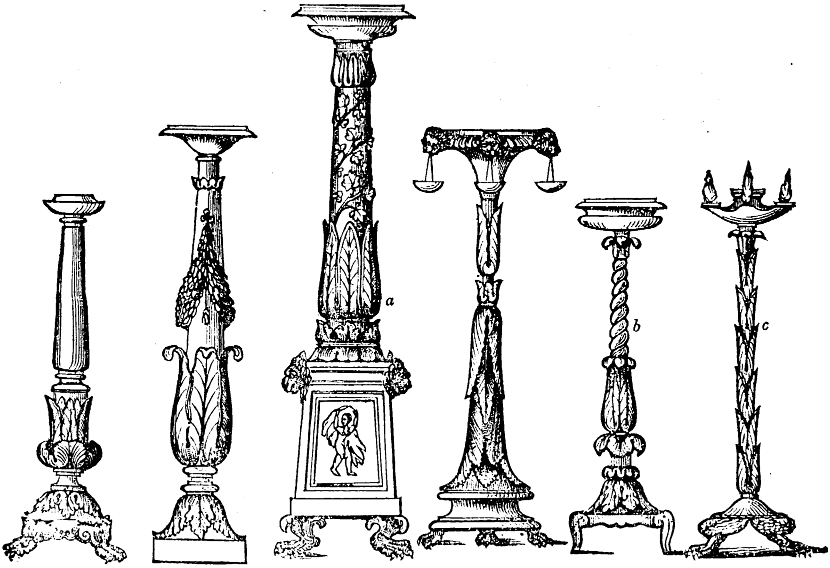


Fig. 146.

go out of use. In Italy, the practice of placing round the altars in churches large chandeliers to hold wax candles seems to be in an imitation of ancient customs, and the size and shape of some of these preserve a tolerably just idea of the ancient candelabra; but they differ essentially from them, in having a socket for the candle, and still more in the choice of forms and taste of ornament. Of late, it has been the fashion here, in the houses of the nobility and wealthy, to have candelabra in elegant apartments, to support lights of various kinds, and many of these are accurately copied from the antique, or designed in the same style.

Sect. XX.—VERY INTENSE LIGHTS.

723. The intensity of the light, in some cases, is very important; and this has occasioned some very accurate experiments to be made upon the various substances employed for producing light. The various animal and vegetable oils have been tried, of which spermaceti oil has been found to give the most light: cocoanut oil is inferior. Gas has likewise been tried, but nothing was gained in intensity of light.

724. *In lighthouses*, it is not only necessary to have a strong light, that may be seen at a great distance, but it is required likewise to have the lights varied, so that the light of one lighthouse shall be distinguishable from that of another. For this purpose, three kinds of lights are employed: a fixed white light; a revolving light, which shall appear and disappear for a minute or two alternately; and likewise coloured lights; the latter are produced by the use of coloured glasses.

725. *The concentric wick lamp, with a double current of air*, was first invented by the writer of this article, upward of thirty-five years ago, and was announced by Sir H. Davy, at the Royal Institution, as very useful for chemical purposes; affording a much more intense heat and light than any lamp at that time made. It consists of two circular wicks, like Argand's, one within the other, and, of course, two concentric flames. A great many of them were sold by Messrs Accum and Garden, Compton-street, London, for chemical purposes. A lamp on the same principle, with four concentric wicks, has since been constructed by M. Fresnel, for lighthouses, which, according to Dr. Brewster, gives a light equal to forty common Argand flames. An inconvenience in the use of these double wicked lamps, when used for ordinary light, is the intense heat they produce, which is, however, very advantageous in a chemical laboratory.

726. *The most intense light that can be produced* is that known here by the name of the *oxy-hydrogen light.* This method consists in projecting a stream of oxygen gas, and another of hydrogen gas, brought into union, in an ignited state, upon a small ball of lime. The light produced is, indeed, so intense as to be insupportable to the eye. By a small ball of lime, only three eighths of an inch in diameter, so brilliant a light is emitted, that it is equal to thirteen Argand lamps united, or 120 wax candles. This light has been successfully employed in various ways: as signals, in surveying; in lighthouses; and in illuminating the microscope, by which means an extraordinary

magnifying power can be used. Exhibitions of these microscopes are now well known: the light is in that case passed through a lens, and it throws the images of objects magnified from 10,000 to 500,000 times, in the manner of a solar microscope, upon a disk of fourteen feet in diameter. It is proper to mention that the original invention of this light does not appear to belong to Lieut. Drummond, as it has been claimed by Prof. Silliman, of North America.

727. *In the original Bude light*, invented by Mr. Gurney, the light was produced by passing a stream of oxygen gas through the wick of an Argand oil lamp; in consequence, a most intense and beautiful light was formed. But the light now known as the Bude light is stated to be "nothing more than an ordinary gas flame from three or more large concentric Argand burners, the air passing up through the centre being only atmospheric air, with chimneys and reflecting apparatus of particular construction." In this latter case, the principle appears to have been borrowed from the concentric wick lamp described above. The Bude light has been found very advantageous in large interiors, such as the House of Commons, and churches.

Sect. XXI.—Management of Lamps.

728. *From the great heat which fixed oil gives out in burning, it scorches and chars the wick*, changing its texture, so that it does not imbibe the oil so fast as at first. The oil also deposites, and particularly the impure oils, a quantity of carbonaceous matter upon the wick, which, constantly accumulating, clogs it to such a degree that the oil cannot ascend, causing the lamp to burn dim. On this account, after a lamp has burned a certain time, it is necessary to cut off the portion of the wick that has been so acted upon, and to kindle the portion below it. This is called *trimming the wick*. A remedy for this has been attempted by making the wick of incombustible materials, as asbestos or wire; but this has not succeeded. There is, however, a considerable difference in various oils, with respect to their liability to clog the wick. The purer the oil, the better will be the light it gives; and it will, in general, in the best lamps, be found most economical to use the best oil instead of the cheapest; bad oil occasioning smoke, much trouble, and injury to the lamps.

729. *Lamps in which the wicks lie horizontally*, and that come in contact with the air, are not so liable to gather this accumulation of coaly matter as those which are upright. The wick of the Argand lamp also collects very little, on account of the current of air inside and outside the flame. A number of small wicks, placed near together, will not accumulate so much black matter as a single large wick, because in the small wicks the air penetrates into the group of flames.

730. *Although fixed oil remains fluid at our ordinary temperature, yet it congeals in very cold weather.* It becomes thick, and though not quite solid, yet too much so to be drawn up by the wick. When it is found in this state, it must be placed at a little distance from the fire to make it become liquid. It may be interesting to mention that the thickening of the oil by cold is an imperfect kind of crystallization; and that Dr. Clarke found at one time, that it had formed regular crystals; the temperature 35°.

731. *In the management of the simple lamp*, several things are necessary to be observed. The wick should not be twisted too much, for if it be too compact the oil will not rise readily in it; nor should it be too loose, for this will cause the capillary attracting power to raise too much oil. With regard to the distance of the flame from the surface of the oil, if it be too near, too much oil will be raised, more than can be readily consumed; in consequence the light will be weak, and the flame will be in danger of being put out. If the distance be too great, the capillary attraction will not raise oil enough. From this it is obvious that most lamps require constant attention to the wick, otherwise the light will be very unequal. It is an improvement to have the wick pass through a very short tube, which assists in raising oil equally.

732. *Cotton is found to be the best material for forming wicks;* so remarkably is this the case, that spun cotton was imported from the Levant for the wicks of lamps in England, ages before it was made use of by the weaver.

733. *Argand lamps require particular care.* It is necessary that they should be trimmed daily; and they should be thoroughly cleaned out twice or thrice every year by pouring warm water into them, having a little pearlash dissolved in it; this will bring away the oil that has thickened and collected in the tubes, thus clogging them up and preventing the passage of the oil and air. The alkali or pearlash in this operation combines with the oil, and forms a soap, which, being soluble in water, easily comes out by agitation. Warm water alone might melt the oil, but it could not dissolve and bring it away like the alkali.

It is also necessary, in trimming, that the wick should be cut *perfectly* level with scissors; any ragged bits on the edge of the wick occasion the flame to be uneven and to smoke in some places. Care should be taken that the holes through which the air is supplied to the interior of the flame are not stopped up, as they are apt to be, with bits of cotton, tow, and oil, during the cleaning and trimming; if they are clogged, the supply of air is not sufficient, and the lamp will smoke.

SECT. XXII.—EXPEDITIOUS METHODS OF PROCURING LIGHT.

734. There are many occasions when there is a necessity for procuring a light where no fire is at hand; either for the purpose of kindling a fire, or of lighting a lamp or candle; and though most of these methods are now pretty well known in this country, yet it will be proper to say something respecting them, to point out the advantages of each, and, in some cases, the danger in using them.

735. *Flint and steel.* This simple and ancient method of procuring a light is still one of the best, notwithstanding several late inventions have some advantages. The flint made use of is of the same kind as is used in muskets and fowling-pieces, but the pieces are of a larger size, and are made somewhat of a wedge form, for the convenience of striking fire more readily; this kind of flint is found nowhere but in the chalk strata. The steel usually employed is made of a convenient form, and should be well tempered; an old file will do as a make-shift upon occasions when no proper steel is to be had.

It is important that the tinder should be carefully burned and kept dry; the brimstone matches are well known. When the flint, steel, and matches are in perfect order, nothing is more easy than to procure a light by this apparatus, and its perfect safety is a great recommendation; a single stroke of the flint is generally sufficient to set fire to the tinder, and the match lights by slightly blowing up the ignited tinder; and yet how often do we hear repeated hammering with the flint and steel before the desired effect is produced? The cause is generally this: the flint, which is not expensive, has been so much used, that all its sharp edges are worn off, and these are necessary to act upon the steel; or the tinder is damp, or badly made, or in too small a quantity. To keep a tinder-box in order, the flint should be renewed when it is too much worn, for which purpose a stock should be at hand, or by dexterously breaking one of the sides with a hammer, a new sharp edge may be procured. For keeping bad tinder there is no excuse. The cause of the appearance of sparks of fire when flint and steel are struck against one another deserves to be explained. The sparks do not come from the flint, as is frequently supposed; but they are little chips of steel which are cut off by the sharp edge of the flint, the heat produced by the sharp blow or friction of the flint and steel together being so great as to set fire to and melt in a red hot state the little bits of steel struck off; for steel is really an inflammable substance, although a piece of it cannot be burned in an ordinary fire; but to show distinctly the inflammability of steel, it is only necessary to throw a pinch of steel filings into the fire or across the clear flame of a lamp, and it will be seen that they burn with a vivid light. To prove that the sparks are only little red hot and fused bits of steel, strike them over a sheet of white paper, and having collected them when cold, examine them by a good magnifying-glass, and it will be seen that every one of these consists of a little rounded ball of black scoriaceous iron or steel, that has been burned, and rendered brittle, and is analogous to those which fly off in smiths' shops when hammering iron.

Tinder is linen rags reduced to charcoal, which is more inflammable than the rag itself. The heat of this, however, in so small a quantity, is not sufficient to set fire to wood; and therefore the ends of the matches are covered with sulphur, which kindles with the small degree of heat excited by blowing the tinder. When once the sulphur or brimstone is perfectly kindled, it sets the wood on fire. It may be observed that the temperature of the blue flame of the sulphur is inferior to the bright flame of the wood in the match, since the former will fail in kindling many substances that the latter will set on fire; as, for instance, the wick of a candle. In cases where no tinder can be procured, other light inflammable substances may be used; as extremely dry leaves; cabinet-makers sometimes employ very fine deal shavings.

736. *German tinder or amadou,* which is so easily ignited by a spark from the flint and steel, is made of a species of fungus called *Boletus ignarius*, that grows upon the barks of trees. It is beaten well to make it soft and pliable, and then boiled in a solution of saltpetre to render it more liable to catch fire. The Germans use it much for lighting their tobacco-pipes; and sometimes keep it burning all night for this purpose, a practice extremely dangerous.

Loosely-twisted cotton, dipped in a solution of nitre, has been found to prove a substitute for the amadou, and to kindle equally well.

737. *The match syringe* is a mode of lighting tinder by condensed air. A small piece of tinder is put into the end of a metal tube, and the bottom screwed on; into the other end a piston that fits tight is inserted; when this is forced suddenly to the bottom, where the tinder is lodged, the latter is ignited, and, by unscrewing the bottom, may be taken out ready to kindle a match. This curious effect is owing to the disengagement of the latent heat contained in the air, condensed or compressed by the syringe.

738. *A burning-glass* affords another method of obtaining a light when the sun is sufficiently powerful. This is a convex lens of glass, which, by conveying all the rays of the sun that fall upon it into a small space at its focal distance, occasions a degree of heat in proportion to the size of the lens. A glass of an inch and a half in diameter, or even less, is sufficient to set fire to any light inflammable substances, of which am-

adou or German tinder is the best. Very large lenses are capable of exciting a degree of heat superior to that of a furnace; the most powerful glass of this kind was thus made some years ago by Mr. Parker of Fleet-street.

739. *The air lamp* was an apparatus for procuring an instantaneous light by acting on inflammable air by electricity; the inflammable gas was contained in the lower part of the vessel, and was forced out through a pipe, when it was wanted, by the pressure of water in the upper part. An electrophorus was at the same time made to give a spark, which fired the gas and produced a flame. It was, however, found difficult to keep in order, and there was some danger of explosions; it is not now used. See *Rees's Cyclop.*, art. *Air.*

740. *Garden's platinum light.* A very curious discovery was made in 1824, by Professor Dobreiner, of Jena, who found that platinum, prepared in a spongy form, possessed the singular property of causing a jet of hydrogen gas thrown upon it to inflame in consequence of its union with the oxygen of the atmosphere; and the heat thus excited is sufficient to render the platina red hot, at which a match may be lighted. Upon this principle an apparatus for procuring an instantaneous light has been constructed by Mr. Garden, 272 Oxford-street, London, as follows: *a* and *b*, *fig.* 147, are two glass vessels, the neck of the upper one being fitted air-tight into the lower by grinding. A hollow cylinder, *c*, is fixed upon the neck of the vessel *a*, and reaches more than half way down into *b;* round this tube a piece of zinc is wrapped. A quantity of diluted sulphuric acid is poured into the vessel *b*, which, acting upon the zinc, produces the hydrogen, which rises to the top of the vessel, but, not being able to escape, it collects there, and forces the acid to ascend through the tube into the upper vessel, the air in which escapes through the stopper loosely fitted. As soon as the production of hydrogen has gone on so far as to occasion the acid to descend to the lower part of the zinc, all farther action, of course, ceases, and the upper part of *a* remains filled with the gas. From this part of the vessel, a tube, *d*, projects, furnished with a stop-cock, and the extremity of this tube turns downward, terminating in *e*, where a jet of hydrogen issues on opening the cock. Immediately below this is a little cup, *f*, to hold the spongy platina; and this cup may be moved farther off or nearer by means of the wire, *g*, which slides up and down through a collar. When a light is wanted, the cock is turned, a jet of hydrogen falls upon the platina, which inflames the hydrogen, and is itself made red hot, and capable of igniting a match. This glass apparatus is sometimes, for security, fitted up in a mahogany frame of elegant form, and is extremely convenient in a library or bedchamber, being quite free from the usual objections to apparatus of this kind. It will continue fit for use until the zinc becomes quite dissolved or the acid saturated, when it must be replenished with these materials. The little cup with platina is secured from damp and dust by a brass cap; and should the platina, by dampness, lose its property of igniting the gas, it may be restored by heating it on the blade of a knife over a spirit lamp, or clean candle.

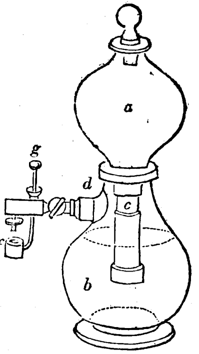


Fig. 147.

The spongy platina is prepared by moistening the muriate of ammonia and platina with a concentrated solution of ammonia; the paste formed is to be heated to redness in an earthen or platina crucible.

741. *Pyrophorus.* Several prepared substances take fire on exposure to air, without the application of heat, which were formerly used occasionally for obtaining a light: a substance of this kind was called by chemists *pyrophorus*; and though better methods have since been invented, it may be useful, on some particular occasions, to be acquainted with their composition. *Homberg's pyrophorus* was the oldest discovery of this kind. It was made by mixing three parts of alum with two or three parts of honey, flour, sugar, or any animal or vegetable matter: this mixture is to be heated in a crucible till the mass is burned black; or, to save trouble, burned alum may be mixed at once with charcoal powder. This is now to be put into a vial, or a matrass, with a neck six inches long. The vessel, however, must not be charged above three quarters full: it is then to be put into a crucible, and surrounded by sand; the crucible is to be put into a furnace among red-hot coals, and kept in a red heat for a quarter of an hour, till a sulphureous blue vapour appears, and the fire is to be kept up till this disappears. The matrass is next to be removed, and its mouth kept closed for some time. The powder is then to be taken out and kept in a vial, with a glass stopper. A little of the pyrophorus shaken out on an easily-inflammable substance, such as dry cotton, will set it on fire immediately. A very good pyrophorus may be made by simply mixing three parts of alum with one of wheat flour, calcining them in a common vial, well stopped with a good cork, when cold.

742. *Phosphoric fire bottles.* Phosphorus takes fire very readily when rubbed, which property has been employed in procuring an instantaneous light. A common match is

dipped into a small bottle containing phosphorus, a minute portion of which adheres to it; the match is then rubbed lightly upon a smooth piece of cork, which causes instant combustion. The manner of putting in the phosphorus is the following: a very small glass vial is procured, and any substance put in to fill it within a small distance; then eighteen or twenty grains of phosphorus is cut into small pieces and put into the remaining part of the vial, leaving room for the cork. The part of the vial containing the phosphorus is heated cautiously with a blowpipe till the phosphorus melts, and the bottle is completed. These fire bottles are rather dangerous.

743. *A fire box is made* by dipping matches charged with chlorate of potash (formerly called oxymuriate of potash) into sulphuric acid, which causes instant ignition. These boxes have been very much used. The matches are prepared by dipping them into oil of turpentine, and drying them; a mixture is then made of an equal weight of finely-powdered chlorate of potash and flowers of sulphur, to which is usually added about an eighth part of vermilion, merely to colour it. This compound is then mixed up with oil of turpentine to the consistence of a paste, and the points of the matches dipped into it. Some asbestos is put into a very small vial, and on that a few drops of strong sulphuric acid: the use of the asbestos is merely to prevent the acid from doing mischief by spilling. Some use sugar instead of the sulphur, and employ spirit of wine to make the paste. Vast quantities of these are used in Paris, and are got up in circular paper cases at a very small expense. It is necessary to put those who attempt to make their matches upon their guard against serious accidents which may happen in the process. The mixture will explode by friction or percussion in a mortar, and the explosion of a few ounces might prove fatal. The substances, therefore, must be rubbed together very gently. But we would not recommend any one to attempt making these matches, except they are well instructed in the necessary precautions. The front of a shop has been blown out by an explosion of this kind, and the operator was seriously hurt.

744. *Prometheans* for procuring an instantaneous light appear as little rolls of paper that contain some red substance enclosed at one end. When you wish for a light you lay the red end of the paper on a table, and give it a knock with a hammer, key, or other hard body, on which the paper inflames. The principle upon which this effect is produced is the following: it is a chemical fact that a mixture of the substance called chlorate of potash with sugar inflames when it comes into contact with sulphuric acid. Now the red substance in the paper is this mixture, and in that substance there is a little glass hollow bead that contains sulphuric acid. When the end of the paper roll is struck, the bead is broken and the acid liberated, which inflames the chlorate. The making of prometheans is rather a difficult operation, and we would not recommend any one not well versed in chemical experiments to attempt it, as the substances are extremely apt to explode by handling.

745. *Lucifers* or *Congreves* are matches prepared by dipping them into phosphoric preparation, which is inflamed by being rubbed sharply on a piece of glass paper, or any other rough substance. They are, perhaps, on the whole, the most convenient and the safest of any contrivance of this kind, as they are not liable to spoil by keeping, nor to inflame spontaneously. They are, at present, sold at a very low price. For safety, they should be kept in a metal case, as friction by some accident may set them on fire

CHAPTER V.

ILLUMINATION BY MEANS OF GAS.

746. *History of gas light.*—Illumination by means of inflammable gas affords one of the most striking instances of the adaption of scientific discovery to the comforts and elegances of life; and it is the more remarkable, since this vast improvement is altogether within the memory of many persons now living.

747. *It had been shown by Dr. Clayton, in* 1688, that the air which comes from bituminous coal, when subjected to a red heat in a retort, is inflammable, and burns with a bright flame. Dr. Watson, bishop of Llandaff, also, in his "Chemical Essays," mentions his having ignited gas produced by the distillation of coal.

748. *Mr. Murdoch, engineer to Messrs. Watt and Boulton, was the first person who put in practice the idea of producing light on an extensive scale by means of this gas.* He commenced his experiments on this subject in 1792, when he applied it to the lighting of his own house at Redruth, in Cornwall; and afterward to that of the extensive manufactory of Watt and Boulton, at Soho, near Birmingham, on the occasion of the celebration of the peace of Amiens in 1798. But, notwithstanding these successful experiments, and also that several manufactories in Birmingham, Manchester, and other towns were lighted with gas, under the superintendence of Mr. Murdoch, an account of which was published in the transactions of the Royal Society in 1808, so little was

the public in general acquainted with the merits of this invention, that, a few years afterward, Mr. Windsor exhibited the gas light in London as an invention of his own; at least, it was so understood generally; and it was at that time looked upon by most persons merely as a speculation calculated to delude, and not likely to be carried to the extent that was represented. The continual and successful exhibition of this kind of light, however, at the Lyceum Theatre, and in Pall Mall, induced many to inquire into and discuss its merits, and, at last, a company was formed for the purpose of lighting the streets of London. The success of the project is too well known for us to carry its history farther. We shall only observe that, at present, the number of gas lamps for lighting the streets is upward of 168,000, and that above 200,000 chaldrons of coals are annnally employed in generating the gas.

749. *Nature of coal gas.* We have already explained that the flame from coals burning in a common fire proceeds from the combustion of the carburetted hydrogen gas that is volatilized and set free; and every one must have observed that, occasionally, jets of flame from some parts of the coal are extremely bright, proceeding from very pure gas. It was natural to imagine that, if this gas could be collected by any means in proper reservoirs, and afterward forced out through small apertures, it might serve, when set on fire, for the purpose of illumination instead of lamps or candles. To effect this, a quantity of coal is introduced into a closed vessel, generally of iron, placed in a proper furnace, by which it is heated so as to throw out the volatile parts, which are conducted, by means of pipes leading from the vessel, to the place where it is to be burned. But as all the products of the coal are not proper for combustion, and some of them are injurious, the gas is first conducted into vessels, where it is purified by several processes. After this it is passed into a recipient called a *gasometer*, from whence it is sent to the various places where it is to supply light. A familiar idea may be formed of this process by a very simple experiment. Put a few bits of good coal into the bowl of a tobacco pipe, and cover the top of it with pipeclay made into a thick paste. When this is dry, introduce the bowl of the tobacco pipe between the bars of the grate into a clear part of the fire, and let it remain till the whole is red hot. Apply now a lighted taper to the end of the stem of the pipe, and a flame will be seen, occasioned by the inflammable gas that issues from the decomposition of the coal. After the whole of the flame has burned out, the bowl will contain only coke.

750. *There are several varieties of inflammable gas.* Pure hydrogen gas, such as is produced by the action of diluted sulphuric acid on filings of iron or zinc, is extremely inflammable; but, though it affords much heat when burning, its flame is too feeble to be employed for artificial illumination. The hydrogen that comes from coal by the above process is united to a quantity of carbon, and is called *carburetted hydrogen*, which burns with a bright white flame. It is supposed that it is the combustion of the carbon that gives out the greatest quantity of light; for the greater the proportion of carbon the greater is the light. There are two varieties of carburetted hydrogen; one having more carbon than the other: that which has the most carbon, called *bi-carburetted hydrogen*, or *olefiant gas*, gives the greatest light; the other is usually termed *light carburetted hydrogen*, and is the same as what rises in bubbles from the mud of marshy places when stirred. The gaseous products from coal consist of a mixture of these, with some others; and a great deal of the beauty of the light obtained from coal depends upon the kind of coal employed, the modes of conducting the process of decomposition in the retorts, and likewise of purifying the gas afterward. It seldom occurs, in domestic economy, that this gas is prepared by an individual for private use; but there are cases, in very large establishments, where this is desirable. We shall describe, in general, the nature of the decomposition of coal for this purpose, as stated by Dr. Ure.

751. "*When coals are heated in a cast-iron retort to ignition*, the progress of decomposition is as follows: First, and before the retort becomes red hot, steam issues along with the atmospheric air. When the retort begins to redden, coal tar distils in considerable quantity, with some combustible gas, of which hydrogen, mixed with ammoniacal gas, forms a part. The evolution of gas increases as the retort becomes hotter, with a continual production of tar and ammoniacal liquor, as well as of sulphureous acid, from the pyrites of the coal, which unites with the ammonia. When the retort has come to a bright cherry-red heat, the disengagement of gas is most active. By-and-by the gaseous production diminishes, and eventually ceases entirely, although the heat be increased. In the retort carbonized coal or coke remains, while tar is found at the bottom of the receiver, covered with the ammoniacal liquor, and combined with carbonic and sulphureous acids, and sulphuretted hydrogen.

"If, during this distillation, the combustible gas be collected and examined at the several stages of the process, it is found to differ extremely in its luminiferous powers. That which comes off before the retort has acquired its proper temperature gives a feeble light, and resembles the gas obtained by the ignition of moist charcoal, consisting chiefly of hydrogen. That evolved when the retort has just acquired throughout a vivid red heat is the best of all, consisting chiefly of bi-carburetted hydrogen, or olefiant gas. From good coal it consists, for example, in 100 measures, of 13 of olefiant gas, 82·5 of carburetted hydrogen, 11·0 of carbonic oxyde, 1·3 of azote; the mixture having a specific gravity of 0·650. At a later period, as after five hours, it contains 7 measures of olefiant gas, 56 of carburetted hydrogen, 11 of carbonic oxyde, 21·3 of hydrogen, 4·7 of azote; the specific gravity of the whole being 0·500. Towards the end of the operation, as after ten hours, it contains 20 measures of carburetted hydrogen, 10 of carbonic oxyde, 60 of hydrogen, 10 of azote, with a specific gravity of only 0·345. The hydrogen becomes sulphuretted hydrogen, if there be much iron pyrites in the coal. The larger proportion of the gas is disengaged during the first hour, amounting to about $\frac{1}{5}$ of the whole; in the three following hours the disengagement is tolerably uniform, constituting in all $\frac{54}{100}$; in the sixth hour it is $\frac{1}{10}$; in the seventh and eighth hours $\frac{16}{100}$."

752. "*From these observations are derived the rules for the production of a good light gas from coals.* They show that the distillation should commence with a retort previously heated to a cherry red, since thereby good gas is immediately produced, and a portion of the tar is also converted into gas, instead of being simply distilled over into the condenser pit; that this heat should be steadily continued during the whole operation—from five to eight hours; that it should not be increased, especially towards the end, for fear of generating carbonic oxyde and hydrogen gases, as well as of injuring the retort when the cooling agency of gasification has become feeble; and that the operation should be stopped some time before the gas ceases to come over, lest gases with feeble illuminating power should impoverish the contents of the gasometer. Upon the average, a pound of good coal affords four cubic feet of gas, more or less, according to the force of the retort, and the manner of firing it."

753. *The gas as it comes from the retort is not, at first, adapted for the purpose it is designed to answer,* as it is easy to see from the above statement. It must be carefully freed from the tar and ammonia, and also from carbonic acid and sulphuretted hydrogen gases; the presence of which, especially the latter, would be highly injurious. Hence the purification of the gas demands the utmost vigilance on the part of those who superintend gas-works, and is the part of gas-making with which the public is chiefly concerned: an ill-conducted gas-work affords not only an imperfect light, but emits offensive and deleterious effluvia.

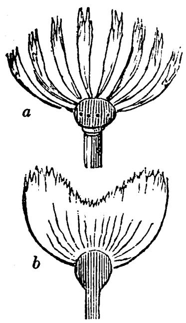
754. *The process of purification* is somewhat differently conducted in different works. In very large establishments, the gas is made to pass through a mixture of lime and water, which is kept in constant agitation. This limewater absorbs the ammonia, carbonic acid, and sulphuretted hydrogen. In smaller works, purification is sometimes effected by forcing the gas through successive layers of fresh-slacked lime. The purer the gas, the lighter it becomes; hence the specific gravity is considered as a test of its purity.

755. *There is much difference in the quality of coal for affording gas.* The most bituminous or caking coal is generally best; and the Newcastle coal is much employed; but the cannel coal yields the most gas. The sulphuretted hydrogen in coal gas, which is so injurious, proceeds from the sulphuret of iron, or iron pyrites, of which almost all coal contains a portion, more or less. The coke, which remains in the retorts after the gas has been extracted, is employed as fuel for domestic and other purposes.

756. *It is surprising to see with what facility and neatness gas lights are now managed.* The gas, being collected in a purified state in the reservoir or gasometer, is conveyed by tubes, which branch out into smaller ramifications, until they terminate at the places where the lights are wanted. The extremities of the branching tubes are furnished with burners having small apertures, out of which the gas issues with a velocity corresponding to its degree of pressure. Near the termination of each tube there is a stop-cock, upon turning which, when light is required, the gas instantly flows in an equable stream, and instantly inflames, on the approach of a lighted taper, into a brilliant, soft, and beautiful flame, requiring no trimming or snuffing to keep up equal brightness; and the quantity of gas that issues, and, of course, the height of the flame, is regulated simply by turning the stop-cock: it may be made to give a considerable flame, or one so low and dim as scarcely to be perceived.

757. *The gasometer,* into which the gas is collected in the gas-works, previously to its being sent out in pipes to be burned, is not merely a magazine for receiving it, and keeping it in store for use, but it is likewise necessary for communicating to the gas, in the act of burning, such a uniform pressure as may secure a steady, unflickering flame. It consists of a large cylindrical vessel, inverted, or with the open end downward in a cistern of water, the gas being sent through the water into it: a pipe leads from it; and the pressure applied to force the gas out is regulated by weights attached to the gasometer.

758. *The construction of the burners,* or the mode of burning the gas as it issues from the jets, has a great influence upon the quantity and quality of its light. Originally it was only a simple beak perforated; and these are still employed in butchers' and other



a

b

Fig 148.

shops of a similar kind, where the gas burns outside the house; but these generally give much smoke. A more elegant mode is to divide the flame into three or more small jets in fanciful forms, protected by glasses, which form splendid substitutes for oil lamps in streets, and some other places, *fig.* 148, *a.* In this way, when the gas is well purified, there is scarcely any smoke, on the principle we explained when treating of lamps, that several small flames produced a more perfect combustion than one thick flame. Another kind of burner is called a "bat's wing," *b, fig.* 148; this is a thin sheet of flame issuing from a narrow aperture between two plates of metal: for the same reason this flame has little or no smoke.

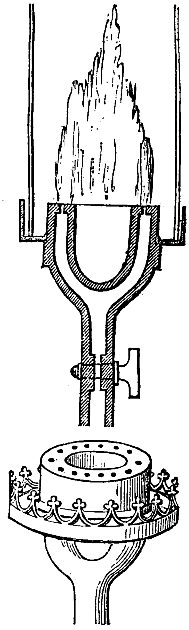


Fig. 149.

759. *But when the gas lights are burned in the interior of apartments and shops*, where the smoke is to be entirely destroyed, the usual method is to make the gas issue through a circle of very small pinholes near each other, by which all the small flames unite together to form a circular flame, like an Argand lamp, and, at the same time, a column of air rises through the centre of this flame, as is seen in *fig.* 149, which represents the perspective view and section of one of these burners. The ornamented stage on this burner supports a cylindrical glass, which prevents the flame from flickering with the wind; but it has little effect in destroying the smoke. When a very strong light is required, causing, of course, a greater consumption of gas, it is proper to use glasses contracted in the manner shown when treating on lamps, that cause the current of air to impinge upon the flame. This kind of glass is the more necessary for oil gas, on account of the quantity of carbon which it contains, which, if unburned, would occasion smoke. The pinholes should be exactly of equal size, otherwise the light will burn like a badly-trimmed Argand lamp. The height of the flame is regulated by turning the stop-cock on the pipe.

Fig 150 exhibits the usual manner in which two gas burners are suspended, or, rather, appear as if suspended; here the gas is supplied to the burners by a tube in the centre, from which branches proceed furnished with stop-cocks. An infinite variety of other designs are employed; and some closely resembling the forms of elegant chandeliers are introduced.

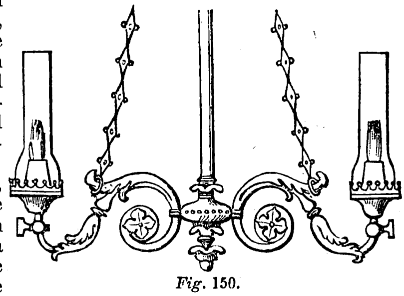


Fig. 150.

760. *In a gas flame, as in that of a candle*, it may be observed that the bottom of the flame is blue; because, as it issues with great velocity, the gas gets mixed with a large quantity of atmospherical air, and the hydrogen is consumed too rapidly for the carbonaceous part to be burned also; the flame of hydrogen alone being blue; but, higher up, the flame becomes white, because it is there the carbon is consumed, which produces the whiteness and luminous property of the flame.

761. *The various other products of coal, when distilled, besides the gas, are turned to some account.* From the ammoniacal liquor muriate of ammonia is made. 200 lbs. of coal afford 17 lbs. of coal tar, which again contains in 100 lbs. 26 lbs. of coal oil, and 48 lbs. of pitch. The tar is employed as a paint to preserve wood, but its smell is disagreeable. The pitch may be used for some of the purposes answered by common pitch, though it is inferior.

762. *Coal oil*, procured by the distillation of coal tar, mixed with an equal bulk of water, may be used as a fuel under a boiler. The mixture is made to boil in a kettle, and the mingled vapours of the oil and the water, when passed through a perforated nozzle, are kindled, and give a great heat; the water is thought to be in part decomposed. Coal oil, rectified by distillation, is extensively employed for dissolving caoutchouc in making the varnish of waterproof cloth, and also for burning in peculiar kinds of lamps, under the improper name of naphtha.

763. *Portable gas.* The inconvenience of being obliged to have the lights fixed in the ordinary way of employing it gave rise to the contrivance of portable gas, which was the invention of Mr. Gordon. To make these lights portable, the gas is forcibly com-

pressed into a strong metal vessel, provided with a narrow jet of brass, and a stopcock. When the cock is turned, the gas, by its elasticity, issues from the jet, and continues to come out and supply the flame as long as its density exceeds that of the atmosphere. The elasticity produced by the compression of the gas is considerable, and were not the vessels strong, would burst them. In general, thirty volumes of gas are compressed into one; but the metal is sufficiently strong to resist a much greater pressure. Portable gas was much in use at one time, but now appears to be nearly laid aside. A company was formed for its distribution, who sent it to any part of London where it was wanted.

764. *Gas lamps may, to a certain extent, be made portable,* by having a flexible tube of caoutchouc coming from the service gas pipe, and reaching to the place where the gas is required to burn, where it may supply a stand like that of an ordinary candlestick or lamp. This stand may be detached when required, by having one cock at the service pipe, and another at the stand. These are found useful for the desk in offices or other places lighted with gas.

765. *The gas meter* is an instrument intended to measure the quantity of gas that passes through it. It is usual for persons to pay for gas in proportion to the quantity they consume, which is estimated by means of this apparatus. It is, perhaps, the best mode of supplying the gas, where any considerable quantity is consumed, because then each person can burn it when he pleases, as much as he pleases, and can distribute in any kind of light that he may find convenient, paying for no more than he actually consumes. The companies generally supply the meters, and reserve to themselves the right of examining them from time to time. This practice prevents those disputes which arise out of the system of contracting for lights to burn a certain number of hours; thus removing, on the part of the consumer, every temptation to defraud or deceive the company, and, on the part of the company, any incentive to doubt the honesty of its customers. Many parts of private dwellings may be lighted with coal gas, independently of the principal apartments, as the offices, halls, passages, &c., and one great advantage of a gas meter is, that lights may be multiplied by using small lights in certain parts. If brought into the nursery or bedrooms, it may be employed on occasions for boiling food, or for keeping it warm, &c.

766. *Other substances besides coal have been employed for obtaining gas light, as oil, fats, rosin, tar,* &c. Indeed, any substance containing much of these matters will do, and some of them, particularly oil and rosin, afford a whiter and more beautiful light than coal, having more carbon in them; and their flame is likewise free from sulphuretted hydrogen, consequently fit to be used in apartments, resembling the flame of wax lights; but the gas from coal is so much cheaper, and now so well purified, that oil and rosin are very little used in gas lighting. They would probably, however, be the best substances to employ where the gas is to be made in a private establishment.

767. *Oil gas* was made by a very simple apparatus for this purpose, constructed some years ago by Mr. John Taylor. The materials were not put into metal retorts to be heated alone in the manner of coal; if they were, they would distil over in the state of volatile oils, and very little gas would be generated. It becomes necessary, therefore, to fill the retorts with pieces of brick or coke, and to keep them in ignition while the oil, &c., is slowly introduced, drop by drop, into their interior. The oil then coming into contact with the heated bricks is instantly decomposed into combustible gas. Oil affords, at a lively red heat, a gas which contains, in 100 measures, 19 of olefiant gas, 32·4 of carburetted hydrogen, 12·2 of carbonic oxyde gas, 32·4 of hydrogen, 0·4 of azote: the specific gravity only 0·590. The crudest and cheapest oil that can be bought will do, even blubber and sediment of whale oil; and the illuminating power of oil gas is said to be nearly twice that of coal gas.

768. *Rosin gas* is equally good, and has been successfully employed in some parts of France where good coal is scarce; but the price of this material in England, compared with that of coal, renders its use disadvantageous.

769. *Coal gas, impregnated with the vapour of coal naphtha,* is a late invention by Mr. Lowe, which affords a light more brilliant than coal gas alone, and is said to effect a saving of from 15 to 20 per cent. For this purpose, the coal gas is either passed through pieces of pumice or sponge saturated with naphtha, or over the surfaces of shallow vessels filled with this liquid.

770. *The advantages of gas light* are, its cheapness, compared with any other, when much light is required; the vast saving of the time and labour that would be necessary for cleaning and trimming lamps, or in cleaning candlesticks and snuffing candles, together with the constant attendance required for these operations. Gas lights are perfectly cleanly, and are not accompanied with the dropping of grease and spilling of oil which accompany the other modes of lighting. They may likewise be easily conveyed by pipes to situations where it would be difficult to fix any other lights. When the gas is managed in the best way, and particularly oil gas, the light is extremely agreeable, and the smoke which always proceeds from candles is avoided. The advantage of gas in street lighting is too well known to require comment. But to coun-

terbalance these advantages, the want of portability prevents its competition with candles for the ordinary purposes of domestic economy.

771. *In comparing the price of the different lights*, it appears that if a certain quantity of light given by tallow candles costs 1*s*., an equal quantity of light from an Argand's lamp will be 6½*d*., and from coal gas 2¾*d*.

772. *Gas is found to be most economical as well as most convenient for lighting streets and public places*, where much light is wanted, and the generation of foul air is of little consequence; but though it is much employed in lighting rooms for large assemblies, it is particularly necessary that proper means of ventilation should be provided, which in many cases is not easily effected.

773. *It does not appear that gas light is more unwholesome* than any other light, provided the gas be properly purified, and the burners are constructed in the best manner; but there can be no doubt that when the gas is not deprived by purification of its sulphuretted hydrogen, carbonic acid, and carbonic oxyde, that it is very hurtful to health, and more particularly where any is suffered to escape into the apartment unburned. On account of the difficulty of guarding against the sources of danger, it is certainly not so well calculated as lamps or candles for burning in apartments where there is not a free circulation of air; and its use has been of late generally confined to shops, theatres, and other large places that are so open as to admit of a ready change of air. But those who use much gas light, even when the gas is purified in the best manner, are often not aware of the degree in which the light deteriorates the air. They forget that no flame can burn without consuming the oxygen of the atmospheric air in the apartment; and the greater the quantity of light, the greater is this consumption. We refer the reader to what we have said on this subject in the beginning of this section, when describing the "Nature of Flame," and likewise under "Ventilation."

A single gas-burner will consume more oxygen, and produce more carbonic acid to deteriorate the atmospheric air in a room, than six or eight candles. If, therefore, no provision is made for the escape of the vitiated air, and likewise for the introduction of pure air to supply its place, the health of those persons must suffer who pass much of their time in a place where the gas is burned.

774. *Gas lights, when not well managed, frequently give out more or less smoke*, which has the great inconvenience of blackening the ceiling and walls of the apartment; and some have thought that, by getting rid of this smoke, the unwholesome effect of the gas was remedied; but this is far from being the case. The smoke is merely charcoal in a finely-divided state, and is not found to be particularly hurtful, if at all, to the lungs. It is the lessening the quantity of oxygen by combustion, and hence leaving too large a proportion of nitrogen in the air, together with the introduction of much carbonic acid, that causes the impure, and more or less injurious nature, of the air, where gas lights are employed.

775. *In some places, as in shops, a bell-shaped vessel of glass* is frequently suspended over *the gas flame, fig.* 151, in order to collect the smoke; and this has, in some degree, the intended effect, as far as the smoke is concerned; but, as we have stated, the deleterious effect of the gas remains the same, since this vessel has no effect whatever in preventing the formation of the various kinds of air, which are always produced notwithstanding their invisibility. The only effectual cure for the evil we are alluding to is, to have a pipe from the head of this funnel or bell-shaped vessel passing into the flue of the chimney, or to the outside of the house; a current of the burned hot air proceeding from the light would thus constantly pass out through this tube, instead of coming into the apartment. This is, in fact, done in some places; but the unsightly appearance of the tube is, perhaps, chiefly the reason why it is so seldom adopted.

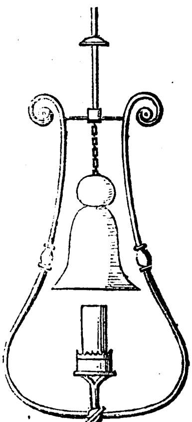


Fig. 151.

776. *Professor Faraday's mode of obtaining the perfect ventilation of gas-lamp burners.* When treating "On Ventilation," in Book III., we noticed the bad effect produced on the air of apartments where many lights were burning without sufficient means of getting rid of the foul air thus generated. Various methods have been tried, but several difficulties had not been removed until the well-known talents of Professor Faraday were directed to this object. His method is not only very simple, but appears to be quite perfect in effect, where the lamps are supplied with gas.

We give the account of it from that which was read at the meeting of Civil Engineers, June 13, 1843.

"In consequence of the serious injury sustained by the books in the library of the Athenæum, London, and the complaints made by the members of the vitiated state of the air in the rooms, causing headache, oppressive breathing, and other unpleasant sensations, the attention of Mr. Professor Faraday, as well as that of other scientific members, was drawn to the subject of ventilating lamp-burners in houses, and he was induced to suggest the trial of various plans for effecting the removal of the products of combustion produced by sources of artificial light. All substances used for the purpose of illumination may be represented by oil and coal gas; although tallow and wax are also greatly employed, yet, as, until rendered fluid, like oil, they cannot be burned, for all practical purposes they may be classed with it. Oil and gas both contain carbon and hydrogen; and it is by the combination of these elements with the oxygen of the air that light is evolved. The carbon produces carbonic acid, which is deleterious in its nature, and oppressive in its action in closed apartments, and the hydrogen produces water. A pound of oil contains about 0·12 of a pound of hydrogen, 0·78 of carbon, and 0·1 of oxygen; when burned, it produces 1·06 of water, and 2·86 of carbonic acid, and the oxygen it takes from the atmosphere is equal to that contained in 13·27 cubic feet of air. A pound of London coal gas contains, on an average, 0·3 of hydrogen, and 0·7 of carbon; it produces, when burned, 2·07 of water, and 2·56 of carbonic acid gas; consumes 4·26 cubic feet of oxygen, equal to the quantity contained in 19·3 cubical feet of air. A pint of oil, when burned, produces a pint and a quarter of water, and a pound of gas more than two and a half pounds of water; the increase of weight being due to the absorption of oxygen from the atmosphere, one part of hydrogen taking eight by weight of oxygen to form water. A London Argand gas lamp, in a closed shop window, will produce, in four hours, two pints and a half of water, to condense or not upon the glass or the goods, according to circumstances. A pound of oil also produces nearly three pounds of carbonic acid, and a pound of gas two and a half pounds of carbonic acid. For every cubical foot of gas burned rather more than a cubical foot of carbonic acid is produced. Now, carbonic acid is a deadly poison: an atmosphere containing even one tenth of it is soon fatal to animal life. The various accidents from lime and brick kilns, brewers' vats, occasionally from the sinking of wells, as at Cheltenham, and from the choke damp in coal mines, attest the extreme danger contingent upon the presence of this substance. A man breathing in an atmosphere containing seven or eight parts of carbonic acid would suffer, not from any deficiency of oxygen, but from the deleterious action of the carbonic acid. M. Leblanc has recently analyzed carefully the confined air of inhabited places, and concludes, as stated in his memoir, that the proportion of carbonic acid gas in such places may be regarded as measuring, with sufficient exactness, the insalubrity of the air; that, in the proportion of 1 part to 100 of air, ventilation is indispensable for the prevention of injury to the health; that the proportion of carbonic acid gas had better not exceed a five-hundredth part, though it may rise without inconvenience to a two-hundredth part. If a room, twelve feet square and twelve feet high, with the doors, windows, and fireplace closed, has a gas lamp burning in it, consuming five cubic feet of gas per hour, the light will produce sufficient carbonic acid, in rather more than three hours, to be in the proportion of 1 part to 100 of air, and, as M. Leblanc states, when in such condition, the air is decidedly injurious to health; and even in one hour and a half it will produce that proportion of carbonic acid which he considers should never be exceeded. If a lighted taper be applied to the top of a lamp chimney, it will be instantly extinguished, or a glass jar held over it will become immediately filled with air in which a light cannot burn, nor can any animal live in it. Or, if a portion of limewater be poured into the jar, it will become turbid in appearance, owing to the precipitation of the carbonate of lime, formed by the combination of the carbonic acid with the lime. Sulphureous and sulphuric acid are also contained in the water, which results from the combustion of coal gas, and are products injurious to metals and articles of furniture.

"It will now be understood that the object sought to be attained in the ventilation of lamp-burners is the entire removal of all the noxious products of combustion; and, with this view, at Professor Faraday's suggestion, the gas lights of the chandelier in the library at the Athenæum were ventilated by pipes dipping into the lamp glasses, and conjoining, at a short distance upward, into one central pipe, which carried away all the burned air out of the room, *fig.* 152. In this first practical experiment many things were learned as to the mode of arranging the pipes; the disposal, when the pipes were very long, of the water produced, &c., &c.; but the objects sought for by the ventilation were at once and perfectly obtained. This principle may be illustrated by a simple experiment, showing the difference between allowing combustion to give its products to the air of a room, and carrying off these products, as soon as found, to the exterior. Let a short wax candle be placed, burning, on a plate, a glass jar put over it, and the upper aperture of the jar closed by a globular cork, through which passes a piece of glass tube, about half an inch in diameter, and twelve or fourteen inches long; the tube descending to the top of the candle flame, and being placed just

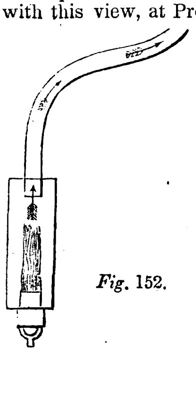


Fig. 152.

above it. Under these circumstances, there will be plenty of air passing into the jar between it and the plate, and out by the tube, to supply all that is needed for combustion, and keep the glass chamber sweet: the consequence is, that, in this position, it will go on burning for any length of time, and the jar remain quite clear and bright. But, on moving the cork a little, so that the tube shall no longer be over the flame, all these results will change, though the airway remains exactly as before. The candle will now give the products of its combustion to the general air of the glass chamber, which immediately becomes dull, from water deposited upon it; the air itself will become worse and worse, the light dim, and in a few minutes will go out; but if prevented, by the tube being again placed over it, signs of recovery will appear, the light will resume its former brightness, and, after a short time, even the dew will disappear from the glass, and all this in consequence of the proper ventilation of the light. These effects, though striking, may easily be understood by any one who will think of the difference of lighting a fire in the middle of a room, instead of under, or in right juxtaposition to a chimney.

"Then came the desire of modifying the system, by removing the ascending flue from its place over the lamp, not from any deficiency in action, but for appearance sake only; and finding that there was sufficient ascension power in the main part of the metal chimney to allow of a descending draught over the lamp, the tube, in place of going directly upward, was made to turn short over the edge of the glass, to descend to the arm or bracket, to pass along it, and then ascend at the central part of the chandelier, or against the wall, if applied to a single light. To this succeeded another form, which is exceedingly beautiful, and appears to be the perfection of lamp ventilation. It is, in fact, a beautiful application of the principle of a descending draught to a lamp-burner. The gas light has its glass chimney, as usual, but the glass-holder is so constructed as to sustain not merely the chimney, but an outer cylinder of glass, larger and taller than the first; the glass-holder has an aperture in it, connected by a mouthpiece with a metal tube which serves as a ventilating flue, and which, after passing horizontally to the centre of the chandelier, there ascends to produce draught and carry off the burned air.

"*Fig.* 153, *a*, is the burner; *b*, the gas pipe leading to the burner; *c*, the glass holder, with an aperture in it, opening into the mouthpiece *d*, which is attached to the metal chimney; *e*, the ordinary glass chimney; *f*, an outer cylinder of glass, closed at the top by a plate of mica, *g*; or, still better, by two plates of mica, one resting on the top of the glass, and the other one, *h*, dropping a short way into it. They are connected together by a metal screw and nut, which also keeps them a little apart from each other; thus forming a stopper, which cannot be shaken off the glass chimney, but is easily lifted on and off by the small metal ring or knob at the top; *i* is the metallic tube chimney; *k*, a ground globe, which may be applied to the lamp, and which has no opening, except the hole at the bottom, where it rests on the glass-holder: but any other form, as a lotus glass or vase, may be substituted at pleasure.

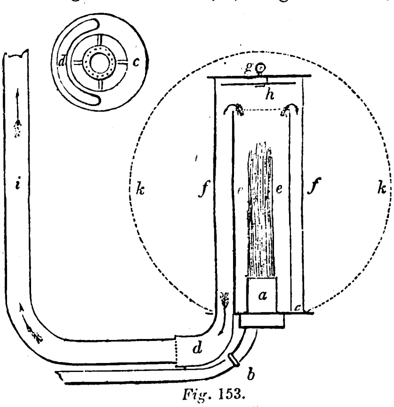


Fig. 153.

"A, *fig.* 153, is a plan of the glass-holder, showing the burner, *a*, in the centre, perforated with jets, with openings round it to allow of a free admission of air to the flame; and the aperture, *d*, which opens into the mouthpiece connected with the metal chimney, *i*.

"The burned air and results of combustion take the course indicated by the arrows, and are entirely carried away by the chimney.

"Now, with a lamp burning in the ordinary way, the products of combustion issue out as a torrent of aerial impurity from above; but, if the above arrangement be applied, on closing the top of the outer glass cylinder by a plate of mica, all the soot, water, carbonic acid, sulphureous and sulphuric acid, and a portion of the heat, are entirely carried away by the aerial sewerage, and discharged into a chimney or the open air; and the air in rooms may thus be kept in the same sweet and wholesome condition, and as fit for the purposes of respiration, as if artificial light were not being used.

"A curious but important result of the enclosed lamp is the increase of light produced, amounting to from 10 to 20 per cent., according to circumstances, the same quantity of gas being consumed as before. If the current of air through a lamp glass, when the gas is burning in the usual manner, be diminished, the flame rises in height, and the light is increased in amount; the combustion, in fact, is not so intense, because the access of air is retarded, the particles of carbon which give the light are not so highly ignited, but are more abundant, and are ignited for *a longer time*, thereby causing an increase of light.

"The advantages of this invention are many: it is not objectionable in architectural appearance; the ventilation is perfect; the heat given to a room is modified and pleasant, and may be either sustained or diminished at pleasure; the light, for good philosophical reasons, is increased considerably for a given portion of gas; and additional safety from accidents is obtained, as, in the event of any leakage from the pipes, or from a gas-cock being inadvertently left open, the gas, instead of mixing with the air of the room and becoming explosive, would almost inevitably be carried off by the metal tubes.

"Mr. Professor Faraday has transferred his right to this invention to his brother, Mr. Robert Faraday, 114 Wardour-street, Soho, who has secured it by a patent."

It is to be observed that this ingenious method is chiefly applicable to gas lights, where the products of combustion can be carried off by a pipe that goes parallel to that which supplies the gas. To adapt it to suspended oil lamps, there must be a tube reaching from the lamp to the ceiling, into which the separate tubes from each burner shall unite; and then a method of discharging the noxious gas from the top of the tube at the ceiling into the open air.

The same effect has been attempted by having funnels with tubes over each light, *fig.* 154; but this is not found to answer, because so much common atmospheric air enters the funnel, together with the burned air, that the draught is not found sufficient.

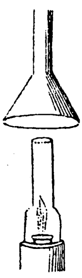


Fig. 154.

777. *It is proper to be known that coal gas mixed with common air will explode like gunpowder*, when a light of any kind is brought into it. Hydrogen by itself, or carburetted hydrogen alone, only burns; but when mixed with a certain proportion of atmospheric air, it explodes when brought into contact with a burning body. The danger is evident of suffering this gas to escape from the pipes, or any other part, into an apartment. When the quantity that escapes is but small, it may be discovered by its peculiar smell, and there may be yet no real danger; but when the quantity becomes considerable, it forms with the common air an explosive mixture. Several accidents have happened through the escape of the gas in this manner, in consequence of which persons have lost their lives, or have been severely wounded; and the premises have been sometimes destroyed by the explosion. This accident is of the same nature, on a small scale, as what we hear of in coal mines, where, from the issuing of the carburetted hydrogen from the coal strata, explosions sometimes destroy thirty or forty people. Whenever it is suspected, therefore, that gas may have escaped into a room, it is imprudent to enter it with a lighted candle, without first ventilating it by some means. Fortunately, the smell of the gas gives warning of its escape.

Notwithstanding this evident danger, it is surprising how few serious accidents have occurred in the employment of gas for lighting. Still it is proper that every one should be fully aware of the risk that is incurred by neglect.

778. *Coal gas has sometimes the effect of turning white oil paint black*, owing to the sulphuretted hydrogen contained in the gas. This may be prevented, in a great measure, by varnishing the paint, which will protect the white lead from the action of the gas. The same effect is not produced upon any part coloured by whiting: it being the *oxyde of lead* alone that is changed in colour.

779. *The laying on of the gas pipes in a proper manner* is essential in this species of illumination, and demands much experience and skill in this kind of work: hence it is now executed by a particular class of artisans, termed *gas fitters*. It is not safe to employ pipes of pewter, lead, or tin, as their softness would render them liable to serious accidents: copper or iron pipes alone should be used. Before the pipes are fixed, they are proved by a condensing hand pump in water, and likewise after they are fixed by a condensing syringe, and a lighted taper carried along the pipe.

780. *The gas for lighting has been prepared in private establishments*, but the apparatus for this purpose is expensive; and the preparation of the gas and purification demands considerable scientific knowledge, without which it would be unwise, and indeed unsafe, to attempt it. We do not consider it necessary, therefore, to describe the apparatus that would be requisite for that purpose, since those who intend to make gas for themselves must apply to more extensive sources of information than can be expected in a work like the present.

BOOK V.

ON HOUSEHOLD FURNITURE.

CHAPTER I.

GENERAL OBSERVATIONS.

781. *The term furniture* includes all the articles, for common use and ornament, required in an inhabited house, and may be classed in various ways. They are divided into *fixtures* and *moveables;* the first, being fixed to some part of the building, cannot be easily removed without injuring it, or causing great inconvenience; they consequently remain attached to the house on every change of inhabitant, the new tenant paying the value; or they become the property of the landlord, as may be agreed upon. A list of the fixtures is inserted in every lease. Furniture may likewise be classed according to their several kinds and uses, as tables, chairs, &c.; or according to the apartments in which they are placed, as parlour, bedroom, nursery, &c., furniture. We may likewise arrange them according to the several trades by which they are prepared, as joiner's work, cabinet work, upholstery, ironmongery, glass, pottery, &c. We shall not adopt exclusively either of these modes of classification, but describe the articles as their connexion with each other may seem to require.

782. Before we proceed to describe in detail the several articles of furniture in common use, it will be proper to say something of the several trades by which they are produced, and also of the materials usually employed in their manufacture.

CHAPTER II.

CABINET-MAKER AND UPHOLSTERER.

783. *The household furniture that comes under the class of fixtures*, such as kitchen dressers, shelves, closets, sinks, &c., are made by the joiner in finishing the house; but the moveable furniture of wood work is chiefly executed by the cabinet-maker and upholsterer. As these are the most important trades in the furnishing a house, some hints respecting them may be useful to their employers; but it is not our intention to enter so much into the subject as to attempt the instruction of those who practise these several arts.

784. *The business of the cabinet-maker* is, in strictness, different from that of the upholsterer: the former being a superior kind of joiner, but who, instead of being employed, like the joiner, in executing the parts of the building itself, is occupied with the nicer kinds of furniture made of the finer woods, such as tables, sideboards, chairs, sofas, cabinets of all kinds, &c. The upholsterer is concerned with certain articles of furniture that do not belong to this class, as beds and everything belonging to them, carpets, floor cloths, window curtains, &c. But these trades are necessarily so connected in many parts that, as far as the public is concerned, the cabinet-maker and upholsterer are now often united in the same person. The upholsterer, indeed, seldom himself manufactures the furniture he sells, but gets the several articles made by persons who, from the subdivision of labour, confine themselves to particular branches: thus there are chair-makers, bedstead-makers, bed and mattrass makers, cabinet-makers who make tables, sideboards, wardrobes, and other things altogether of wood, &c. A few cabinet-makers and upholsterers, indeed, who are in a large way of business, sometimes employ work-people on their own premises in their several departments, and can thus assure themselves that the articles they undertake to have executed can be depended upon for materials and workmanship; and for this advantage, which requires considerable superintendence, the public pays, with justice, a higher price. Of the practical skill of our best mechanics in executing the several articles of cabinet-making, as far as strength and excellence of work are concerned, it is sufficient for us to say, that it is not excelled in any part of the world. Before we proceed to the description of the various materials of which furniture is made, we shall take notice of such of the processes in these branches of art as are necessary to be generally known.

785. *All the parts of some furniture are made out of solid wood*, and it is very important that this should have been thoroughly dried, or, as it is termed, *seasoned;* wood not well seasoned is apt to warp, and the work will sometimes come to pieces, or cause defects not easily remedied; and here appears the superiority of manufacturers who have sufficient capital to keep materials long enough on their own premises to ensure their being completely seasoned.

786. *Wood is sawed into logs or into planks* in the countries where it grows; and it is

subdivided here into the sizes requisite for different kinds of work; for which purpose steam machinery is occasionally employed in a few of the large workshops: circular saws are used for this purpose.

787. *When wood is required of curved forms* in cabinet work, it is generally cut out of the solid, which is very expensive, particularly when the wood is of a rare kind; but in this department, as well as in joinery, wood is occasionally bent by first softening it with steam, then bending it into the required form, and fixing it there by drying. This method has been practised from time immemorial in Russia, where it has been applied even to making cart-wheels.

788. *The veneering of furniture* is employed to obtain a very beautiful wood at less expense. The choicest specimens of mahogany are considered too valuable to be wrought up in a solid state, and are therefore sawn into thin leaves or slices, called *veneers*, which are fixed with glue as facings, either on mahogany of a coarser kind, or to oak or other hard woods. By these means this beautiful substance may be made to cover a great extent of surface; and the parts, by judicious management, may be so united as to appear like one entire piece. As the operation of veneering requires great skill, and is sometimes apt to fail or be imperfect, veneered furniture is not so much to be depended upon as that which is made of solid wood. Such furniture requires more care; it should be kept in dry situations, and, after having been exposed to damp, should not be placed too near a fire, as it is apt to warp. If the veneering has not been well executed, or the ground beneath is improper, the veneer will sometimes blister or come off. Deal is sometimes used to veneer upon, but it is a bad material: upon the whole, however, the veneering of furniture is a great improvement, on account of the economical use of fine specimens of wood. Formerly these veneers were cut by the pit or hand saw, but at present they are cut with much greater accuracy, as well as expedition, by large circular saws having a very thin blade, which cut twelve veneers out of a board one inch thick.

789. *Furniture is sometimes executed entirely of a single kind of wood*, as oak, mahogany, rosewood, ebony, &c., and sometimes several species of wood are used in the same article. The first is, generally, the best taste, and particularly when it is ornamented by carving: occasionally the tops of round tables are made of various pieces of the same kind of wood, so skilfully joined that the lines of junction are not to be traced without the closest inspection, or by means of the pattern produced by the different direction of the grain. Nothing can exceed the beauty of some modern English tables of this kind, made of native as well as foreign woods; and, upon the whole, we can safely recommend these as some of the most beautiful kinds of furniture.

790. *Staining wood*, in imitation of a few of the more expensive kinds, such as rosewood, is now so successfully performed, that it can scarcely be distinguished from the original wood; and although this stain is not perfectly durable, yet it is sufficient for a number of ordinary purposes: of course, the difference in price between real and stained wood is very great.

791. *Inlaying* is a mode of ornamenting furniture resorted to by those who are not content with the natural beauty of wood, or where a certain richness and gayety is proper. When this inlaying is done with various kinds of wood, it is called *marquetry*; when inlaid with brass or tortoise-shell, it is termed *buhl*. On these we shall make a few observations.

792. *Marquetry* is in wood what mosaic is in stone; pieces of various woods, or those which have been stained for the purpose, being put together. The art is very ancient, and was formerly held in great esteem. Some of the oldest specimens are executed only in black and white, and are termed *morescoes*; and it is said that the first who employed a great variety of colours was John of Verona, who was contemporary with Raphael. He stained his woods with various colours, and invented the method of producing shadows on them by burning one edge. The art was much cultivated among the French in the seventeenth century, and may frequently be observed in furniture of that period. A design being made, the forms in it are cut out of the wood to be ornamented, and woods of various kinds, or stained wood, suitable for the various parts of the design, are selected, cut to the proper shape, and fixed in with glue. The woods are now cut into thin veneers, not above the thickness of the twelfth part of an inch, and afterward sawed into the various shapes according to the design. Three or four pieces are usually sawed out together, if possible, on account of the thinness of the stuff; after they are glued down, the whole is put into a press to dry, planed over, polished, and varnished. It is obvious that the utmost nicety in joining the several pieces is essential. Marquetry is sometimes confined to simple forms, as squares, lozenges, &c., as in the floors of apartments; but all kinds of subjects have been occasionally represented on furniture. Some, however, as, for example, landscapes, are obviously so difficult, from the nature of the process, that, success being impossible, they had better never be attempted. For certain kinds of ornaments, marquetry has a pleasing effect. In fruit and flowers the art, as usually executed, appears generally more curious than beautiful; and the expense is greater than it deserves. Some specimens of

the best French marquetry are valued as the furniture and style of a certain period, and we believe that none executed in our shops at present comes quite up to them, although occasionally pretty specimens are produced.

An extremely elegant kind of marquetry is sometimes seen, consisting of tolerably large figures in satinwood, having the internal lines drawn in umber, and the whole let into mahogany. In this art there is a considerable field for invention and improvement.

793. *The staining of wood for inlaying* is effected as follows: A bright red stain is produced by a strong infusion of Brazil wood in water impregnated with pearlash: a red less bright is made by a solution of dragon's blood in spirits of wine; and a pink colour by the Brazil wood stain diluted: a yellow stain is made with the tincture of turmeric or French berries: an orange with dragon's blood and turmeric. Blue is obtained by indigo, or by a solution of copper in aquafortis. Green is made by verdigris dissolved in vinegar. Purple by a decoction of logwood and Brazil wood. Black, by brushing the wood first with a solution of sulphate of iron, and then with an infusion of gall nuts. The woods to be stained must be white.

794. *Buhl*, or inlaying cabinet work with ornaments of brass or tortoise-shell, *fig*. 155, is said to have been the invention of a German of that name; or as it was first practised in a town of Germany so called. It consists of a complicated kind of light ornament let into grooves of ebony or some dark wood. When tortoise-shell is used, it is usually laid upon a red ground, which appears through the transparent part of the shell. Sometimes the pattern in brass is let into a ground of tortoise-shell, and sometimes tortoise-shell is let into brass: the figures of both are cut with a fine saw together, so that one fits into the other without any difficulty. A good deal of buhl is imported on foreign furniture; but it is too expensive to be much practised in this country, although it is made occasionally to decorate small articles. Rosewood inlaid with buhl may be cleaned, when the brass has become dull, by rubbing it with tripoli or rotten stone and a very little sweet oil.

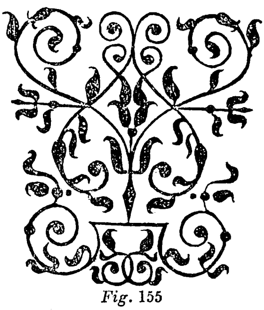


Fig. 155

795. *Mosaic* work consists of an assemblage of little rectangular pieces of marble, precious stones, or glass, arranged so as to represent a picture when fixed upon a ground of stucco by means of a cement.

Among the ancients, mosaic appears to have been confined to pavements, for which it is admirably adapted; since, notwithstanding its being frequently trodden upon and washed, it is not injured.

Of modern mosaics, some of the most celebrated are the works of Joseph Pine, and the Chevalier Lanfranc, in the Church of St. Peter, at Rome; also some at Pisa, Florence, and other Italian cities. There is also some good mosaic in the chapel at Versailles. Extremely minute mosaics are sometimes brought from Italy.

796. The *Pietra dura*, brought from Florence, is a sort of mosaic; but, instead of the stones being cut into little squares, they are cut into the forms of the objects represented, like marquetry. We can say nothing for the beauty of the art; for, whatever ingenuity may be employed in it, the effect of imitation is very incomplete, at least in the subjects usually attempted.

797. *Carving*. In a great part of our best furniture there is more or less carving. The art of carving in wood is so ancient, that, probably, the first attempts at sculpture were in that material. Not long since, among the uncivilized South Sea Islanders, very curious specimens of carving on their canoes were seen, executed without the use of iron tools. We find carving in cedar mentioned among the arts of the Israelites; and some of the earliest statues of the Greeks were in wood as well as marble. In modern times, carving in wood was practised to a great extent in Italy, Germany, and the Netherlands. In Germany, more than in any other country, a taste for sculpture in wood prevailed, which, indeed, partly exists at the present day. Not only are their churches richly decorated with exquisite carving, to be seen in the pulpits, stalls, and confessionals, but the ancient chateaux of the nobility, and even the residences of the wealthy citizens, can boast of fine specimens of wood carving. In Holland and Belgium the same may be observed. The finest examples of this art appear to have been executed between the twelfth and seventeenth centuries. In this country, it is evident, from our churches and mansions, that our ancestors endeavoured to keep pace with their continental neighbours in the arts of sculpture in wood; and down to a late period, admirable carvings of this kind were executed, as may be seen by the exquisite performances of Grinlin Gibbons, in St. Paul's and other places, in the reign of Charles II. Gibbons died in 1702, and was the last of our native carvers who arrived at eminence. After the time of Gibbons, the art declined in this country from various causes, and until very lately had become nearly extinct, owing, in a great measure, to the introduction of composition and paper-machée ornaments, which, being moulded and glued

on to wood, answered so many of the purposes of the carver's art as to destroy entirely his practice. These substitutes are still largely employed, particularly in picture frames, ceilings, cornices, and other parts where enrichments are required; but for some years past, carving has been again encouraged to a certain degree, and is now making some progress, chiefly from the style of the time of Louis XIV. getting into fashion, the ornaments of which being in a style of great boldness, it is necessary to resort to carving in many cases.

798. *Castors* are the small wheels fixed to the feet of such heavy furniture as are required to be moved frequently, as tables, sofas, &c.; and they are, in consequence of the weight upon them, peculiarly liable to be out of order, yet sometimes a little care may put them to rights: it is useful, therefore, to understand their construction. *a*, *fig.* 156, is a castor of the common kind: it has a brass socket, which is driven on the end of the leg, which is cut round to fit it: on the bottom of this socket there is an iron plate, in which is riveted an iron pin, on which the brass shank, *b*, carrying the brass wheel, turns. *c* represents a castor upon an improved construction: to lessen the friction of the shank, which is considerable, it turns against three little balls which are moveable in the interior of the socket: this causes the shank to revolve with much greater freedom, and allowing the wheels to act with greater certainty by presenting their faces always in the direction of the motion required: except they do this, castors are of no use. There are other improved castors: and it is worth while, in most cases, to have the best, the common ones wearing out too soon.

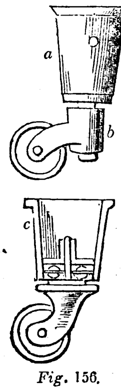


Fig. 156.

799. *When cabinet work is finished*, it is well rubbed with fine sand-paper, to smooth it, and afterward dusted: it is then polished. Three principal kinds of polish are used: wax polish, oil polish, and French polish.

800. *Wax polish.* This is the most ordinary kind of polish, where it is desirable not to darken the colour of the wood; but it is not good for table tops, or many other parts of furniture, as it is apt to leave a degree of clamminess that causes every touch of the hand to leave a mark; and water spilled upon it tarnishes the lustre, which it requires hard rubbing to restore. Nevertheless, it answers sufficiently for many general purposes. It is applied in the following manner:

To four ounces of bees' wax scraped fine, add one ounce of black rosin pounded very fine, and on these pour oil of turpentine sufficient to dissolve them, so that the solution shall be of the consistence of cream. Suffer this to remain for twenty-four hours, till the whole is completely dissolved. Apply this solution, with a clean linen rag, to the cabinet work, until the whole wood is covered. After the liquid is absorbed by the wood, rub the latter hard with a roll made of baize, and afterward with soft woollen cloths, taking care that no part shall be left clammy, and also taking great care that no dust or dirt attach to the work to occasion scratches. Repeat this in a few days, or a week; if any more of the solution be necessary, add some, but the less of the solution that is used to get the work to shine, and the more rubbing is employed, the better.

801. *Oil polish.* This is the best polish for the tops of dining tables. It is prepared and executed as follows: Before the application of the polish, clean the table top by washing it with oil of turpentine, so as completely to eradicate any stains of grease that may be on it: then clean this well off by linen cloths. Dip a brush similar to the medium-sized painter's brushes, or a piece of linen cloth, into some of the best cold-drawn linseed oil, and apply it to every part of the table top, or other article of furniture. Let the oil remain on for six or twelve hours, or more, taking care to guard it from dust. Then rub it with a clean woollen cloth for an hour or more. As soon as it appears perfectly clean and dry, apply linen rubbers, to remove any moisture that may be left on the surface. In three or four days repeat the application of oil, as before; and when this operation has been performed about four times, before the oil is again applied, take a sponge with water blood warm, and wash the table-top all over: wipe it quickly, and dry it with linen cloths, to extract all dirt. The oil will have saturated the wood sufficiently to have prevented the water from penetrating. The lustre may not come out so soon as may be expected; but, by perseverance for a month, or perhaps two or three, the labour will be amply compensated by the result. The polish will be brilliant and lasting: it will bid defiance to stains from hot dishes, fruits, boiling water, and other liquids, and may be kept to its maximum of lustre with a very slight proportion of regular labour. Some persons have recommended the use of alkanet root and rose pink with the oil: this gives a rich reddish hue when the wood is too light; but the effect of these ingredients is to darken and to destroy the beautifully-variegated shades in good mahogany. Even with the oil alone, the wood will become darker than with wax, as in the last receipt: but after it has come to its proper polish it will change very little. This polish must not be used for rosewood, as it would render it too dark.

802. *French polish.* This most beautiful varnish for furniture derives its name from its having been invented in France some years ago; but it is now universally used in this country. Although it may be applied by any one who will take the trouble of learning how to use it, this is not necessary now, nor worth the while, since French polish has become a distinct trade; and, as it requires considerable practice to execute it properly, it is cheaper and better to employ those who are already familiar with the process. We therefore give the receipt for it merely to explain its nature, without recommending any one to depend upon themselves for its application. With a brilliancy superior to any other polish that can be given to furniture, it is not so easily scratched as the other polishes, and is not marked by hot things placed upon it; but wine destroys it, and any liquid containing spirit, which dissolves the material of which the varnish is composed. Soap does not injure it: it may be washed with soap and water, and therefore washstands may be varnished with it.

803. *Receipt for the French polish.* To one pint of spirits of wine add 1½ ounce of shell-lac, ¼ ounce of gum copal, and ¼ ounce of gum arabic: all the gums to be bruised. Keep the vessel into which these are put well corked, and let it remain in a warm place for two or three days: then pour off the clear part into another bottle. To use it, place the piece of furniture under the eye in a good light. Make a rubber by rolling up a piece of fine cloth not very hard. Apply the polish to the end, covering the part with a piece of soft cotton rag that is free from lint: damp the rag with the best cold-drawn linseed oil in the smallest possible quantity, so that the polish may spread when rubbed. The oil may be applied to the rag with the end of a skewer, or some such instrument. Proceed to rub briskly, with a moderate pressure, in a circular direction, over a space equal to about a square foot at a time, and replenish both as the wood dries. Go over the whole surface in this manner, and give three or four coats according to the grain of the wood. The operation must be performed in a place of moderate warmth. Gradually clear off the oil from the surface with the polish, and sometimes turn the rag, otherwise the brightness will not be perfect. Be careful in using a frequent succession of soft and clean rags, since on that depends, in a great measure, the clearness of the polish. If too much oil be used in the operation, which is apt to be the case from the difficulty of spreading the varnish, the work is, after some time, liable to assume a bluish dulness, a fault which may be remedied by using the following preparation:

The ingredients are, rectified spirits of wine, half a pint; shell-lac, two drachms; benzoin, two drachms; put these in a bottle, and keep them in a warm place till dissolved. Then having let the mixture stand till it is cold, add two spoonfuls of the best linseed oil; shake it well, and it will be fit for use. The application may be made according to the above directions, only observing that a fine soft muslin rag made into a wad is preferable to cloth. The fluid must be well shaken while in use.

804. *A cement proper for filling up holes in mahogany* may be made by grinding upon a stone with oil of turpentine, some red-lead or Venitian red, Spanish brown, a little lake and yellow, so as to match the colour of the mahogany: this must be made as thick as paste: then take as much turpertine varnish as will barely soften it, and apply it to the cavity: in a day or two it will bear polishing like the wood.

805. *Glue*, a common substance for cementing, is made of skins, and other gelatinous parts of animals, boiled to a thick jelly, and then formed into a solid mass by spreading it out in thin layers upon a net, and drying it until it is quite hard, in which state it is sold. To use it, broken pieces should be soaked for some hours in water, which softens it, and occasions it to swell; some more water is then added to it in a glue-pot, and it is kept on the fire till it is melted. The strength must be judged of by observing how it falls from the glue brush. A lesson from a joiner will best teach its use, and a glue-pot is very handy in a family. *Jeffcrey's patent marine glue* is a cement not affected by moisture.

806. *Size* is sold in the shops ready for use, and is only a weaker kind of glue: the jelly, indeed, without having been hardened; but it is generally made of better materials. It is dissolved by putting it into a pipkin over the fire. It is employed to mix with distemper colours or whitewash, to prevent their rubbing off, and for similar purposes

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CHAPTER III.

ON THE MATERIALS EMPLOYED IN FURNITURE.

807. *The nature of the materials used in the various articles of furniture* is a subject, among others in domestic economy, that it is useful to understand. A judicious choice of furniture cannot be made without a knowledge of the substances of which they are formed, since upon the various qualities of these their durability often depends, as well as the proper methods of preserving their strength, beauty, and usefulness.

It is more particularly necessary to have an accurate knowledge of the metals, on account of the expense of some, and the great damage that may be done to them through ignorance or inattention. In the utensils employed in our culinary processes, this subject acquires an importance in another point of view. It is well known that several metals are of a poisonous nature, and serious accidents have happened in consequence of their improper use. The same judgment of the mistress or the housekeeper, therefore, which watches over and regulates every part of the household, should be exercised and extended to the furniture and utensils of the cook, who is too often but imperfectly acquainted with those facts which it is so important that all should know. Nor are tradesmen, and even the manufacturers themselves, to be always depended upon for information respecting the materials they employ; many of them being ignorant of the difference between a simple metal and an alloy, knowing the latter only by a name, and having erroneous ideas respecting its composition; with respect to the latter, indeed, the grossest quackeries and impositions are daily put forth and practised, sometimes through fraud, but in some cases also from ignorance. We consider, therefore, that it would be useful in this work to supply some information on this head.

Sect. I.—woods.

808. *General observations.*—Much of the beauty and excellence of modern furniture depends upon the judicious selection of the wood of which it is constructed: and of this there is now a considerable variety.

We have already, in our history of Furniture, mentioned the taste of the ancient Romans for beautiful kinds of wood. Anciently, in Britain, the native woods alone were worked into furniture, and of these the oak had the preference; but after the acquisition of mahogany, the beauty of which far surpassed all others then in use, our native woods were much neglected, although some of them possess great merit, and had formerly been studied with attention to their curious curling veins; of late these have come again into fashion, together with new species from distant countries. Woods vary much in their colours: some are of a kind of chocolate colour, as mahogany, cedar, rosewood; others are of a light yellowish hue, as walnut-tree and satinwood; others, again, are almost white, as pear, plane-tree, and deal. Their hardness, and of course their durability, and the property of receiving a polish, vary considerably. The most valuable and beautiful woods for the best furniture are mahogany, rosewood, satinwood, zebra, and Coromandel wood. For certain parts of bedsteads, chairs, and sofas, beech and elm are employed; oak for strength and for Gothic furniture; the cherry, plane, holly, yew, box, walnut, lime, poplar, and a great variety of others for occasional purposes; and deal enters more or less into the construction of almost every article. Many of the more expensive kinds are very nearly imitated by staining and painting; but these processes, though much employed and extremely useful, fail in durability where there is much wear. Varnishing the woods themselves, to exhibit the grain, greatly improves their appearance; and since veneering has been so much employed, and the French polish has been in use, the splendour of fine woods in our furniture has become very remarkable.

809. *These various beauties and merits depend, in a great measure, upon the natural structure of wood* in general, and the manner in which it grows. The varieties of wood usually employed in Britain are produced by that class of trees termed by botanists *exogenous;* that is, which increase in thickness by a yearly addition of a circular layer of new wood, which grows between the bark and last layer. A section across such a tree, *fig.* 157, exhibits a number of concentric rings of wood, equal to that of the years which the tree has been growing. Each of these rings is unequal in density in different parts, being composed of a hard substance on one side and a soft substance on the other, both of which generally graduate, more or less, into each other, the colour being at the same time different, which enables us to count them with tolerable facility. The whole substance of wood is composed of two kinds of minute parts: one consists of very small hollow globules invisible to the naked eye, and the other of bundles of tubes finer than human hairs. The most solid parts contain the greatest proportion of the latter. Besides the concentric rings just mentioned, which form a series of hollow cylinders, one within the other, there are thin plates of dense wood, which extend nearly from the centre to the circumference of the trees in a radiating manner, and consequently crossing the last-mentioned concentric layers. These radiating plates constitute what the cabinet-makers call the *silver grain,* which is very conspicuous in some woods, and which often has a principal effect in producing the elegant stripes so frequently seen. Besides the very minute tubes and cellular tissues which always constitute the substance of wood, there are likewise many tubes passing through the lengthway of the tree, which are so much larger than the rest as to be visible to the naked eye, and which, when divided longitudinally, appear as minute grooves on the surface, and give a coarseness of grain. This is particularly observable in the coarse mahogany and in oak; and they catch and hold the dirt, and then appear as dark lines on the surface. In some of the close-grained woods, as lime, pear-tree, beech, birch, and lignum vitæ, these large tubes either do not exist, or are not

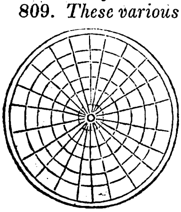


Fig. 157.

sufficient in size to be conspicuous; and the wood appears, even when examined by a high magnifier, to be composed of fine shining threads, not tubular, the hollowness being too minute to be easily ascertained. The various striped, wavy, curled appearance of the various woods, depend much upon the direction in which these parts are cut across by the saw. Another variety in the figure of woods is the occurrence of eyes, round spots, and small curls, which, although hardly suited to the larger kinds of cabinet work, is often extremely ornamental in smaller articles, as stands or work tables. Birds' eye maple, Amboyna wood, and the root of the common yew and elm, are perhaps the most beautiful in this respect.

810. *Another class of trees* is that termed by botanists *endogenous*, *fig.* 158, the structure of which is very different. These may be exemplified by palms and bamboos, and is well seen in the common *ratan* cane. The trees have their stems straight, and their leaves only at the top. In the section of the stem no radiating lines are seen, but only very minute circles, which are the ends of tubes disposed longitudinally. Trees of this kind grow only in warm climates, and their wood is not employed for furniture in this country in the manner of exogenous trees.

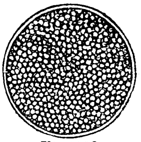


Fig. 158.

811. *Mahogany.* There are two kinds of mahogony in common use for furniture. The finest and most valuable kind is imported from St. Domingo and Jamaica, and designated by the cabinet-makers Spanish mahogany; the other is inferior and coarser, called Honduras, being the produce of the British colony of that name in South America. *Spanish mahogany*, being brought from a foreign colony, is subject to a very heavy import duty, charged by weight. It is very hard in texture, and the grain is close and has a silky aspect; the pores are short, and sometimes are scarcely to be observed: consequently it receives a fine surface and polish, and is always used in the best dining-tables, sideboards, and other articles of good furniture, for which it is admirably adapted, not only on account of the closeness of its fibre or grain, which prevents its harbouring dirt, but from its beautiful mottled, wavy, and curled appearance, in which, together with its rich colour, it excels all other woods. The cabinet-maker runs a considerable risk in purchasing mahogany, as he is often disappointed in the quality of the wood; that in the interior of the log, when sawed up, sometimes not answering the expectations which were formed from the examination of the outside. *Honduras mahogany*, being imported from a British settlement, is charged with much less duty. In most instances it is very inferior to the Spanish: it is of lighter weight, and softer in substance; and, the pores being wider and longer, it is not susceptible of so fine a polish. It is liable to retain and absorb more dirt: if wetted, especially when new, the surface becomes rough and woolly. The logs of Honduras are, in some cases, very large, measuring nearly four feet in diameter; but its general value is about one half or two thirds of that of Spanish.

812. Although we have stated that Spanish mahogany is superior to Honduras, yet that must be understood generally; for some logs of the latter are occasionally found equal to the former; and, from this circumstance, it is not always possible for the most practised eye to determine which of these two woods a piece of furniture consists of, instances occasionally occurring, though rarely, where Honduras has all the beautiful curl and close grain of the Spanish. It is a practice with some cabinet-makers to stain mahogany to improve the colour: this stain is apt, in time, to change. Good mahogany is never stained.

813. *The history of mahogany* is rather interesting.

The first mention of the employment of mahogany was in the repair of some of Sir Walter Raleigh's ships at Trinidad, in 1597; but the discovery of the beauty of its grain for cabinet work was accidental, about the beginning of the eighteenth century. It is thus related by Mr. Phillips, in his work on "Fruit-Trees." Dr. Gibbons, an eminent physician, was building a house in King-street, Covent Garden. His brother, who was a West India captain, brought over some planks of mahogany as ballast, which he thought might be serviceable in his brother's building; but the carpenters finding the wood too hard for their tools, it was laid aside as useless. Soon after, Mrs. Gibbons wanting a candle box, the doctor called on his cabinet-maker (Wollaston) to make him one of some wood that lay in his garden. Wollaston also complained that it was too hard; but the doctor insisted on having it made, and, when finished, it was so much liked that the doctor ordered a bureau to be made of the same wood, which was accordingly done; and the fine colour, polish, &c., were so pleasing, that he invited all his friends to see it. Among them was the Duchess of Buckingham. Her grace begged some of the wood of Dr. Gibbons, and employed Wollaston to make her a bureau also. On this, the fame of mahogany and Mr. Wollaston was much raised, and furniture made of this wood became general.

814. *Rosewood.* This is a favourite wood for many smaller articles of furniture, although it is apt to be too dark. It grows in Brazil, and is considerably more expensive for furniture than mahogany, partly on account of the price of the wood, and partly from that of the workmanship, it being very hard. Many articles of rosewood furni-

ture are veneered, but the best are of solid wood. The colour, which consists of large elongated dark zones on a reddish-brown ground, is permanent, except it be much exposed to the rays of the sun; and it takes a fine polish, which is improved by slight waxing, or, what is better, by the French polish, which brings out the colour of the wood admirably.

815. *Satinwood.* This very elegant, light-coloured wood, so denominated from its silky aspect when polished, is employed for a variety of purposes in cabinet work, but chiefly in conjunction with other woods. It is very expensive.

816. *Coromandel wood* is, perhaps, the most beautiful of the brown woods, consisting of pale reddish-brown fibres crossed by large stripes of deep, rich brown, with various veins and spots; the lustre silky.

817. *Cedar.* There are two kinds of wood known by this name in cabinet work, but neither of them is the true cedar of Lebanon. *The sweet-smelling or pencil cedar* (*Juniperus Virginiana*) is a native of North America and the West India islands. The wood is of a brownish-red colour, has a well-known agreeable odour, and is very durable, being unattackable by insects. It is employed in manufacturing drawers, wardrobes, &c., for which it is valuable, on account of its property of keeping away moths. It is soft, but of a uniform texture, and light. Some recommend that all cabinets or sets of drawers should have some of this wood as a material in its manufacture.

818. *The Havana or Bermuda cedar* (*Juniperus Bermudiana*) is another variety, a native of Bermuda and the Batavia islands, and also employed in various articles of furniture. It somewhat resembles mahogany, but is much softer.

819. *Oak.* Our native oak is of a dark colour, and, though much used formerly in furniture, and ornamented with carving, is now generally superseded by the Riga oak, called *wainscot*, which is of a light yellowish tinge. This is usually varnished, which prevents the dust from filling up the pores of the wood, and causing it to become darker; or it may be well rubbed with a small quantity of the wax polish. Wainscot being of an agreeable colour, cheaper than mahogany, and not being liable to warp, is much employed. It is, likewise, used conjointly with mahogany, as in drawers, the latter constituting the fronts, the former the interior.

820. *Pollard oak.* This native, beautiful wood has a distinguished claim upon our attention, from its intrinsic merit. It has been recently introduced as veneers sawed off from the stumps of old pollard oaks, that otherwise would have been consigned to the flames; but which, when cut, are found to contain the richest variegated spots and figures, arising from knots and irregularities of growth, that, when brought out by polish, are extremely various and beautiful. This wood is, however, usually decayed in parts and perforated by insects; that these defective places have to be filled up with the greatest neatness and care by the workmen, with other pieces of wood let in, which causes it to be expensive: various pieces are frequently veneered in one table top to produce an elegant pattern.

821. *Walnut-tree.* This native wood is now little used for furniture; but, before mahogany and other foreign woods were imported, was much in request for the beauty of its grain. It is much employed by the coach-builder, and for making gun stocks, being lighter, in proportion to its elasticity and strength, than any other.

822. *Elm.* This is little used in furniture, as it twists and warps too much; but, as it is very tough, and not liable to split, is very useful for some purposes, as for chopping blocks, and tops of kitchen tables; and, on account of its great durability in water, it is employed in pumps, pipes, planks and piles in foundations, coffins, and sometimes for the naves of wheels.

823. *Ash* is a wood but little used in furniture, but, from its toughness, is useful in some cases.

824. *Pear-tree.* This wood is of a light yellow colour; and being very uniform, and easily cut, though firm and solid, it is occasionally used for carving, also for measuring rules and similar purposes.

825. *Ebony* is a wood naturally of a deep black colour, and highly prized by the cabinet-maker for several purposes, particularly inlaying. It is exceedingly hard, heavy, and durable; but is only used in a small quantity. As it is expensive, cabinet-makers often substitute pear and other woods dyed black; but these are not so susceptible of good polish and lustre, nor do they keep their colour equal to true ebony. The best ebony comes from Africa; a kind variegated with brown is brought from Mauritius and Ceylon.

826. *Box-wood* is a close-grained, hard wood, of a yellowish white colour, and takes a fine polish. Its heaviness prevents its being much used in furniture, except for inlaying and smaller works. It is much used in instruments, particularly in musical wind instruments. Its bitter quality prevents its being attacked by insects. It is the wood of a shrubby evergreen that, in some places, grows to the height of twelve or fifteen feet.

827. *Bamboo.* This cane grows in India and China, and is there very extensively employed for a vast variety of purposes. It is one of the most common plants in those

countries, and shoots up often to the height of forty feet, with a stem perfectly straight, hollow, and jointed, and covered with a thin, shining, hard coat, that appears like a varnish, and which is actually a solution of flint laid on by the hand of nature. The natives of India raise their houses with poles of this cane, and of the smaller shoots they make all kinds of furniture. Indeed, the various uses to which this elegant species of reed is applied would require a volume to enumerate. In China, their chairs, sofas, tables, screens, bedsteads, and many other household moveables, are entirely con structed of it. It is used on board of ship for poles, for sails, for cables, for rigging, and for calking. In husbandry, it is employed for carts, for wheelbarrows, wheels to raise water, for fences, for sacks to hold grain, and a variety of other utensils, as baskets, boxes, water pipes, &c. The young shoots furnish an article of food, and the wicks of their candles are made of its fibres, which are also twisted into cordage, and manufactured into paper. Furniture made of it is remarkably light and strong; but we have not the material here in sufficient quantity to manufacture it as in the East. Articles of furniture brought from China, made of bamboo, as chairs and bedsteads, some of which are made to fold up, are remarkably curious.

828. *The ratan, of which the seats of cane chairs are made,* is a small sort of cane brought from China, Japan, and Sumatra. It is exceedingly tough, and, for the purpose of chairs, is split in several strips. In China they are twisted into cables.

Sect. II.—Ivory.

829. This beautiful material is occasionally employed in ornamenting articles of furniture. It was largely used for sculpture by the Greeks, even for colossal statues of their deities, which were sometimes executed of gold and ivory. In modern times, also, smaller works in ivory have been produced by the sculptor; but it is seldom now resorted to for this purpose.

830. *Ivory is, properly, the substance of which the tusks of the elephant consist,* though the name is also given to the tusk of the sea-horse and of the hippopotamus. The greatest part of our ivory comes from Africa, where elephants exist in great numbers. A part of Guinea, from which the greatest quantity of it is shipped, has obtained the name of the Ivory coast. Very fine ivory comes, also, from the east coast of Africa. That from Ceylon is particularly esteemed, on account of its whiteness. The component parts of ivory are nearly the same as those of bones, namely, phosphate of lime, combined with a gelatinous substance; but the proportion of the latter is so considerable, that shavings and turnings of ivory can be dissolved by digestion in boiling water, and converted into jelly, which is not the case with bone. Heat does not soften ivory, like horn, nor is it so hard and brittle as bone. 100 parts of ivory contain 64 of phosphate of lime, 24 of gelatin, and 0·1 of carbonate of lime. It is worked with the saw and cutting tools, and polished by pumice and tripoli. It admits of being easily stained of various colours; and, when long exposed to the air, its beautiful white colour is changed to a dull yellow. Bleaching with chlorine will restore it to its original whiteness. When burned in a close crucible, it makes ivory black. The size of the tusks varies according to the age of the animal, the largest being about ten feet long. Those from Guinea weigh about from 100 to 120 pounds. The tusks are always more or less curved; from which circumstance, and their small diameter, this material can never be had of a large size; and, though in countries where ivory is found, as in India, considerable articles of furniture are executed of it, it is found too expensive for that purpose when brought to this country.

831. *The teeth of the sea-horse* are much harder than the ivory of the elephant, and the enamel is used for making artificial teeth.

832. *Carvings in ivory,* when not kept under glass, sometimes become covered, in time, with a multitude of minute cracks, which get filled with dirt, and deface them. Glass not only protects them from this, but affords the means of bleaching or whitening ivory that has been discoloured. This effect is produced by exposing them to the sun's rays under glass, turning each side, in succession, to the rays of that luminary. To remove the cracks above alluded to, the ivory should be washed in soap and warm water with a brush till the cracks disappear, after which it should be placed under glass for preservation.

833. *Ivory may be silvered in the following manner:* Immerse the ivory in a weak solution of nitrate of silver, and suffer it to remain till it has acquired a deep yellow colour; then take it out, wash it with water, and expose it to the sun's rays, which will turn it black in about three hours: the ivory will, upon being rubbed, acquire a silvery lustre.

834. *Vegetable ivory* is a singular substance lately introduced, and which is occasionally worked into small articles. It resembles ivory exactly, though somewhat more brittle, and more liable to change colour. It is the seed or nut of a plant (*Phytalephas macrocarpa*), having a character between a palm and a cycas, and growing in the valleys of the Peruvian Andes. The nuts are about the size of a hen's or pigeon's egg, and have been used from time immemorial by the natives of South America for the same purposes as ivory.

SECT. III.—MARBLE.

835. *All marbles are carbonates of lime;* that is, they consist of carbonic acid and lime. Of course, they are the same as chalk, only that they are crystallized, which gives them their hardness, whereas chalk is of a soft, earthy texture. Marble is corroded and dissolved by acids, and it agrees in its composition with limestones; whenever the latter are of such a texture as to admit of a polish, they are called marbles.

836. *Marble is slowly rendered more brittle, and thus slabs are sometimes even bent by long-continued heat,* as may be seen on the mantles of some chimney-pieces, where they are much exposed to the heat of the fire. White marble becomes easily stained by smoke and dust, and sometimes it is stained artificially of various colours for useful purposes.

837. *The purest white marble is termed statuary marble,* and comes to us from abroad, chiefly from Italy. It is the most expensive, as well as the most elegant. The veined marble is also imported, as well as several of the coloured marbles.

838. *Rare and beautiful marbles,* in almost endless variety, are much sought after for tops of small tables, and similar pieces of furniture; and some of these fetch very high prices. It requires no small skill to distinguish accurately the different sorts, which are frequently incorrectly named. Some substances, also, are called marbles that are not strictly so; for example, *serpentine,* which is not a carbonate of lime, but consists of silica and magnesia. The Florentine alabaster is sometimes incorrectly classed with marbles; but it is sulphate of lime, and does not effervesce with acids as marbles do. We have in Britain and Ireland many variegated marbles of great beauty, which are occasionally used in furniture.

839. *For the method of cleaning marbles,* see the section "On cleaning Furniture."

SECT. IV.—ALABASTER.

840. *This substance has a near resemblance to marble,* but is distinguished from it by greater transparency.

841. *There are two kinds of alabaster:* one is a carbonate of lime, and therefore is of the same composition as marble, but has been formed, in the manner of a *stalactite,* by water dropping in a cavern. Though very transparent, it is also very hard, and therefore seldom used for sculpture. The other kind is a sulphate of lime, and the same substance as gypsum, from which plaster of Paris is made; but gypsum is called alabaster only when it is translucent, and has a grain resembling that of marble. *Gypseous alabaster,* being soft and easy to cut, and having often great beauty and transparency, is much employed for some ornamental works, particularly vases, stands for time-pieces, and similar things. Much beautiful alabaster being found near to Florence, the business of manufacturing these ornamental articles is much prosecuted there, and also at Leghorn and Milan. Objects of this kind, made of alabaster, are liable to become yellow, particularly if exposed to any smoke, but they may be restored, in a considerable degree, by washing with soap and water, and afterward polishing with shave-grass. Grease spots may be removed by rubbing the places with powder of French chalk, which is a kind of talc. As the alabaster is very soft and tender, they are easily scratched or broken, and therefore require to be taken great care of; if valuable, they should be kept under a glass. Broken parts may be joined together again by quicklime and white of egg. Alabaster may be easily stained with metallic solutions, by the spirituous tinctures of dyeing substances, or by coloured oils, in the same way as marbles.

SECT. V.—SCAGLIOLA.

842. *This is a material which is made to imitate various marbles, porphyry, and serpentine,* so well, that it is difficult to discover, by the appearance, that it is not real stone. It is much employed for columns in the interior of houses, also for lining parts of walls; and for table tops, stands and pedestals of various kinds for statues, busts, &c., and other ornamental parts where marble is used. It admits of a very beautiful polish, but cannot be employed in the outside of a building, as it is destroyed by damp, and requires to be kept very dry. It is chiefly composed of plaster of Paris and glue, coloured by different pigments. These are mixed together separately, according to the various parts of the marble to be imitated, and while they are in a moist state, are stirred together like the veins in marble. This substance is very useful where great richness and magnificence is required at small expense.

SECT. VI.—LEATHER.

843. *The skins of animals were among the most ancient materials* employed for clothing, and for certain parts of furniture. But, although these are pliable when recently stripped from any quadruped, as they dry, they shrink, become hard, like horn, and will no longer adapt themselves to the free motion of the parts they are intended to cover. Some process is therefore necessary to restore their original flexibility and suppleness,

and to preserve them permanently in that state. Skin so treated is said to be converted into *leather*. The art of preparing leather is of great antiquity; we find it described in the poems of Homer, and it has been practised by the eastern nations from time immemorial. The objects of this art are to prevent the destruction of the skin by putrefaction, and to render them strong, tough, durable, and impervious to moisture, at the same time that they admit of dyeing and polishing.

844. *Skins may be converted into leather by three methods.* The simplest, and probably the first that was invented, consists in soaking the skin in water, and then forcing oil or grease into its pores by hard rubbing. The oil, which is thus introduced among the fibres in the place of the water, preserves the suppleness of the skin as long as it remains there. This method is mentioned by Homer; and the North American Indians prepare in this manner their deer and buffalo skins. They soak them in a mixture of the fat and brains of the animals, rub them well with their hands, and afterward hang them up in the smoke, which assists, by its antiseptic property, in preventing their putrefaction.

Leather is made in this country chiefly by two processes—by *tanning*, and by *tawing*, and both of these are sometimes combined, as in sheep, goat, and deer skins.

845. *The tanning of leather is effected* by steeping the skins, properly prepared, in infusions of astringent vegetables, as oak bark. Although this has long been successfully practised, yet the principles upon which the process depends were not understood until about the beginning of the present century; modern chemistry threw light upon the subject. It had been supposed that the effect of hardening and thickening the skin was owing merely to that peculiar corrugation which is perceived when astringent juices are taken into the mouth, and the lips are puckered and constringed, and that the fibres were thus brought closer together. But M. Seguin, a French tanner, and a man of science, discovered that the effect produced by tanning was not of a mechanical, but of a chemical nature. The skin is composed of two parts or layers; the outer one is thin, and is called the *cuticle* or *epidermis*, and the inner is named the *cutis* or *true skin*. The cutis consists of minute fibres, which are composed of gelatin or glue, as is evident, because that substance is produced by boiling skin till it is dissolved. Now M. Seguin discovered that, when gelatin is dropped into an infusion of oak bark, or any vegetable astringent, a brown precipitate falls down, consisting of a combination of the astringent matter with the gelatin; and that this new substance was insoluble in water, and was that, in fact, which leather contained, and to which it owes its properties. The astringent principle which thus combines with the gelatin of the skin M. Seguin named *tannin*, or tan. When skin is tanned, therefore, a chemical change takes place in its nature; it resists the action of water, and is no longer capable of putrefaction. Besides tannin, astringent vegetables contain another principle, *gallic acid*, which, as well as tan, has the property of forming an ink or black liquid with the salts of iron; hence leather is easily rendered black by rubbing it over with a solution of green vitriol or sulphate of iron. What we have just stated is the chemical principle upon which the making of tanned leather depends; but in the practice of tanning a variety of circumstances are to be attended to. The various kinds and qualities of leather are owing to the different skins employed, or the modification of the art of tanning, in order to suit them for their several uses. Some are made very thick and strong, for the soles of shoes; others are rendered soft and pliable, being intended for the upper leathers of shoes, for gloves, and other articles.

846. *Leather tanned in England consists chiefly of three sorts:* the thickest and strongest kind, used for the thickest soles of shoes, is known by the name of *butts* or *backs*, and are made of the stoutest and heaviest ox hides. The next in thickness, used for thinner soles of shoes, are called *crop hides*, and are made of cow hides or lighter ox hides. The third sort is named *calf skins*, and are made from the skins of calves, horses, seals, dogs, &c.; they are used for the upper leathers of shoes, boots, &c.

Besides the skins of animals recently slaughtered in this country, many are imported in a dried state; those of cows and bulls chiefly from the pampas of South America; sheep skins from the Cape of Good Hope; lamb and kid skins from Italy; and goats' skins from Barbary, &c. Different tanners and leather-dressers have, generally, some parts of the process peculiar to themselves; but the following are those which are usually practised in this country.

847. *For butts, or the strongest sole leather*, after the horns are taken off, the hides are laid smooth in heaps for a few days, after which they are suspended on poles in a close room called a smoke-house, where the temperature is kept somewhat elevated by a smouldering fire of wet tan. This occasions a slight putrefaction, which causes the cuticle with the hair to be got easily off by spreading the hide on a wooden horse, and scraping it with a crooked knife. The reason for taking off the cuticle is this: it is not formed of gelatin, like the cutis, but of albumen; it is analogous to thin horn, is incapable of combining with tannin, and would prevent the latter from acting upon the true skin. The hides are then put into a pit containing a strong infusion of bark, called *ooze*, which operation is termed *colouring;* after which they are removed into another

pit containing water impregnated with about a thousandth part of sulphuric acid: this is called *raising*, and is for the purpose of distending the pores of the hides, and occasioning them more readily to imbibe the tannin infusion, which is to combine with the gelatin of the skin and form leather. They are next transferred into a pit, where they are disposed with ground oak bark between each layer of hides. The pit is filled up with ooze, and the hides remain in this for about a month or six weeks. By that time all the tannin of the bark has combined with the skin, and the liquor is then drawn out, and fresh ooze and bark put in as before. The skins lie in this for three months, at the end of which time the process is repeated; and after remaining four or five months longer, they are usually completely tanned, except the hides are remarkably thick, when they may require another repetition of the process. The time required for tanning in this manner is from a year to eighteen months, or even two years. They are now taken out of the pit to be dried by being hung on poles, and they are then beaten smooth with wooden hammers, called batts, and compressed with a steel tool to render them more firm, when they are fit for sale.

848. *When the leather called crop hides is to be made,* the skins are put into a pit full of water saturated with lime for a few days; they are then taken out, and the hair is scraped off, and afterward the loose flesh and other superfluities. Next they are put into a pit with weak ooze of oak bark, from which they are transferred to pits with stronger ooze; all the time they are daily moved about, which is called *handling*. After this is continued for about six weeks, they are placed in a pit with strong ooze, with bark between each two layers. In this they continue several months, and this last process is repeated several times, till the hides are perfectly tanned; they are then dried and smoothed.

849. *The leather called calf skins* are tanned by a process somewhat different. These, after being washed in water, are put into pits with limewater, as before mentioned, where they are taken up and put down again every third or fourth day, for a fortnight or three weeks, in order to destroy the cuticle or epidermis of the skin. The hair is then easily scraped off, and the grease and loose flesh being removed, they are put into a pit of water impregnated with pigeons' dung, called a *grainer*, forming an alkaline lye, which, in a week or ten days, soaks out the lime, grease, and saponaceous matter. During this period they are several times scraped with a crooked knife to work out the dirt. The skins are thus softened and prepared for the reception of the ooze, in which state they are termed *pelt*. They are then put into a tan pit with weak ooze; and, after remaining there a sufficient time, are transferred to others with stronger ooze, until after six weeks they are put into very strong ooze with fresh bark, where they lie for several months till they are completely tanned. They are then dried as the others.

850. *The lighter sort of hides, called dressing hides,* used for coach work, harness, &c., are managed nearly in the same manner as the last, and afterward go to the currier. In consequence of the application of chemical science to the subject of tanning, it was expected that the time employed in the process might be very much shortened, so much so as from a year and a half to two years, to a few months; but the combination of the skin with tannin is a slow process, and it requires a long time for the tan to penetrate to the centre of the hides. Although, by making stronger infusions of the bark, leather could be made in a few months, yet such leather was found to be harder, and more liable to crack. Even the method described by Mr. Babbage as a recent improvement, namely, forcing the bark liquor into the pores by exhaustion with the air pump, is not found to answer. Weak infusions of tan, applied for fifteen months at least, make the best leather; but, as tanned leather is sold by weight, there is a strong inducement to the manufacturer to make his hides weigh as much as possible in the tan-pit, although at the expense of the toughness or compactness of the leather. Weak infusions not only take longer time to produce their effect, but also give leather of less weight; and the price which it fetches in the market is scarcely sufficient to make up for the increased expense in point of time.

851. *All barks contain more or less of the tanning principle;* but in this country oak bark is preferred, on account of its richness in tannin, and its abundance. In Russia, where the best of leather is made, the bark of the black willow is preferred, and next to this birch bark. But, of all the substances which have been tried, catechu, a sort of gum, contains the greatest quantity of the tanning principle. The tree which produces this grows in New South Wales, from which we shall probably obtain it at a cheap rate.

Oak bark being a very expensive article in the process of tanning, various substances have been proposed as substitutes for it. All the parts of vegetables which are of an astringent nature contain this principle (which may be known by their giving precipitates with gelatin insoluble in water), and will answer this purpose. The leaves, branches, fruit, flowers, of a vast number of plants; every part of the oak, as the leaves and acorns, oak sawdust, and the barks of all trees, contain more or less tannin. From experiments which have been made, the following are the quantities of the tanning principle in various barks.

	grs.		grs.
Bark of elm	28	Bark of willow	59
—— oak cut in winter	30	—— mountain ash	60
—— horse-chestnut	30	—— poplar	76
—— beech	31	—— hazel	79
—— willow (boughs)	31	—— ash	82
—— elder	41	—— Spanish chestnut	98
—— plum tree	58	—— smooth oak	104
—— willow (trunk)	52	—— oak cut in spring	108
—— sycamore	53	—— Huntingdon or Leicestershire willow	109
—— birch	54	—— sumach	158
—— cherry-tree	59		

852. *The thickest leather*, used for the soles of boots and shoes, requires nothing more than the process above described; but that which is wanted to be supple and soft, such as the light cow hides, and those of calves, horses, dogs, seals, &c., and for the upper leathers of shoes and legs of boots, also for coach and harness leather, saddles, and other things of that kind, are subjected to another process after the tanning is finished, called currying.

853. *Currying consists* in steeping the leather in water, covering one surface with a mixture of oil and tallow, and then stoving it. As the water evaporates, the oil takes its place in the pores of the leather; the *grain* side, to which the hair was attached, is then rubbed over with a solution of sulphate of iron, which strikes a black with the tannin of the leather. Beating and passing it between rollers, to smooth its surfaces, is the last process. If the flesh side of the leather is required to be blacked instead of the grain side, it is rubbed over with a mixture of lampblack, oil, and tallow, called waxing.

854. *The tanning principle in oak and other barks is sometimes applied to the purpose of preserving other substances besides skins.* Fishermen resort to this to render their nets more durable, and the sails of their boats are sometimes treated in the same manner: the application to other articles is obvious. The method of impregnating nets, cordage, &c., with tannin is the following: Two pounds of glue are dissolved in fifteen gallons of water: the nets are dipped into this solution, and steeped in a strong solution of oak or other good bark. The tannin combines with the gelatin, and envelopes the fibres of the hemp with a leathery coating, which prevents the action of the water and the weather. Any gelatinous substance will answer instead of glue: enough might be obtained from many parts of fish now thrown away.

855. *Tawing is the preparation of leather by a combination of tanning and aluming*; and is used for sheep, goat, kid, and other light skins for gloves, bookbinding, and a variety of other purposes.

When the skins of animals just slaughtered are to be tanned, they should be washed immediately and then dried, otherwise they soon ferment and begin to putrefy. When received in the dry state for tanning, they are steeped in water for two days, and the rough parts are removed by the fleshing-knife. The flesh side of the skins is now rubbed with a mixture of lime and water, and the skins are piled on each other with the flesh sides in contact: in a few days it will be found that the wool or hair may be easily removed. They are next well washed, to get rid of the lime, and again cleaned of their superfluous parts. This liming and cleaning is repeated several times. After this they are kept for eight or ten days in a bath of bran and water, which gives them a half tanning. They are then ready for the process of aluming, which is that properly which converts them into leather. A bath of alum and sea salt dissolved in water is prepared; into this the skins are put, at a heat near to boiling, for about ten minutes, and then wheat flour is dusted into the bath with the yolks of eggs, so as to make a kind of paste: the skins are well worked in this, and left in it for a day. It appears that the skins imbibe something in this process (perhaps alumin) from the alum, which cannot be separated by subsequent washing. After this they are stretched, rubbed, stoved, and occasionally polished with pumice. Smoothing with a hot iron, or pressing, finishes them ready for the glover. White kid leather requires the process of being worked in a mixture of eggs, salt, and alum, to render them perfectly white and soft, but the tanning is omitted. If the wool is to be preserved upon the skins, the treatment with lime and limewater is not used, and the alum paste is merely applied to the flesh side, and the skins folded up with it for some time. The rest of the process is nearly the same. Leathers are dyed after they have undergone the process of tanning, and a great deal of these are used for covering chairs, tables, and other articles of furniture.

856. *Morocco leather*, called also *Turkey leather*, is prepared from goat's skin, and receives its name from having been originally brought from Morocco, and other places in the north of Africa. At present some comes from the Levant, but the greater part is prepared in this country. The process employed in making it is nearly the same as that already described, only that it is tanned with sumach, and then dyed on the side of the grain; red with cochineal, blue with indigo, purple with orchal, &c. Some inferior morocco is made from sheep skin.

857. *Russia leather*, well known for its property of not being attacked by mould or worms, is first steeped in an alkaline lye, then in dog's dung: it is afterward fulled and tanned with the bark of birch, and dyed; the peculiar odour which renders it so useful in bookbinding is given by rubbing it over with the empyreumatic oil of birch. The roughness on the surface is produced by an iron tool pressed upon it.

858. *Maroquin leather* is of excellent quality, and is extensively prepared at Astracan and other parts of Asiatic Russia. The process for making it is nearly the same as for Russia leather, and it is dyed yellow or red.

859. *Shamoy, or wash leather*, properly *chamois leather*, is so called because originally, and when of the best quality, it was made from the chamois or wild goat inhabiting the Alps and Pyrenees. It is now made here, chiefly from the skins of deer, goats, and sheep. It is essentially distinguished from the other kinds of leather, in being dressed with oil, without salt, alum, or tan, and in the grain of the skin being taken off. The skins are brought to the state of pelt by liming and washing, as described above. Those skins which are to be of a buff colour are dipped in tan ooze, not to tan, but to dye them. The grain side is next scraped away by a knife, or rubbed off by pumice stone, which renders the skin softer and more extensible, yet sufficiently strong and elastic. They are then soaked in water, and oil is forced in by beating in a fulling mill till the skins have thoroughly imbibed the oil, yet without appearing greasy. They are then stoved, to facilitate the combination with the skin; and, to take away any superfluous oil, they are scoured in water with a little alkali. They are then dried, and smoothed by rollers. Until lately, vast quantities of shamoy leather was made and used in England, chiefly for dress; but it having been observed, during the late campaigns in Spain, that the health of the soldiers was seriously affected by the leather which they wore, which produced chilling and rheumatism by its fitting close to the skin, and being long in drying, the use of it was laid aside, and woollen cloth substituted.

860. *Buff leather* is a very thick and firm, though pliable sort of leather; the true kind is prepared from the skin of the buffalo, and dressed in oil, much in the manner of chamois. Real buff leather is so strong that it will turn the edge of a sword, and is said to be sometimes even pistol proof: hence it was much used for military purposes when metallic armour was going out of use, about the time of Charles II. But the buff leather of modern times is made mostly from cow-hides, which are inferior, and it is used chiefly for soldiers' sword belts, or where great strength is required with great pliability.

861. *Seal skin*, being covered with a very short smooth shining hair, is used sometimes for making waistcoats, and in other places for jackets: also for covering trunks; but are nearly laid aside for the latter purpose, as an insect breeds in them very frequently that attacks the hair.

862. *Parchment* is a very ancient preparation from skins, used for writing upon; and, from its great durability, is still employed for the same purpose in the case of valuable records. It is made of the thinnest sheep or goat skins. After the hair and flesh are cleaned off in the lime pit, the skins are soaked, drained, stretched upon frames, dried, and rubbed with pumice stone and chalk, and then pared to bring them to the required thinness. It is sometimes dyed of various colours.

863. *Vellum* is a superior kind of parchment, not passed through the lime pit, and is made of thinner skins. It is finer, smoother, and whiter than common parchment. Lately, several machines have been invented for splitting hides, by which one half is converted into leather, and the other into vellum or parchment.

Shagreen is a valuable material, used often for spectacle, instrument, and other cases, and is a singular manufacture, brought chiefly from Astracan. To make it, they choose the strong skin that covers the crupper of the ass or the horse. This is soaked in water, and the hair taken off. It is then cut and scraped till it is extremely thin, and in this state, while wet and soft, small, round, hard seeds are strewed over it, and are trodden deeply into the soft, yielding skin. The skin is then dried and the seeds shaken out: the surface is rasped down till the whole is nearly but not quite level. It is then again soaked, and the parts which were depressed now rise above those parts which had been rasped. The skins are now dyed of a green colour, and allowed to dry. Lastly, the grains or projecting warts are rubbed down till the whole is completely level, when the shagreen presents the beautiful appearance of white dots on a green ground.

[The art of tanning is cultivated in this country to much greater perfection than in any other portion of the world; and many of the manufacturers of leather conduct the business on a scale and to an extent far beyond what is known in England. Within a few years very great improvements have been made by American ingenuity and skill, which are unknown to the old world, and by which the process of converting the hides into leather is facilitated, so that a perfect article is made in little more than one fourth of the time formerly required here, and, as it will be seen by the text, still deemed necessary in England.

The process, in some of its parts, is patented by the inventors, and still kept secret among the few who, having purchased the right to its exclusive employment, make the monopoly a source of great emolument, while affording to sell the best leather at lower prices than their neighbours, by reason of their diminished expenses in the ratio of the abbreviation of the process. The improvement essentially consists in employing hot infusions of bark, by which the chemical action of the tannin is hastened; and, at the same time, rapidly effecting by machinery certain parts of the operation, ordinarily performed by hand, and demanding much labour.

In the large tanneries the bark mill is worked by a steam-engine, which, at the same time, drives all the other machinery, and conveniently provides the heat necessary for preparing the ooze with which the vats are filled. In some of the Atlantic cities the manufactories of leather are conducted on a scale of immense extent by men of large capital, who find the business very productive.]

Sect. VII.—PAPIER-MACHEE.

864. *This substance, as its name imports, is made from paper reduced to a pulp* with gum or size, pressed in moulds, and afterward dried: it is at present very much employed in various ornamental works, which were formerly executed in plaster of Paris or carving, such as the enrichments in cornices and ceilings, picture frames, &c. It is originally a French invention, and was much in use sixty years ago, but had been almost laid aside for the above purposes; it was revived a few years ago. It had, however, been always employed for large tea-boards, trays, &c., for which it is admirably adapted from its great lightness and strength.

The black varnish for trays, &c., is prepared in the following manner: Some colophony or turpentine is boiled down till it becomes black and pliable; this is wetted in a glazed earthen vessel, and then as much amber in fine powder is sprinkled in by degrees, with the addition of a little spirit or oil of turpentine now and then: when the amber is wetted, the same quantity of sarcocolla is sprinkled in and stirred; then more spirit of turpentine is added, till the whole becomes fluid. The mixture is next strained through a coarse hair bag, by pressing it gently between hot boards. This varnish, mixed with ivory black in fine powder, is applied, in a hot room, on the papier machée, which is thus set in a gently-heated oven, next day in a hotter oven, and the third day in a very hot one, and suffered to stand each time till the oven is grown cold. The article so varnished is hard, light, and durable, with a fine gloss, and bears liquors, hot or cold, without injury.

Sect. VIII.—TEXTILE FABRICS.

865. These materials, which form so great a part of furniture, as silk, cotton, linen, and woollen, will be treated of among the substances employed as clothing or dress, in Book XVII.

Sect. IX.—HAIR.

866. *The hair of animals is employed in various articles of furniture:* when it is very fine and soft, it is termed *fur* (which see in Chap. IX., Book XVII.). Hair is used for stuffing mattresses, sofas, and chairs, and making sieves, and it is woven into a cloth for covering chairs and sofas. The best for all purposes is horse hair; but that from tails of bullocks is also good; the shortest hair taken off skins being only fit for being mixed with mortar for the plasterer, although a good deal of this is introduced among better kinds in inferior and cheap manufactures. When hair is to be prepared for mattresses, it is twisted round wooden cylinders and boiled, and then baked in an oven to give it a curly and springy form. The long straight hair is reserved for weaving into cloth for chair bottoms, for which purpose it is first dyed a deep black. The satin manner of weaving it is now most generally adopted as the most agreeable and the most durable. Hair is a very lasting substance, not being liable to decay through ordinary causes. It is insoluble in water, but is acted upon and dissolved by alkalies; much soap, of course, injures it.

Sect. X.—HORN.

867. *The horns of cattle are used for a variety of purposes in furniture as well as dress:* those of oxen are the largest and best. *Horn differs essentially from bone* in its constitution and properties. It contains little gelatin, whereas bone contains a great deal; and it consists chiefly of condensed albumen, with a very small portion of gelatin and phosphate of lime. Consequently, horn cannot be dissolved by heat, though it may be softened by it; and it may then be readily bent to any shape, and made to adhere to other pieces of horn in the same state, or pressed out into thin sheets. These properties belong to the hollow horns of the ox, goat, sheep, &c., and the hoofs of quadrupeds; the shell of the tortoise is nearly of the same quality; but the horns of the stag are very different, being composed chiefly of gelatin, and intermediate between horn and bone; they are soluble to a jelly in boiling water.

The horns of the bull and cow, sold by the tanner who had purchased the raw hides, consist of two parts: an outward horny case, and an inward conical substance, somewhat intermediate between indurated hair and bone, and termed the *core*.

868. *The first process in preparing horns for various purposes consists* in separating the horn itself from the included core, to which it is attached by a thin membrane; this membrane is destroyed by macerating the whole in water for about a month, and then the horn is easily separated by a blow. The horny exterior is then cut into three portions. The lowest of these, next the root of the horn, is softened, flattened, and made into combs. The middle of the horn, after being flattened by heat, and having its transparency improved by oil, is split into thin layers, and forms a substitute for glass in common lanterns. The tip of the horn, being solid, is used by the makers of knife-handles, and of the tops of whips and umbrellas, and for other similar purposes. The interior or core of the horn is boiled down in water; a large quantity of fat rises to the surface during this operation: this is put aside, and sold to the makers of yellow soap; the liquid itself is used as a kind of glue, and is purchased by cloth-dressers for stiffening. The insoluble substance which remains behind is then sent to the mill, and, being ground down, is sold to the farmers for manure, or is burned to ashes used in making cupels for chemists.

869. *Horn is prepared for lanterns as follows:* It is first softened by hot water, and then over a gentle fire, generally made of the stalks of furze, which enables it to be slit lengthwise on one side, and kept expanded flat by a pair of tongs while it is placed in a press between iron plates that are greased. Here they remain till they are cold. They are next soaked in water, divided into laminæ, which are scraped and pared down to the requisite thinness and transparency, with a large knife worked horizontally on a block. Afterward these thin plates are polished with willow charcoal and rotten stone. The Chinese are remarkably skilful in preparing this thin horn, as may be seen by a large globular lantern in the museum of the India House, about four feet in diameter, composed entirely of small plates of coloured and painted horn. Horn lanterns were also used by the ancients; for we find one mentioned in the *Amphitryo* of Plautus, and in an epigram of Martial: Pliny likewise speaks of lanterns and various ornamental articles made of dyed and painted horn.

870. *In Holland, France, and Germany, they make use of the parings* and clippings of horn and tortoise-shell, in the manufacture of snuffboxes, and a variety of elegant articles and toys. They first soften the material in boiling water, so as to permit its being pressed in iron moulds, which are heated in order to unite the whole into one mass. Care must be taken that the heat is not so great as to scorch the material; and grease must be carefully avoided, as that prevents their union.

871. *An artificial horn is made in France* from the gelatin obtained from bones, which is tanned by the same process as is used in making leather. When it is quite dry and hard, this assumes the appearance of horn, and it is coloured to imitate tortoise-shell. It is used for the same purpose as these substances, and when softened, by being boiled in water with potash, it is formed into any shape, and the figures are preserved by drying them between moulds. It is also inlaid, when in the soft state, with gold, silver, and other metals.

872. *Large combs, ornamented with open work, are used for the hair.* The tortoise-shell, or horn to imitate it, is first softened by boiling in hot water, till it can be easily cut by a steel die. Horn is coloured to imitate tortoise-shell, for combs and inlaid work, in the following manner: A compound is made by boiling together, for half an hour, pearl-ash, quicklime, and litharge, with a sufficient quantity of water, and a little pounded dragon's blood. This is applied hot to the surface of the plates of horn, and kept ti. the colour has struck; where dark streaks are required, the composition is to be applied a second time. This process, Mr. Aiken observes, is nearly the same as that employed for giving a brown or black colour to white hair, and depends on the combination of the sulphur, which is an essential ingredient in albumen, with the lead dissolved in the alkali, and thus introduced into the substance of the horn. When a dark shade is required, the dragon's blood is omitted.

873. *Horn is employed likewise for a great variety of other purposes.* Bows, having great elasticity, are made with it. The true bugle-horn was made of the horn of the Urus, or wild bull, tipped with silver, and slung in a chain of the same material. Complete suits of scale armour are made of horn in the East. Drinking cups are also made of it by softening, turning, and polishing.

Sect. XI.—tortoise-shell.

874. *This beautiful material is the shell or outside covering of the hawk's-bill turtle* (*Testudo imbricata*, Linn.), which is stronger, thicker, and clearer than that of any other of the tortoise tribe. A large turtle affords about eight pounds of tortoise-shell, which lies in scales, lapping over each other like the tiles of a roof. The animal is a native of the Asiatic and American seas, and is sometimes found in the Mediterranean; but its flesh is not esteemed as food, and the shell constitutes its only value.

Tortoise-shell is semi-transparent, and, being variegated with various spots of whitish yellow and reddish brown, constitutes, when properly prepared, one of the most elegant articles for ornamental purposes. The ancients appear to have been peculiarly partial to this material, with which it was customary to decorate their beds and various parts of their furniture; and, in modern times, it is extensively employed for snuffboxes, combs, knife-handles, inlaying, &c. This shell is capable of so far being softened by steeping in hot water, that pieces may be joined together by placing the edges on each other, and subjecting them to a powerful press and hot iron; and, by the same means, ornaments of gold and silver may be applied to it. If, however, the heat is too great, the colours are much deepened, so as to become almost black, as is the case with moulded snuffboxes; for tortoise-shell, being less fusible than horn, cannot be made soft enough to be moulded without some injury to the colour; accordingly, combs of tortoise-shell, ornamented with open work, cannot be stamped out by dies like those of horn, but are obliged to have the perforations cut out by drills and other tools, while the graver is employed for the lines on the surface.

Sect. XII.—whalebone.

875. *Whalebone is a horny substance found in the mouth of the whale.* This animal has no teeth, but, instead of them, a number of long strips of this substance, having fringes on their edges, through which it strains the sea water, and retains the food contained in it, consisting of abundance of small creatures. The number of strips of whalebone amounts to about 300; and they are from twelve to fifteen feet in length, ten to twelve inches broad, and from four to five tenths of an inch thick. They consist only of parallel fibres, consequently are easily rent or split. From its elasticity, strength, and lightness, whalebone is employed for many purposes: for stiffening stays; for ribs to umbrellas and parasols; for the framework of hats; and the shavings from the plane for stuffing mattresses, instead of hair. When heated by steam, it is softened, and may be easily moulded, like horn.

Sect. XIII.—mother-of-pearl.

876. True mother-of-pearl, a beautiful substance, hard, and displaying a variegated play of blue, red, and green, is the internal part of the pearl oyster. It is easy to work, and takes a fine polish. As it is entirely calcareous, it is easily corroded by acids. But the beautiful iridescence for which mother-of-pearl is remarkable is still more striking in some other shells, particularly in the shell, not uncommon in this country, called the *sea ear;* and it is the inside of this, and not mother-of-peal, which is now so much employed in japanned work.

Sect. XIV.—feathers.

877. Feathers are the peculiar covering of birds. In no other tribe of animals are they met with; and no bird is entirely without feathers, although some species want them on certain parts of the body; as the turkey and vulture, on the head and part of the neck.

878. *This clothing of birds is of two kinds, down and common feathers:* the former are placed under the common feathers; and some birds, when very young, as the goose, have no other covering. The down is designed to defend the bird against cold and wet; hence it is so abundant upon the lower surface of those which frequent the water, and it is most plentiful in those which inhabit only the coldest regions of the north. The common feathers are thickest upon the shoulders and loins, along the under part of the neck and breast.

879. *The large feathers, or quills,* situated upon the wings and tail, should rather be considered as instruments of motion than as mere covering; thus we find them strong and unyielding in those birds that have heavy bodies, as the swan, goose, turkey, &c., while they are wanting in those which do not fly, as the ostrich, &c. There are other long feathers that differ from the quills and common feathers with respect to their structure and position. Of these, we may mention those of the crest of the peacock, and some of the crane kind; also some of the feathers of the birds of paradise, which seem designed for ornament alone. The feather may be considered as divided into the tube or barrel, *a, fig.* 159, and the shaft, *b.* The tube penetrates the skin, and constitutes the root of the feather; it is hollow, semi-transparent, and horny, and contains a thin vascular substance that, when dry, forms that well-known jointed membranous body which we take out of the barrel of the quill when we make a pen. The shaft is elastic, and is quite filled with a very light dry pith. Two sides of the shaft are covered with the barbs, running in a direction from the barrel; and each barb is covered on the edges with smaller ones, or barbules, by which they are, in some measure, bound together, and preserve the bird from being wet. Upon the size, colour, and form of the barbs, the character and appearance of each kind of feather chiefly depends. In the down of all birds the shafts are exceedingly fine and delicate, and often imperceptible: the barbs are long, distinct, and floating; the barbules being long, loose, and silky.

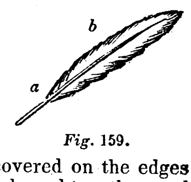


Fig. 159.

880. *The feathers of all the birds employed as food are used for some purpose or other;* but they are not all equally fit for furniture: and feathers are likewise of various qualities, according to the parts of the bird from which they are taken. All feathers are more or less imbued with an oily matter secreted by the living animal, for the purpose of defending it more completely from rain and water, from which they must be freed before they are fit to use in furniture.

881. *Goose feathers are the best for beds*, and are generally employed, being the most elastic. They are usually sorted into white and gray; the latter are cheapest by sixpence a pound, but are equally good for beds as the white.

The best goose feathers come from Dantzic and Hamburg; they bear the highest price, and are most esteemed for their strength and elasticity. Of our feathers, those of Somersetshire are reckoned the best; and the Irish are generally the worst. Irish feathers, it is said, are sometimes adulterated with lime to increase the weight: a small quantity of lime is often sprinkled among the feathers, in order that, by combining with the oil, it may prevent it from turning rancid and injuring them; but the Irish peasantry put a greater quantity than is necessary.

It has been stated that, in some parts of Britain, as in Lincolnshire, geese are plucked five times in the year; the first time, at Lady Day, for feathers and quills; and four times more, for feathers only, between that time and Michaelmas. In cold seasons many geese die by this barbarous custom. In Lancashire they are plucked twice. When killed, each goose yields about a pound and a half of feathers.

882. *Poultry feathers*, as those of the turkey, ducks, and fowls, are soft, but not so elastic as those of the goose. It is difficult to deprive duck's feathers of the odour of the oil which they contain in abundance, and which, if not removed, is highly pernicious, collecting small insects that destroy the feathers.

883. *Down* is furnished by the goose, and more particularly by the swan, of which a good deal comes from Dantzic; but the finest down is from the eider duck, imported into this country from Denmark, and brought from Greenland, Iceland, and Norway. It is used only as a covering to beds, and never should be slept upon, as it thereby loses its elasticity.

884. *Feathers or down, intended for use, should be plucked as soon as possible after the bird is dead*, and before it is cold; otherwise they are defective in that elasticity which is their most valuable property, and are liable to decay. The bird should, besides, be in good health, and not moulting, for the feathers to be in perfection; and when plucked, and a sufficient number collected, the sooner they are dried upon the oven the better, since otherwise they are apt to heat and stick together.

885. *Feathers are prepared for beds* by respectable manufacturers in the following manner: First, all the tail and small wing feathers are picked out; of these there is generally a considerable quantity, and, if suffered to remain, they will injure the softness and elasticity of the bed. The feathers are then put into a building made for the purpose, with flues constructed in the same manner as in a hot-house, where a considerable heat is kept up. In this the feathers are turned over frequently, and a small ventilator at the top suffers the foul vapours to escape. After they have been sufficiently stoved, they are placed in a large cylinder made of loose canvass, which is turned with great velocity by means of the multiplying cog wheels of a horse or hand mill; by these means all the sand and dirt is got rid of. They are then put into linen bags, and beaten, to clear them from the very fine powder or dust that adheres to them. The whole process of cleaning is attended with a loss of one pound in seven of the weight. Much of the comfort and excellence of beds depends, not only upon the quality of the feathers, but upon the operation of cleaning them having been properly performed. In feather beds got up cheap by inferior upholsterers, the feathers are not well freed from the animal oil, and are imperfectly stoved and beaten; in consequence of which they soon harbour insects, and fill the bedchambers with dust and flue, besides emitting an odour that is disagreeable and unwholesome. But it will sometimes happen, even when the feathers have been prepared with great care, that, when quite new, they may have a faint smell when first slept on. To deprive them of it, take off all the blankets every morning, and expose the beds to the air for three or four hours, and in a short time all smell will disappear: for want of this precaution it might remain for several weeks.

886. *The following process of cleaning feathers from their oil* will be a remedy for the above evil, and will likewise supply a method of preparing them for putting into beds. It was communicated to the Society of Arts by Mrs. Jane Richardson. "Take for every gallon of clean water, one pound of quicklime; mix them well together, and when the undissolved lime is precipitated in fine powder, pour off the clear limewater for use. Put the feathers to be cleaned into another tub, and add to them a quantity of clean limewater, sufficient to cover them about three inches, after they have been well immersed and stirred about therein. The feathers, when thoroughly moistened, will sink down, and should remain in the limewater three or four days, after which the foul liquor should be separated from them by laying them on a sieve. The feathers should

be afterward well washed in clean water, and dried upon nets, the meshes of which may be about the fineness of cabbage nets. The feathers must be, from time to time, shaken upon the nets, and as they dry will fall through the meshes, and are to be collected for use. The admission of air will be serviceable in the drying. After being prepared as above, they will only require beating to get rid of the dust." We ought to observe, however, that, notwithstanding the publication of this process, some consider the use of limewater as bad, as the feathers can never afterward be freed from white dust.

887. *The chemical composition of feathers* agrees nearly with that of hairs, consisting of inspissated albumen, mixed with a very minute portion of gelatin, and a little animal oil; but they contain much less mucilage, and receive less moisture from the body. Although feathers are so dry, even when attached to the living bird, they lose much of their pliancy and freshness after being some time plucked.

888. *Feathers intended for dress* are prepared by the *plumasier.* The feathers he employs are those of the ostrich, heron, peacock, swan, goose, and cock. We shall content ourselves with describing the mode of preparing those of the ostrich, which are the principal. The feathers of the male bird are the whitest and most beautiful. Those upon the back and above the wings are preferred; next, those of the wings; and, lastly, those of the tail. The down is merely the feathers of the other parts of the body, which vary in length from four to fourteen inches; it is black in the males and gray in the females. The finest white feathers of the female have always their ends a little greenish, which lessens their lustre, and lowers their price. These feathers are imported from Algiers, Tunis, Alexandria, Madagascar, and Senegal.

They are first scoured in soap and lukewarm water for five or six minutes, and afterward rinsed in hot water. To bleach them, they are immersed in hot water mixed with Spanish white, and well agitated in it: they are then washed successively in three waters. They are next passed rapidly through a bath of cold water, containing a very little indigo; and next sulphured in the same manner as straw hats. The ribs are scraped with a bit of glass, cut circularly, in order to render them very pliant. By drawing the edge of a blunt knife over the filaments they assume the curly form so much admired.

889. *Cleaning and dying feathers* is likewise the business of the plumasier. The original pure white of feathers can never be completely restored when once soiled; but it may sometimes be desirable to give them an artificial colour. The spirituous tincture of turmeric will give them a fine yellow of any depth that may be necessary, and a little lemon juice will brighten the colour. Blue of any shade may be given by liquid blue, or by any sulphate of indigo. Green may be produced by a mixture of the two last dyes for blue and yellow. Buff colour may be produced by adding to a little pearlash a decoction of annotto in water. Red is produced by wetting the feathers with lemon juice, and then with the carmine sold in saucers. Purple is obtained by a mixture of the red and blue dyes.

890. *It has lately been found that a feather, damaged by crumpling, may be perfectly restored by immersing it in hot water.* The feather will thus completely recover its former elasticity, and look as well as ever it did. This fact was discovered accidentally by an amateur ornithologist at Manchester, and may, perhaps, be usefully applied by the plumasier. Having received some skins of birds from South America, he found that the feathers in the tail of one of the rarest specimens had been rumpled in the packing. Accidentally he let the bird fall from his hands into his coffee cup; but instead of its being completely lost, as he at first supposed, having laid it down before the fire to dry, he was agreeably surprised to find that the plumage had been restored to its original straightness and perfection.

SECT. XV.—CAOUTCHOUC, OR INDIA RUBBER.

891. The material called *caoutchouc,* now so much employed in various articles of dress, was for a long time known only in the fine arts by the name of *India rubber,* so useful in obliterating the lines made by a black-lead pencil. The first mention of it which we find is in the preface to Dr. Priestley's "Familiar Introduction to the Theory and Practice of Perspective," printed in 1770, where there is the following notice: "Since this work was printed off, I have seen a substance excellently adapted to the purpose of wiping from paper the marks of a black-lead pencil. It must, therefore, be of singular use to those who practise drawing. It is sold by Mr. Nairne, mathematical instrument-maker, opposite the Royal Exchange. He sells a cubical piece, of about half an inch, for three shillings; and he says it will last several years." How long before that its use in the fine arts had been discovered we do not know; but before the date mentioned, crumb of bread had been used for the purpose alluded to. It is said, however, that the knowledge of this material was first brought to Europe by the French academicians who were sent to South America in 1730 to make astronomical observations.

892. *Caoutchouc,* or India rubber (the latter name having been given to it from the

application we have just alluded to), is originally a white milky juice of certain trees or plants, found abundantly in the Brazils, and Quito in South America, and also in several parts of Asia and Africa. The chief plants which produce it are *Hevea guianensis*, *Jatropha elastica*, and *Urceola elastica*, but particularly the first. These plants grow so extensively in some places, that hundreds of miles are covered with them in a wild state; thus there is no fear of the material falling short of the demand. The juice is procured by making incisions in the tree. For a short time it continues liquid, but soon becomes solid by exposure to the air; and this is the condition in which we usually receive it. The South American Indians prepare of it a variety of useful articles, as water bottles, shoes, boots, &c., by making moulds of clay, and of the shapes required. These they fix to the orifice made in the stems of the trees, so as to permit the juice to flow out and cover them all over with a thin coat. In this state it is held over the fire to dry, and hence its black colour, from the smoke. When it is dry, it is covered with another coat of the juice, which is also dried, and so on, till sufficient thickness is obtained. The clay is then removed from the inside by breaking it into fine powder, or moistening it, and permitting it to pass out at the neck of the bottle. In this way are made the small India-rubber bottles which we see in the shops.

893. *Caoutchouc, when fresh taken from the tree in a liquid state*, is of a dirty white colour, resembling in consistence and appearance buttermilk or cream, and it will keep in this state, if not exposed to the air, for two or three months, at the end of which time it coagulates, and becomes thick and solid. Some of it has been imported of late.

Although the juice in its recent state can thus be easily made to produce any form required, yet, as it is perfectly insoluble in water when once it has become solid, it cannot be manufactured into various articles by any ordinary means; these are, therefore, most easily made where the plant grows.

894. *Though warmth softens solid caoutchouc a little*, and heat will cause it to melt, yet, after being rendered liquid in this manner, it does not return to its former condition, but remains always clammy. This singular material was found to resist most of the usual chemical agents employed for dissolving substances. Alcohol does not dissolve it; turpentine acts upon it, but imperfectly; and ether was the only substance that for a long time was known to effect a solution that would afterward become solid upon the evaporation of the menstruum. This solvent is, however, too expensive for ordinary purposes; and is liable to another objection from its great volatility, which does not permit spreading the solution as a varnish properly.

895. *Caoutchouc dissolves partly in some of the essential oils*, as oil of turpentine; and also in the fat oils, as that of olives and of almonds. It may be dissolved by boiling in spirits of turpentine, and putting in small pieces till dissolved; but the solution does not dry perfectly. If half the quantity of drying linseed oil be added, and both boiled together for half an hour, a varnish will be made, impenetrable to water, but which does not dry completely. This was tried for making water-proof cloth; but it did not answer well. By means of this substance the varnish for balloons is made.

896. *It was afterward discovered by Mr. James Syme, lecturer on surgery in Edinburgh, that real naphtha dissolves it readily*, and that it may be recovered from this solution without loss of its elasticity. Naphtha from coal-tar is equally efficacious; and, as this solvent is cheap, the solution of caoutchouc is now applied to numerous useful purposes. When acted upon by naphtha, caoutchouc swells to thirty times its bulk, and then, if worked with a pestle, and pressed through a sieve, it affords a varnish which may be spread upon cloth by means of a flat edge of metal or wood. Two cloths being thus covered, are put together, and passed under a rolling press. The double cloth is then hung up to dry, and to get rid of the smell of the naphtha. This is the method of manufacturing the water-proof cloth now so extensively prepared under the name of *Mackintosh*, and for which there was a patent, now expired.

Great elasticity is one of the most remarkable properties of India rubber, and a strip may be drawn out into forty or fifty times its former size, and yet return to its first dimensions. From this property it is employed in many articles of dress, and likewise in transferring impressions from copper plates to earthenware. When in a softened state, it can be rolled or pressed into sheets thinner than bladder, which are now employed in various manufactures. Such is its power of distension, that a small piece the size of a walnut, when softened by boiling for an hour or two in water, can be blown out into a ball fifty inches in diameter; and in this way are made the *balloons* sold at present as toys.

Caoutchouc tubes for various purposes are now made, which combine perfect flexibility with impermeability to air. These are extremely useful for surgical and other purposes. Another useful application of this material is in Brockenden's stoppers for bottles or decanters. These consist of some substance made to the shape of a stopper, and covered with a piece of sheet India rubber, which, by its elasticity, closes the aperture more effectually than any other method. (See farther, "Elastic Fabrics and Water-proof Cloth," Chap. VIII., Book XVII.)

897 *A new liquid has been prepared from caoutchouc, called caoutchoucine*, which has

singular and useful properties. It is a solvent of all resins, particularly copal, which it dissolves without heat, at the ordinary temperature of the atmosphere, a property possessed by no other solvent known; and hence it is peculiarly useful for making varnishes in general. It also mixes readily with oils, and will be found to be a valuable and cheap menstruum for liquefying oil paints; and without in the slightest degree affecting the most delicate colours, will, from its ready evaporation, cause the paint to dry almost instantly. Cocoanut oil, at the common temperature of the atmosphere, always assumes a concrete form; but a portion of this caoutchoucine mixed with it will cause the oil to become fluid, and to retain sufficient fluidity to burn in a common lamp with extraordinary brilliancy. It is to be observed, however, that this last property is rather curious than useful, as its expense is too great for such application. Caoutchoucine is extremely volatile, has less specific gravity than ether, or any other known liquid; yet its vapour is so heavy, that it may be poured, without the liquor, from one vessel into another, like water. We should notice, that its volatility and the inflammability of its vapour are so great, that care should be taken not to bring a lighted candle near to it when the vessel is opened which contains it. It is procured by cutting caoutchouc into pieces, putting them into a still, to which the heat of 600° is applied. The caoutchouc melts and rises in vapour, which, being condensed by a worm in the usual way, affords the caoutchoucine.

Sect. XIV.—metals.

Subsect. 1.—*General Observations.*

898. The metals are all simple substances: that is, not compounded of others; but each exists in itself as a separate or unalterable body, apparent alterations consisting always, not in that of the metal itself, but in the addition of some other substance, by which the appearance and properties of the metal are changed. What is called the *rusting* or *tarnishing* of a metal, which is one of the most common changes it is subject to, consists in the addition of oxygen to the metal, the new compound being termed an oxyde in some cases, which is only another word for rust, in common language. Most metals are subject to this change; but a few, as silver, platinum, and gold, are not liable to rust, and have therefore a peculiar value in making coin and plate. There are, in all, forty-one metals distinct from each other; but some of these are extremely rare, being scarcely applied to any use; others are seldom or never employed alone, but only in combination. It will, therefore, be necessary to describe a few only as simple metals. These are platinum, gold, silver, copper, iron, tin, lead, zinc, and quicksilver; and we shall confine ourselves to the description of such of their properties as are important to be known in domestic economy.

Subsect. 2.—*Platinum.*

899. Platinum, resisting the action of most chemical agents, would be a metal extremely valuable for domestic purposes, were it not so expensive in consequence of its rarity. It is of a dull silvery white colour, possessed of considerable lustre, and not at all liable to tarnish or be oxydized. It is likewise the most difficult to fuse of any metal, requiring for this purpose the most intense heat that can be produced, and it is capable of being wrought by the hammer, and rolled out into very thin sheets; it is likewise very hard, and is not acted upon by any of the ordinary acids. From these properties, it is easy to see how invaluable it would be for culinary vessels, did the expense permit. It is, however, occasionally employed for chemical vessels, and even found economical, from its great durability. It is said that, on the Continent, they have succeeded in applying it to copper instead of tinning.

Subsect. 3.—*Gold.*

900. Gold is valuable, not only on account of its scarcity, which renders it very useful as a medium of exchange, but it possesses some peculiar properties which render it preferable to every other metal for particular purposes. Its great malleability is exemplified in the making of gold leaf, so much employed in gilding. Its ductility and tenacity are shown by the drawing of gold and gilt silver wire, and in gold lace and embroidery. Its softness renders it easy to be worked into various delicate forms for ornaments, for which its beautiful rich colour and resplendent lustre, which are different from those of any other metal, peculiarly qualify it; and its perfect unalterability, when exposed to the air or fire, has justly stamped its high character in all ages. Its specific gravity is greater than any metal except platinum. Its hardness is greater than that of lead and tin, but inferior to iron, copper, platinum, and silver. It cannot be dissolved by any acid except the nitro-muriatic, formerly called aqua regia, and which is a mixture of the nitrous and muriatic acids; neither of these acids, separately, can dissolve it; and it is precipitated from its solution in the state of gold powder by an alkali. It forms alloys with most of the metals. These properties render it invaluable for many economical purposes, which are well known; and its never tarnishing, if pure, when exposed to the air, occasions it to be so much used in gilding, both on wood and metals.

SUBSECT. 4.—*Silver.*

901. Silver is a metal not oxydized by the ordinary means, and therefore is perfectly harmless when made into vessels for preparing food. Its expense alone prevents its being employed for all culinary vessels; it is, however, used in these sometimes for particularly nice purposes. Not being acted on by the acetic acid, as iron is, knives for cutting fruit are made of it. Though it is not oxydized by exposure to the air, its surface becomes gradually tarnished, and, in long time, even blackened: this arises from the union of sulphur with the silver, the resulting sulphuret of silver being of a blackish colour. The sulphur is derived from a portion of sulphuretted hydrogen, which is generally present more or less in the atmosphere, and more particularly when the air is impure. Pure water has no effect upon silver; but if the water contain animal or vegetable matter, it often blackens the surface, in consequence of the sulphur it may contain. The well-known blackening of a silver spoon by a hard-boiled egg is owing to the sulphur which all eggs contain in the yolk. Silver is dissolved readily by nitric acid, forming with it a highly corrosive substance, lunar caustic, or nitrate of silver, used as marking-ink. Though a hard metal, silver yields to the knife, but not nearly so easily as tin, which is the metal that comes nearest in resemblance to it. Silver is next in malleability to gold, and is capable of being rolled out and beaten into leaves of extreme thinness; it is so ductile that it may be drawn out into wire as fine as human hair. It is difficult of fusion, but may be melted and cast into moulds. It has been proposed to line the insides of sauce-pans and stew-pans with silver rolled out into thin sheets: these linings might be loose, by which they could be taken out to be mended. Plating copper with silver is a less perfect mode for that purpose, as the thickness of the plating cannot be easily examined. Electro plating copper vessels is now practised. There are several alloys which have been made to assume the improper names of silver, as German silver, nickel silver, &c., in which there is not a particle of this metal; and such names serve only to delude the public. It is to be observed that there can be but one kind of silver; and the same observation may be applied to every other metal.

SUBSECT. 5.—*Iron.*

902. Iron is the metal most abundantly employed for economical purposes; and, fortunately, it is the most plentiful in nature: on account of its great importance and usefulness, it demands particular notice.

903. *Iron is procured from the ores dug out of the earth* by fusing them in a furnace at a very strong heat; the metal, thus freed from the earth with which it was combined in the ore, flows out in a liquid state.

904. *This first product is called cast iron*, because it can be run or cast into moulds. All articles of cast iron are formed by first making models of them in wood, wax, or some other substance; these models are then pressed into very fine sand, and the impression so made is called a *mould*, into which the fluid iron is run from the furnace. But this cast iron is very far from being pure iron. It is iron combined with some carbon, or charcoal, besides various earthy impurities. It differs from pure iron in being crystallized, in not being malleable, or capable of being extended by the hammer; and it is likewise extremely brittle; but it is very hard, and, except made in a particular manner, cannot be cut by a file; consequently, all articles of cast iron are liable to be broken by a blow or fall, or by throwing water upon them when heated. Its fusibility, however, is a valuable property, since many articles of furniture can be made of it by casting, as saucepans, fenders, and ornaments of various kinds, that could not be fabricated in this manner of pure iron, since this cannot be melted in any ordinary degree of heat, even of a furnace.

It must be observed, that, by late improvements in the manufacture of iron, cast iron can be made so soft as to be filed with considerable ease after it is cast into moulds: a circumstance of the greatest importance in fitting together the various parts of castings.

Great quantities of various kinds of cutlery are made of this kind of cast iron, particularly forks, scissors, snuffers, &c. The models are made of lead, and the moulds are in sand. The iron employed is of the kind which contains a large quantity of carbon, fuses at a low temperature, and becomes very liquid. It is the only kind that can be used for small articles; these, when cast, are almost as brittle as glass; but, to obviate this, they are afterward heated in pots with ashes or sand for the purpose of annealing them. After this process, they are found to be very soft, and to be capable of even bending a little without breaking. They are then finished in a manner similar to those that are forged, with the exception that they are not hardened and tempered; were they subjected to that process, they would return to the same state as before annealing. Cutlery made in this manner is sold at a very low price; but the knives and forks are not only liable to break, but they soon turn blackish, and then can be very little improved by the common mode of cleaning; they are susceptible of only a very miserable polish.

Various attempts have been made with a view to improve the cast iron cutlery, some of which have been rather successful.

905. *The art of casting iron is carried to a great degree of perfection in Prussia.* Ornaments made of cast iron *come to us from Berlin* that are quite surprising for their delicacy and beauty; not only figures, candlesticks, lamp-stands, ink-stands, &c., but necklaces, ear-rings, broaches, and similar ornaments. These have of late been imitated here with tolerable success; but it is said our founders are not acquainted with the Prussian method of staining the iron with a deep black that never wears off: they can only apply a thin varnish that is liable to come off.

906. *Pure, or malleable iron, called also wrought iron, is manufactured from cast iron* by reheating masses of it, called pigs, and subjecting them to the action of a heavy hammer worked by powerful machinery. By heating and hammering repeatedly these pigs of crude or cast iron, the carbon is expelled, and the metal at last is obtained in a state of purity, when it manifests its well-known properties of great ductility or malleability, by which it can be fashioned into various articles by the smith, although it has become very infusible, and cannot be melted in the ordinary heat even of a furnace. It can now be *welded;* that is, two or more pieces of iron, when heated intensely, can be made to adhere and unite together under the smith's hammer: a property of very great value not possessed by cast iron. In this state it is likewise so soft that it can be subjected to the file, and made into any form. Hence, wrought iron is employed for many domestic implements, in the fashioning of which filing is necessary, except where brittleness would be a great objection, as fire-iron, and various things forged by the smith: but it rusts easily when exposed to damp air, and does not take a high polish. Wrought or malleable iron is not sufficiently hard for making cutting instruments; for this purpose, it must be converted into steel.

907. *Steel is an artificial combination of iron with carbon*, though somewhat different from that which composes cast iron. When steel is made red hot it is soft, and can be hammered and filed into any shape; but if suddenly plunged, in its heated state, into cold water, it instantly becomes extremely hard, and can no longer be acted upon by a file, which is itself steel so hardened, and has the power of cutting and piercing iron or steel before it is so hardened. Steel is likewise brittle, and no longer yields to the hammer; and it is extremely elastic: hence it is employed for making springs; it takes the most beautiful polish, and it is then less liable to rust than iron.

Steel might, however, be too hard and brittle for many edge tools, and, therefore, after this process of hardening, most tools and instruments go through another process called *tempering*, which is letting down or reducing the hardness to the degree just proper for the instrument, and thus giving it a certain firmness and toughness.

908. *The tempering of steel instruments* is effected by heating them again to a certain point, and plunging them into cold water, or some fluid, as mercury or oil. Steel, when tempering, assumes various colours with different degrees of heat. At 430° it appears of a pale yellow; with a higher degree of heat it becomes brown; and by increasing the heat, it appears at last of a beautiful blue. Giving the temperature proper for each kind of cutting instrument is a very delicate operation, and is managed with great nicety by the cutler.

There are several kinds or qualities of steel in common use; to explain which, we must describe briefly the process by which iron is converted into steel.

909. *To convert iron into steel*, bars of soft iron are put into a particular kind of furnace, in layers, with powdered charcoal between each layer, and the whole is covered up close with a mixture of clay and sand, so as to prevent the access of atmospheric air. A strong heat is then applied for eight days, and the furnace is then suffered to cool; in about eight days more it is sufficiently cooled, and the bars of iron are thus found to be converted into steel. The explanation of the conversion of the iron into steel is this: the iron, at a high heat, absorbs carbon from the charcoal put between the bars, and forms a chemical combination with it, steel being iron and carbon. This mode of making steel is called *cementation.* As the bars, after this process, always appear blistered on the surface, they are called *blistered steel.* These bars are then hammered into rods of various sizes, and are sold as *common steel*, of which all kinds of forks and cheap cutlery are made.

910. *Tools which require great tenacity without great hardness*, such as table knives, scythes, plane iron, &c., are made of what is called *shear steel*, so named, because first employed in making wool shears. Shear steel is made by laying a number of bars of blistered steel together, heating them to a welding heat, and working them together into bars by a forge hammer. This forms a tough steel free from flaws.

911. *All the fine articles of cutlery*, such as razors, the best penknives, scissors, and instruments required to have a high polish, are made of *cast steel.* Cast steel is made by fusing blistered steel in covered crucibles, and pouring it into cast iron moulds, so as to form it into ingots; these ingots are afterward drawn into bars or rods of suitable dimensions. Formerly this kind of steel could only be worked at a very low heat; but it can now be made so soft as to be welded to iron with the greatest ease, which saves the expense of making certain articles entirely of steel, the edge part only requiring to be of this material.

Wootz is a species of steel manufactured in India only; and as it admits of a higher temper than our steel, it has been imported for making razors and surgical instruments, for which it answers admirably, though it does not appear to be certain that it is superior for these purposes to our best cast steel. It is not known accurately in what manner it is produced from the ore, but it is supposed to be a natural steel.

912. *Silver steel, and Peruvian steel,* are also names which we see announced as designating metals of superior qualities, but without any good reason.

913. *The discovery of steel* is, perhaps, second in importance to few of those which man has made; for it has given him all the best edge and cutting tools by which he has moulded almost every other substance to his wishes. A savage will work for twelve months with fire and sharp stones to fell a great tree, and to give it the shape of a canoe, which a modern carpenter, with his tools, could accomplish in a few days. So manageable has steel become, that it can be softened sufficiently to admit of being engraved on like copper; and it is afterward hardened, by which the plate so produced can give ten times as many, or more, impressions than a copper plate before it is worn out.

914. *Iron is perfectly harmless, when employed in culinary vessels.* Its rust or oxyde, so far from being hurtful, is frequently prescribed as an excellent tonic; and the only inconvenience arising from employing the metal in its pure state is its liability to rust, thus wearing into holes; and, in this case, it is likewise apt to tinge the colour of food prepared in it. On this account, sauce-pans, tea-kettles, and other utensils made of iron are tinned over, to prevent rusting. Cast iron is much less apt to rust than hammered or rolled.

915. *There is one precaution by means of which the disagreeable effects produced by this metal on food, when it rusts, may be very much diminished,* and, indeed, in most cases almost entirely prevented, especially when the utensil is made of *cast iron.* If, instead of scouring the inside of such boilers and stew-pans with sand, they be simply washed and rinsed out with warm water and wiped with a soft cloth, the surface of the metal will soon become covered with a thin crust or coating of a dark brown colour, resembling enamel: which covering, if it be suffered to remain and to consolidate, will at last become so hard as to take a very good polish, and will serve, very efficaciously, to defend the surface of the metal from farther corrosion, and consequently to prevent the food from acquiring that taste and colour which iron alone is apt to impart to it. The process by which this covering is gradually formed is similar to that by which some gunsmiths brown the barrels of fowling-pieces, and would, no doubt, be greatly expedited by the same means which they employ for that purpose: the object had in view is likewise the same in both cases, by causing a hard and impenetrable covering of rust to be formed on the surface of the iron, to defend it from contact with those substances which are capable of dissolving or corroding it, or, in other words, to prevent the farther progress of the rust.

Subsect. 6.—*Copper.*

916. Copper, from its malleability and ductility, as well as hardness, is extremely useful in articles of domestic economy. It suffers little change in a dry atmosphere, but in moist air it rusts, and is converted into a carbonate of copper, which is oxyde of copper united to carbonic acid, being of a green colour. It is remarkable that, though copper is oxydized by sulphuric or muriatic acids, and by the vegetable acids, in the air, yet if air be thoroughly excluded, these acids do not attack it. All the oxydes and salts formed by copper are violently poisonous; yet metallic copper is not so; copper coins swallowed by persons have lain in the intestines for months without any inconvenience.

917. *Copper is easily acted upon by the acetic acid* or vinegar, and a green substance is formed, well known by the name of *verdigris;* which is an acetate of copper, or acetic acid united to oxyde of copper, the poisonous nature of which is generally known: it is a powerful direct emetic, producing vomiting as soon as it is swallowed, without exciting nausea.

918. *Copper is likewise acted on by fat and oil of every description,* and carbonate of copper is thus formed: therefore, when copper vessels have been used for preparing food, fat should never be suffered to remain in them: many cases of poisoning are known to have happened from soup or fat broth having been left for some time in copper boilers.

919. *Chemists and physicians have repeatedly pointed out the danger arising from the use of copper vessels in culinary operations;* and numerous cases have been cited where this deleterious metal is suffered to enter into our food and drink; some of which, however, appear more alarming than is perhaps necessary. Thus it has been observed that the brewer boils our beer in copper vessels; the sugar-baker employs copper pans; the pastry-cook bakes our tarts in copper moulds; the confectioner uses copper or brass vessels; the oilman boils his pickles in the same. Though the quantity of copper thus introduced into our food and drink is not so great as to produce sudden fatal effects, yet it is not improbable that it may be sufficient to cause, in the course of time, derangements of the system. The senate of Sweden, in 1753, was so much impressed with the importance of the subject, that they prohibited the use of copper vessels for culinary

purposes, and ordered that none but such as were made of iron should be employed in their fleets and armies.

Confectioners rarely make use of any other vessels than those of copper untinned, even in the preparation of acid sirups, as of oranges and lemons; but they take care that these vessels are well scoured, and kept perfectly clean; also, that the sirups remain in them no longer than is absolutely necessary. Some preserving pans are made of brass and bell-metal; and these are preferable to copper.

920. *Tinning on the inside prevents copper utensils from having the poisonous effect they would otherwise have* upon food if prepared in them. Copper boilers, sauce-pans, and other things of this kind, are not made of copper *previously* tinned, as in the case of iron, but they are tinned *after* they are made. They are first scoured bright, and then made hot, and the tin is rubbed on over the fire with a piece of cloth, or some tow, having first sprinkled the surface of the copper with some powdered resin, oil, pitch, or some other inflammable substance, the use of which is to reduce such part of the tin to the metallic state as may happen to be oxydated; for, as we observed in the case of tinning iron, it is essential that both the metal and the tin should be in the pure, and not in the oxydized state, in order that they should unite. If the copper were tinned first, the tin would be melted off by the heat required by the hard solder used in making the joints. In this process nothing ought to be used but pure grain tin; but we are sorry to observe that lead is sometimes mixed with the tin, to adulterate its quality, and to make it lie more easily. This is a pernicious practice.

921. *All copper vessels, as soup-kettles, stew-pans, &c., should be examined every time they are used;* these, as well as their covers, should be kept well tinned, to prevent those accidents which are so liable to occur from neglect; and no food should be suffered to remain in them any longer than is necessary for its preparation for the table.

922. *It is stated as an interesting chemical fact, that copper cannot be dissolved by acids while tin is present.* If a copper sauce-pan be so worn that part of the tinning is off, the acids take up some of the tin and deposite it on the abraded part, thus repairing, in some degree, the damage; in the same manner as brass pins are tinned by boiling with tin filings and cream of tartar. It is said, also, that no verdigris is formed in copper vessels while the substances they contain are in a state of actual boiling; and that it is only when the acids are cold, or, at least, not boiling hot, that they corrode the copper; but it is best not to trust to any chemical facts of that kind, but to have all copper well tinned, as the safest practice.

923. *Although copper may be, and to a considerable extent is, cast in sand,* like other metals, it is in the state of sheets rolled out that the largest consumption takes place. It is an easy and pleasant metal to hammer, being at once soft and tenacious. These sheets, when cut into the desired form, are united by hard solder, and thus formed into various utensils. The hard solder employed is composed of three parts of brass and one part of zinc, being more fusible than common brass. A copper tea-kettle presents a familiar, but ingenious specimen of the coppersmith's art, both with reference to soldering and hammering; taken, indeed, in all its parts, it exhibits the result of almost every operation of his workshop. Most of the parts are cut out of sheet copper, and soldered up; the spout is formed by filling a tube with lead, and hammering it upon a mandrel; and the lid is stamped. Copper tea-urns and sauce-pans are formed by soldering and hammering in a similar manner, the brown colour of the former being produced by the application of sulphate of copper, or Roman vitriol, previous to the planishing and burnishing.

924. *Attempts have been made to line copper culinary vessels with tinned iron,* in order to guard against the poisonous qualities of the copper; but the tin was then found to rust with uncommon rapidity, owing to a galvanic effect between the two metals; and it is observed that, in cases where iron is riveted to copper, the rivet holes are acted upon in a similar manner, which causes the iron to loosen.

SUBSECT. 7.—*Lead.*

925. *Lead is a metal, fortunately, too soft, by itself, to be used for culinary vessels,* otherwise it would prove very dangerous, since all its salts produced by acid substances are more or less poisonous, and some of them highly so. It is readily dissolved by the acetic acid or vinegar which exists in all acid fruits, and the result is *acetate of lead,* or sugar of lead; although this is scarcely a poison of itself, yet it may be converted, when in the stomach, into the carbonate of lead, which is a deadly poison. It is not safe, therefore, to admit into the human constitution any of the salts of this metal, in any form whatever, except, as in medical practice, it should be administered with certain correctives of its poisonous qualities. It is supposed that lead, in its metallic state, like all other metals, is probably inert; but it is so easily acted upon by even the weakest acids and alkalies, that its presence in the stomach can never be free from danger. Of all the salts of lead, the *carbonate* is the most virulent poison. When metallic lead is exposed to the air, it soon acquires upon its surface a thin white coating, which is a carbonate of the metal. When lead is exposed to the action of rain-water and air, the

same kind of white powdery crust is formed; and this appears just at the surface line of the water in leaden cisterns, when the water has been suffered to remain long. Rain-water, collected from the roofs of houses where there are leaden gutters, and coming down through leaden pipes, and in similar cases, when water and lead have been long in contact, holds always more or less of this poisonous salt. Sulphuric acid does not act upon lead when cold, but when hot it dissolves that metal.

926. *Although lead is not much used in vessels for preparing or holding food, yet there are several cases in which its improper use may be pointed out.* In some parts of the country it is, or was, the custom to keep milk in leaden vessels, particularly in Lancashire, from a mistaken idea of its cleanliness and coolness; but the consequence is, that the acid of the milk dissolves a portion of the lead, which is thus converted into a dangerous substance; and though the quantity may be small, yet, long continued, it may produce disease.

Vats of lead have been used in some cider countries, and have produced incalculable mischief. What is called the Devonshire colic is occasioned by this practice, and is identified, by its effects on the system, with the colic of the plumbers, painters, and white-lead makers.

Brewing coppers, in some places, have their bottoms only of copper, their sides being of lead; these are dangerous, as the lead must be more or less dissolved by the wort. The glaze of some kinds of earthenware is made with oxyde of lead, and is improper for pickling vessels.

927. *The poisonous effects of lead are sensibly felt in white-lead manufactories*, where the air breathed by the workmen is, in some degree, impregnated with it; and house-painters, who are continually inhaling vapours containing some of this, and having their hands and clothes stained with it, are frequently attacked with a peculiar disease, termed the painter's colic.

928. *Lead can be plated with tin*, and as the latter metal is much less deleterious than the former, this method is sometimes resorted to in pipes. To effect this, heated lead is rubbed with melted tin, using, at the same time, turpentine, or some other resinous matter, as a flux. The lead being thus covered with tin, any quantity of the latter metal will readily adhere to the surface of the cylinder of lead, which is then ready to be drawn into pipes. This useful process, however, we believe, is not much practised.

SUBSECT. 8.—*Tin.*

929. *Tin* is a metal of a white or more silvery colour than lead, and it is somewhat harder. Nearly the whole of our tin is procured from the tin mines in Cornwall, where the masses of the metal, made ready for sale, are termed *block tin;* and a purer kind is called *grain tin.*

930. *The metal tin, by itself, is sometimes employed for making certain vessels*, as boilers for dyers, worms for stills, and for other purposes in the arts, but it is never formed into kitchen or culinary utensils.

931. *What is usually called tin*, when employed for articles of this kind, as sauce-pans, tea-kettles, &c., is, in fact, sheets of iron coated over, or plated with tin; this is a material so very important, and so frequently misunderstood, that it will be proper to describe it somewhat at length. We have mentioned the poisonous qualities of copper and brass; and that iron is not unwholesome, but so extremely liable to rust, that it cannot conveniently be employed for the ordinary utensils of the kitchen. Tin does not rust; and it is this property, and the facility with which iron is coated with it as a protection, that occasions it to be so much employed.

932. *The forming of tin plate is one of the greatest improvements in our culinary apparatus.* The process of making is the following: the best iron is rolled out by a flatting mill into plates of the proper thickness, and these are cut by shears into suitable sizes. These plates are first thoroughly scoured with sand to clean off all the black oxyde, and they are then steeped in water, having in it a little muriatic acid, to dissolve what oxyde may remain. They are next hammered, rolled, and steeped again, till they are perfectly bright, and free from black spots, and they are again scoured with hemp and sand, to make them quite ready to be tinned. In order to coat them with tin, an iron pot is nearly filled with this metal in a melted state, and a quantity of tallow or grease, sufficient, when melted, to cover the fluid tin to the thickness of two inches, is put into it. Into this pot the sheets of bright iron are plunged, in order to coat them over. But previously to this, another pot is filled with melted grease only, and the sheets of iron are immersed in it. From the grease pot they are removed, with the grease adhering to them, into the pot containing the melted tin, in which they are placed in a vertical position. About three hundred and forty plates are usually put into the pot at once, and they remain in it an hour and a half: they are then taken out and drained. But when they are first taken out, more tin adheres to them than is necessary; this is taken off by a subsequent process, called *washing*, which is done by passing them through a large quantity of melted grain tin, which operation melts all the loose tin on the surface of the plates, which are immediately brushed on each side, with a brush made of hemp. The

plates are then immersed again for a short time in melted tallow, and are cleaned with bran, ready for sale. It is absolutely necessary that the iron should be quite bright and free from oxyde; and the use of the tallow is to preserve the tin from the action of the air, it being requisite that both metals should be in a perfectly pure state before they will adhere together.

These sheets of tin plate are purchased by the tinman, who cuts them with his shears into the requisite forms, and solders them together to make various utensils, as tea-kettles, coffee-pots, sauce-pans, candlesticks, and similar things to be found in his shop.

933. *We hear it frequently said that certain articles of this kind, as dish-covers, coffee-pots, &c., are made of block tin:* and many persons suppose that such things are made of the pure metal tin *only;* but this is an error: the metal tin will not do to use in this way: it would bend too easily; and all such articles are, as we have observed, made of iron coated with tin. What is sold under the term *block tin,* is only tin plate better planished, and a little stouter than ordinary; but it is singular enough that the term block tin applied to manufactured goods is not used in the tinman's trade, and it appears to be an error which has crept in among his customers, and of which he permits the existence. The terms *single* and *double block tin* mean only tin plate of different degrees of stoutness.

In the ironmongers' shops there are articles of three kinds of tin, known by them under the names of common tin, planished tin, and strong tin. The last two are termed *block tin* by the customers.

934. *The advantages of tin plate for culinary vessels* may be thus enumerated. It resists great heat and changes of temperature, and is not liable to crack like earthenware; it is quickly heated, it is lighter than earthenware, it is not brittle, and can be mended, which the latter cannot be; hence, though dear at first, it is, perhaps, cheaper in the end, if great care be taken of it. It is perfectly clean and wholesome, which earthenware glazed with lead is not.

935. *As the use of tinning iron is to prevent its rusting,* in the same manner as a varnish, it is obvious that whatever wears off the tin lays bare the surface of the iron, and exposes it to the action of moisture and air, which occasions its rusting. It may be easily understood from this, that, to preserve tin sauce-pans, candlesticks, and all other utensils made of tin plate, care should be taken not to wear away the tin from the surface. Every one has seen silver-plated candlesticks which have been cleaned so often that the copper is made visible by wearing away the silvering. This is easily known from the reddish colour of the copper, so different from that of the silver; but many cooks do not know that tin sauce-pans, &c., are only iron plated with tin, and that they are destroyed by frequent rubbing, just as plated candlesticks are. The colour of the tin being so near to that of the iron prevents this from being seen at first. But the iron itself, when exposed, soon becomes black, while the tin preserves its brightness. If the iron so exposed be scoured with sand, it also will become bright, but it never has the silvery colour of the tin, and may be easily distinguished by an attentive eye. As soon as the tin is worn, the iron soon rusts, and gets into holes, which the tinman cannot mend.

936. *To clean covers, or any other article of bright tin.*—Get a ball of the finest whiting (common whiting has generally a little sand); mix some of it powdered with a very little drop of sweet oil, and rub the tin with this; then wipe it clean; after that, dust some dry whiting on it, and clean it off with shamoy leather. To prevent rusting, tin requires to be kept in a dry place; for, though the metal tin is not itself liable to rust, yet there are always some edges or minute places of the iron imperfectly covered, which are sure to rust; and this, in time, will corrode into holes.

Subsect. 9.—*Zinc.*

937. *Zinc has lately been introduced into domestic economy* for vessels of various kinds, and other purposes. The salts of zinc are not so poisonous as those of lead; but they are so to a great degree, and therefore this metal is improper for all purposes where food is concerned. In America, a patent was taken out for an improved milk vessel of zinc, which, it was said, had the effect of "causing the milk to throw up more cream, and to prevent it from turning sour;" but this effect could only be produced by a portion of the metal being dissolved, and forming acetate of zinc, a poisonous salt.

938. *Zinc is very little liable to oxydate in the air,* and therefore it is a useful material for many utensils formerly made of iron or copper. Coal skuttles are now made of zinc alone, or of sheet iron lined with zinc, which are more durable, though dearer, than those of iron; and they are cheaper than those of copper. Zinc is likewise employed instead of lead for baths, as being cheaper, and for pails, rain-water, and other pipes; pierced with numerous holes, it serves for window blinds, for enclosing safes, and many similar purposes: also various cowls for chimney-tops are made of it. Zinc is not malleable when cold, but, heated nearly to the melting point, it can be rolled into sheets with great facility. It has not been in use here in this way above twenty years.

Subsect. 10.—*Quicksilver.*

939. Quicksilver, called also mercury, is so far different from all the rest of the ordi-

nary metals, that it is always fluid in the common temperature of the atmosphere, and can be rendered solid only by exposing it to an intense degree of cold, when it is found to be malleable; but as it retains its solid form only so long as the cold is continued, this fact cannot be applied to any useful purpose. The fluidity of mercury, and its bright lustre, are properties that render it extremely applicable to various uses, as in the construction of barometers and thermometers; likewise in the uniting with tinfoil to form the silvering for mirrors. It is an extremely heavy metal, and does not oxyde readily; but its oxydes are poisons, as well as the fumes of mercury, when it is boiled, which it can be with a very high degree of heat, equal to 600° Fahr.

SUBSECT. 11.—*Alloys of Metals.*

940. *These are compounds formed by fusing two or more metals together;* and it is the more necessary to state this, because the compound receiving a distinct name, many persons are not aware that they are not separate metals, but only mixtures. Formerly the term alloy was confined to compounds formed of gold, silver, and a little copper, used for coin; but now the term means any mixture of metals whatever.

941. *Alloys are formed for various reasons.* Some metals that are too soft, as gold, are alloyed to render them less liable to lose weight by wear. Some alloys are made to procure a hard or tough metal; others for the beauty of their colour; others, again, to prevent oxydation. In short, almost all the mixtures of various metals with each other have particular properties that render them valuable for some purpose or other; and thus the number of the metals appear as if they were increased, although it is not so in fact.

The changes in the properties of metals by alloying are sometimes very remarkable. Thus gold and lead, and gold and tin, metals extremely malleable, form brittle alloys. The alloy of copper and gold is harder than either of its component parts. A minute quantity of arsenic added to copper renders it white. The fusibility of an alloy is generally greater than that of its components. Thus, an alloy of lead, tin, and bismuth, melts with the heat of boiling water.

942. The alloys in common use are,

943. *Standard gold,* which consists of 11 parts pure gold, 1 part copper; of this, 1 pound troy is coined into 46 sovereigns.

944. *Ring, or jewellers' gold:* 1 ounce 5 pennyweights gold coin, 6 pennyweights 12 grains fine silver, and one pennyweight of copper.

945. *Standard silver:* 11 ounces 2 pennyweights of fine silver, and 18 pennyweights of copper.

946. *Brass is a mixture of copper and zinc* in various proportions, but generally in the proportion of seventy-five of the former to twenty-five of the latter. The colour, and some other properties of the brass, vary according to the quantities of copper and zinc, the paler kinds containing most zinc. In some kinds the colour approaches very near to that of gold, and is extremely beautiful. Brass is more fusible, but less malleable, when cold, than copper; and is not only capable of being easily cast in moulds, but can also be rolled out into sheets.

It is less liable to rust and to be acted upon by acids than copper — a property that renders it more useful for cooking utensils; and, before tinned iron came into use, brass vessels were much employed in the kitchen. At present, the superior malleability of copper has almost driven brass out of the field for sauce-pans and stew-pans, though copper is more difficult to clean and more liable to tarnish. These ancient brass vessels were all cast: some are now made of sheet brass.

But, notwithstanding that brass is not so liable to be acted upon by acids and other corrosive substances as copper, this danger is far from being entirely removed, as may be easily seen by the green carbonate of copper which is formed on it by acids, and by fat or oil. Brass vessels, therefore, require the same precautions as copper, and should never be employed to keep food in for any length of time.

Next to iron, brass is the most useful metal in the modern arts and manufactures. As it is variously compounded or alloyed, it is more or less adapted for that amazing variety of purposes to which it is so extensively and profitably applied. When in its purest state from the foundry, it is so soft and malleable as easily to admit of being spread out into sheets under the rollers; and it may be beaten out into tinsel with the utmost facility. Brass in this state admits of being stamped or embossed with a degree of ease which renders it valuable for cheapness and beauty, in numerous useful and ornamental articles. When properly made, it has a considerable degree of ductility and tenacity, and may be drawn into very fine wire: a slight degree of heat will increase its ductility; but, when heated to about 300°, a smart stroke of the hammer will reduce it to powder.

947. *Pinchbeck* consists of 1 ounce of brass, from 1 to 5 ounces of copper, and 1 ounce of zinc.

948. *Tombac* has more copper, and is of a deeper red than pinchbeck.

949. *Manheim gold, or similor;* 3 ounces of copper, 1½ ounce of brass, 15 grains of pure tin.

950. *Or-molu* is the name given to a particular alloy of 52 parts zinc and 48 copper.

951. *Bronze* is a mixture of tin and copper, sometimes with the addition of zinc; but the proportions vary. It is tougher and harder than copper, and does not rust so soon when exposed to the air; but in time, and particularly by being buried in the ground, it is covered with a dark green rust. It was much employed by the ancients for a variety of purposes: Homer describes most of the arms, offensive and defensive, as brazen, or of bronze, and does not mention steel: most of the arms and instruments found in Herculaneum, Pompeii, Stabia, &c., are of bronze or brass, among which there is even a complete set of surgical instruments. Bronze was also extensively employed for statues, candelabra, candlesticks, lamps, and a great number of domestic utensils and articles of furniture, of which a vast variety may be seen in public museums. No doubt the facility with which it can be cast, and the sharpness of the impression which it receives, together with its great durability, were the causes for its preference. It is at present employed to a considerable extent for similar purposes, although the modern improvements in casting iron, which is a much cheaper material, has superseded the use of bronze on many occasions.

Birmingham is the chief place in England for the manufacture of articles of bronze. But the most extensive manufactory of this kind is in Paris, where there are 250 houses engaged exclusively in it. There every description of chandelier, candelabra, lamps, candlesticks, &c., are made. The number of workmen is estimated at 5000, to which we may add 1000 gilders, who form a distinct body. The manufacture is estimated to produce annually the sum of about 800,000*l.*, great part of which is exported. At Paris, there are made every year 15,000 bronze clocks, 40,000 pairs of candlesticks, 3000 pairs of candelabra, and 100 *surtouts de table*, which are large ornamental vases for holding flowers, placed in the centre of the table at large dinner-parties. These articles of French manufacture display great skill and taste, and many of them are seen in the annual exhibition in Paris.

952. *Bell metal* is a species of bronze, consisting of 78 parts of copper and 22 of tin: some bell founders add zinc and lead; but these metals are prejudicial, and are only added to save expense. The *Chinese gongs* are made of an alloy of copper and tin, in the proportion of 78 of the former to 22 of the latter, according to an analysis by Klaproth. They are forged by the hammer, and tempered.

953. *Gun metal* consists of 100 parts of copper and 12 of tin, with or without a little brass.

954. *Tutenag*, called also *white copper*, is a Chinese metal, the method of preparing which is not known in this country; but, when analyzed, it is found to consist of, in 100 parts, copper 2·02, zinc 1·27, nickel 1·58, iron 0·13. It is extremely sonorous, and not easily tarnished. It appears to be very similar to our German silver.

955. The alloys known among us by the names of *German silver*, *nickel silver*, *albata*, and *British plate*, consist of zinc, copper, and tin chiefly, but without any silver, though they are spurious imitations of that metal; and, as each manufacturer pretends to have some peculiar composition or proportions, it is impossible to state these with accuracy. See some observations on them under "Plate," Chap. XVII.

956. *Pewter* is a compound metal, or an alloy of tin, antimony, and lead; but its composition is not always uniform. There are three kinds of pewter in common use, called *plate metal*, *triple*, and *ley*. Plate metal is said to be formed of 112 parts of tin, 6 or 7 of antimony, and a small portion of brass or copper to harden it; it is the best kind, and used for making dishes. The sort termed triple is used for alehouse pots, and is composed of lead and tin, with a little brass. The ley pewter, used for wine and spirit measures, has more lead. Lead being a cheaper metal than tin, it is the interest of the manufacturer to employ as much as he can of the former metal; and, consequently, pewter is apt to contain too much of it.

Lead, being a noxious metal, danger was apprehended from its employment in this way; and the French government appointed a commission of some very able chemists to examine the subject. They found that, when wine or vinegar is allowed to stand in vessels composed of an alloy of tin and lead in different proportions, the tin is first dissolved, while the lead is not sensibly acted upon by these liquors, except at the line of contact of the air and the liquor; and no sensible quantity of lead is dissolved even by vinegar, after standing some days in vessels that contained no more than 18 per cent. of lead. Hence it was concluded that, as no noxious effect is produced by the very minute quantity of tin which is dissolved, pewter may be considered as a safe material when it contains about 80 per cent. of tin; and, where vessels are intended merely for measures, a much less proportion of tin may be allowed. But the common pewter of Paris was found to contain no more than 25 to 30 per cent. of tin, and the remainder was lead: there is reason to fear that this is also the composition of our common pewter; if so, malt liquor, and particularly porter, always containing more or less acetic acid, cannot fail to dissolve some of the deleterious metal.

It has been just stated that vinegar dissolves a very small portion of the lead as well as of the tin, just at the surface of the fluid where the acid is in contact with the metal and the air; and there may thus be occasionally cases where the dissolved lead may pass into our food and drink: for instance, where vinegar is distilled through a pewter worm, traces of lead, as well as of tin, have been discovered in the vinegar. The use of such pewter as contains much lead, for any vessels where food or drink is concerned, should, therefore, be as much as possible avoided.

957. *Britannia metal*, or *Prince's metal*, has lately come much into fashion, and has superseded the employment of ordinary pewter in a great many articles of common use: this alloy is composed of 3½ cwt. of best block tin; 28 lbs. of antimony; 8 lbs. of copper, and 8 lbs. of brass. It takes a high polish, and does not readily tarnish: when kept perfectly bright it has great beauty, far excelling pewter, and approaching in lustre to silver. A quart teapot of it costs only a few shillings; but from attempting to reduce the price so much, the metal is frequently made so thin as to occasion its being bulged or warped by very slight accidents, or even by the heat of the water. It is also employed for candlesticks, coffee biggins, and measures for liquids. It is not easily acted upon by acids, and is perfectly safe. One of the most valuable uses to which this metal is applied is the manufacture of spoons, which are not only brighter and better looking than pewter, but less apt to bend. There are various qualities of Britannia metal, arising from the introduction of lead into some of it. The principal seat of this manufacture is at Sheffield.

958. *Biddery ware* is made in India, and receives its name from the place of its manufacture, Biddery, a large city about sixty miles northwest from Hyderabad. When its metallic colour is brought out, it resembles pewter or zinc. Dr. Hayne informs us that it is composed of 16 oz. of copper, 4 oz. of lead, and 2 oz. of tin; these are melted together, and to every 3 oz. of the alloy 16 oz. of spelter is added. The people of the East prefer making it black, and inlaying it with silver with great labour; the colour is given by dipping the articles into a solution of sal-ammoniac, saltpetre, common salt, and blue vitriol.

959. *Speculum metal* consists of 32 parts copper, 15 tin, 1 brass, 1 silver, and 1 arsenic.

960. *Type metal:* lead hardened by antimony, with some copper and brass.

961. *Hard solder* consists of 2 pounds copper, and 1 pound tin.

962. *Soft solder:* two thirds tin and one third lead.

SECT. XVII.—SUBSTANCES FOR SCOURING AND POLISHING.

Few things in domestic economy are less understood than these operations, although so much practised.

963. *To remove dirt or discoloration of any kind from the surfaces of various utensils* or other articles of furniture, and to restore the polish they have lost, demands an intimate knowledge of the nature of the materials to be operated upon, as well as of those which are employed in effecting the change; otherwise infinite damage may be done that cannot be remedied. With respect to metallic vessels, it is necessary to know whether they consist only of one metal in the solid, or whether that seen on the outside is merely superficial, as is the case of tinned copper and iron, silver plate, and gilt articles, which may be entirely destroyed by the same process that might be safely used for solid copper, iron, silver, or gold. In many cases the dirt is to be removed from culinary vessels by some substance that will soften or dissolve it, as soaking in cold or hot water; or if oily or greasy, by the use of alkali, or other means sufficiently well known in the scullery. But when recourse must be had to materials that act only mechanically, by grinding or wearing away what is to be removed, attention must be paid to the nature of the mechanical process, to prevent errors and misconceptions. It is necessary, first, to observe that no surface, however smooth, is absolutely so. The difference between a surface which is level or flat, but rough, and one that is smooth and polished, consists only in the magnitude of the inequalities with which they are both covered. When these are visible to the eye, the surface is called rough; but when the inequalities are so minute that none can be seen by the naked eye, we say that it is smooth; and when they are still smaller, so as to be perfectly invisible with a magnifier, and to reflect most of the light in one direction, we say that the surface is polished.

964. *In the commencement of the process of polishing any substance,* they begin by grinding down the surface so as to reduce it to a level, by means of some coarse sandstone, or cutting powder like sand, or emery and water. When the surface is rendered flat, it will be seen covered with an infinity of deep scratches in all directions, made by the powder employed. A continuance of grinding with the same substance would not make the surface any smoother, and therefore a new material for grinding, the particles of which are smaller, is now necessary. This wears down the surface still farther; the former scratches are all obliterated, but the surface is equally covered with scratches, only they are all of a smaller character. As finer and finer powders are employed, so the scratches will be diminished in magnitude, though not in number, until at last, by employing an extremely fine polishing powder, the greatest diminution in the size of the scratches, and consequently the highest degree of polish, is obtained.

965. *This being the true nature of polishing,* it may be readily seen how very essential

it is that the nature of all polishing substances should be well understood, in order to determine which ought to be employed in each particular case, that the process may be effected in the best manner. For example, let us consider the method of polishing any pieces of metal. At first the surface must be got perfectly level, and tolerably smooth, by rolling, hammering, or other mechanical process. Next it must be rubbed with a coarse powder, consisting of hard particles, as sand, or coarse emery, which will scratch it all over, and reduce the general surface to an accurate level. By using finer sand, or finer emery, the size of the scratches will be reduced. After that another powder must be employed, still finer, perhaps washed emery; and next tripoli or rotten stone, which is finer and softer still. To lessen the danger of large scratches, great care must be taken that no coarse particle get mixed with the fine; and to facilitate the rubbing, oil is also used; but it is to be observed that the oil itself can have no effect in producing scratches, or wearing away; it merely facilitates the motion of the substances used for this purpose.

966. *For taking the rust out of iron or steel*, where it has gone deep, or for wearing away any surface of stone, marble, &c., substances must be first employed, such as sand, sandstone, emery, pounded glass, &c.; and these must be used either with a piece of wood, leather, or cloth, with or without water. For taking out the scratches left by these, and producing a polish, polishing powders must be used, each one finer than the other, as tripoli, putty (the name for oxyde of tin, not glazier's putty), crocus martis, whiting, cuttle-fish bone, &c.; and for giving the highest polish, some of these substances washed extremely fine, and used with oil on leather, felt, or some similar material.

967. *When the surface of any hard substance is to be rubbed off, common sand is, perhaps, the substance most frequently employed.* It consists of minute fragments or broken pieces of the mineral called quartz, and, to be understood, should be examined by a magnifying glass. The grains of which it consists are harder than glass, which it, of course, can grind down. Coarse sand consists of large grains; fine sand of smaller. Sand is never so fine as not to make scratches visible to the naked eye, and therefore it must carefully be excluded from finer polishing powders. It is only to be used where much of the surface is to be removed, or where the articles are of such a nature that a scratch on the surface is immaterial. *Sand-paper*, so well known for scouring, is made by sifting clean sand on paper previously covered with an adhesive substance.

968. *Bath brick.* This is a soft kind of brick, the powder of which is much employed in scouring bright many articles of furniture, as brass candlesticks, knives and forks, &c. The particles of this are not nearly so hard as those of sand. The latter from hardness are seldom bruised much finer in the process of scouring; but those of the brick are broken readily into smaller pieces during the operation, and do not leave those scratches that appear after the use of sand; at the same time that they have sufficient sharpness to remove a portion of the surface.

969. *Common brickdust* is a soft red brick of a similar nature reduced to powder.

970. *Emery* is a substance which is the most powerful in grinding down surfaces, from the extreme hardness of its particles, which are harder than sand; but it is too expensive for common use, and is only employed on particular occasions, where it is required to rub rust out of metals, or remove defects by grinding down a considerable portion. Emery is, in fact, a variety of corundum, the hardest known substance except diamond. It is brought to us in lumps from the isle of Naxos, in the Archipelago, and it is bruised to powder in a powerful stamping mill, and is then sifted into various degrees of fineness. It is used with oil or with water, according to the particular case.

971. *Emery paper* is made of various degrees of fineness, in the same way as sand-paper, and is more convenient than the powder of emery.

972. *Emery cloth is much superior to emery paper* for the purpose of cleaning furniture and utensils of iron and steel. There is a great consumption of sand-paper and of emery paper in private families; but paper is so brittle that it will not hold together after having been used a little while, and, unfortunately, this happens just when its quality as a polisher is the best, from the coarser grains of sand or emery having been rubbed off. By substituting the cheapest kind of calico for paper, an article has been produced, the durability and utility of which more than compensates for the additional cost. It is easily prepared. The calico is strained on stretching frames, after having been wetted with warm size made by dissolving 2 lbs. of glue in 6 quarts of warm water, and then mixing in 2 quarts of water that has been boiled with half an ounce of alum, and 6 ounces of flour. When this size is dry, another coat of stronger size is to be laid on, composed of 4 lbs. of glue dissolved in 3 quarts of warm water, one pint of the first size, together with one ounce of gum arabic, and another of gum tragacanth. While this strong size is yet wet, the emery, sand, or glass powder, is to be sifted on as nearly as possible, and the calico again set to dry, and afterward brushed to remove the loose particles. A second coating of strong size is then laid on, and this is to be covered with another sifting of emery, &c. When dried and brushed, it will then be fit for use. (*Trans. Soc. Arts.*)

973. *Glass-paver* consists of paper covered with powdered glass; it is sharper than sand-paper.

974. *Tripoli* is a pulverulent substance, brought from the Continent, and is much used as a polishing powder. It is of a silicious nature, and hence its power of rubbing down rapidly most substances, while its extreme fineness does not cause visible scratches.

975. *Rotten stone* is a variety of tripoli almost peculiar to England, and found in Derbyshire and North Wales. It is extremely valuable for giving the last polish to metals, glass, and even hard stones.

976. *Chalk* is a pure carbonate of lime, which exists in vast strata in England; when burned in a kiln it makes lime, from the carbonic acid being driven off by the heat. Chalk, before it is burned, is not at all caustic like lime, and is extremely useful, not only for marking, but for scouring and cleaning various articles, and for many purposes in the arts.

977. *Whiting* is chalk entirely freed from the small quantity of sand which is sometimes in it, consequently it does not scratch anything cleaned with it, as chalk may perhaps do. In every other respect it is the same thing as chalk. The French *Meudon white* is the same; but the substance called *French chalk* is very different; it is a greenish gray stone, translucent, and of an unctuous feel, used to mark woollen cloth, and to take out grease; it is not calcareous, but is a compact kind of talc, consisting of silica and magnesia.

978. *Putty of tin* is a powder which consists of the oxyde of tin, much used in polishing glass and other hard substances, and quite different from glazier's putty.

979. *Dutch rushes*, commonly used for polishing wood and ivory, are the stems of plants, called by botanists *Equisetum hyemale*. This plant owes its polishing property to a circumstance that would not be suspected, to the edges observed in its sides being covered with a series of little points of flint set on like the teeth of a saw. This may be made evident by burning a piece carefully, and holding up to the light what remains unconsumed: the little silicious points will be found to be arranged spirally and symmetrically.

980. *Wheaten and oaten straw* reduced to ashes are also found, by the experience of our good housewives, to be good polishers of their brass, milk, and other vessels, without the cause being at all suspected by them. It is a curious fact, that this is owing to an actual coating of flint that covers the outside of the straw, like a varnish, and which gives its lustre; and this flint coating is not destroyed, but remains after the combustion.

981. *The process of scouring* pans will be described under the article "Cleaning the Apartments." Soap will be treated of under the "Laundry."

982. *Fuller's earth*, a substance useful in removing greasy spots, was formerly considered as indispensable in the process of fulling or thickening of cloth, usually termed *milling*, and for scouring them and worsteds, and on that account the exportation of it was forbidden; but lately they have contrived means of effecting the same purposes by soap and other substances, and fuller's earth is less used. It is, however, a material employed in domestic economy, for removing spots of oil from boarded floors, and cleansing greasy vessels of various kinds, &c. Although usually spoken of as being of a saponaceous quality, it has none of the ingredients of soap in its composition, consisting almost entirely of alumina, or fine clay, and silicious earth; the latter in the largest proportion. Every clay that has some unctuosity, that is, which will receive a polish when the nail is rubbed on it, will, in some degree, answer for fulling; but not so well as proper fuller's earth, which is distinguished from common clay by its falling to pieces in water, with a slight crackling noise, instead of making a paste with it, as clay does. When good, it is of a dull greenish-gray colour, and the best is dug in Buckinghamshire and Surrey. The detersive, or absorbing, power of fuller's earth consisting chiefly in the alumina, this ingredient ought to form one fifth of the whole; but not more than one fourth, lest it should be too tenacious.

983. *Sponge* is a marine production, now classed as belonging to the animal kingdom, although this was for a long time doubted. It is composed of minute, elastic fibres, interlaced together, somewhat like a felt. From its property of readily imbibing water, and parting with it as readily when squeezed, it is particularly useful, and is well known as an instrument for cleaning. It is brought from the Mediterranean and other seas, in which it grows at the bottom, and is dived for. When it first comes over, it has often a great deal of sand in it, which must be carefully cleaned out. The best is extremely soft and fine to the touch, and sells for considerably more than the common kind. If carefully used, sponges are very durable.

984. *Black-lead* is a well-known substance, much employed for giving a black, shining surface to cast-iron grates, fenders, and other articles of furniture of this kind. Notwithstanding its name, it has no connexion with the metal *lead*, nor is there any *lead* in its composition. It is, indeed, a mineral substance dug out of the earth in many countries, in lumps, which are reduced to powder when sold for the use of the chambermaid. It consists essentially of carbon with a little iron, and the finest varieties are employed for making the black-lead pencils for drawing; the best of the latter kind is dug at Borrowdale, in Cumberland; but the common black-lead is found in many other places; a good deal comes from Germany and Spain. There are several qualities of it; the best

is the cheapest in the end; some is much adulterated. The goodness is known by observing the brightness of the polish it will give with the least trouble; for, though many things may increase the apparent quantity, there is no known addition but what must impair this quality.

985. *Sulphur, called also brimstone,* is an extremely inflammable substance, dug out of the earth in various countries, and considered as a volcanic production; or it is procured from mineral substances, of which it is a constituent. The most usual employment of it in domestic economy is for matches, which are made by dipping slips of wood in melted sulphur. The suffocating property of a brimstone match is well known; but the explanation of it is not so, generally. When heat is applied to sulphur, it inflames, and combines with the oxygen of the atmosphere, forming an acid gas, called *sulphureous acid gas;* this is the fume which rises from a brimstone match, and which has a sharp, suffocating smell. When this gas or vapour comes in contact with water, the latter absorbs it to a considerable extent, and when the water is saturated with it, it makes *sulphuric acid,* or oil of vitriol, a strong acid which has more oxygen than the sulphureous acid. The common roll sulphur does not differ essentially (being only less pure) from flowers of sulphur, used as a medicine. Sulphur is one of the simple bodies, or elements, and is therefore incapable of alteration, although it may combine with other bodies, and thus form new compounds. It is common for those unacquainted with a little chemistry, to call by the name of sulphur, and sulphureous, a multitude of things which have no connexion with it; as, for instance, the fumes of burning charcoal; and this leads to absurd reasoning, and to the wrong application of terms. Among the familiar uses of sulphur, we may mention the property which its fumes have of bleaching straw bonnets; and it is likewise employed by the cooper. (See "Wine.")

CHAPTER IV.

GILDING.

986. Some knowledge of the nature of this kind of ornamental work, and the processes employed in producing it, is necessary, with a view to preserve it in a proper manner, and to prevent its being damaged by wrong treatment.

987. *Gilding, in general, may be described* as the art of covering certain substances with gold, either in very thin leaves, in powder, or in amalgam by quicksilver, according to the material to which it is applied, and to the object in view. Wood, leather, paper, and similar substances, are gilded by fastening on leaves of gold by means of some cement; but metals are gilded chiefly by a chemical process, called amalgamation; or, as has lately been discovered, by the action of galvanism. Gilding on wood is the most general, being used for various mouldings and ornaments in apartments, and on articles of furniture, as chairs, picture frames, &c.

988. *Gold has not only the advantage of a rich colour and splendid lustre, but also that of unalterability in the air,* retaining its metallic appearance and beauty in all weathers, and for an indefinite length of time, which is owing to its property of not rusting, or oxydating, by the ordinary causes. Its great value and ductility led the ancients, as well as the moderns, to extend it into very thin leaves, for the purpose of applying it to the surfaces of other bodies, so as to imitate the solid metal; and it is astonishing to what a degree of thinness gold is extended by the gold-beater.

989. *The gold for this purpose must be very pure, and it is hammered out, or beat,* after it has been rolled as thin as paper, by being put between the leaves of a book of parchment and extremely thin skins, called gold-beaters' skin; the book is then laid upon a block of marble, and beat with a heavy hammer. When the leaves of gold are extended to the full size of the book, they are divided, and each portion is placed between the leaves of another book, which is hammered as before. This process is continued till the requisite thinness is acquired. The thinness of gold leaf is quite surprising; it has been calculated that it does not exceed the $\frac{1}{248532}$ part of an inch.

990. *The sort of gilding on wood, called oil gold,* cannot be burnished, and is always of the natural colour of unwrought gold. It has the advantage that it may be washed and cleaned with water, which burnished gold never can. It is often used for picture frames, parts of furniture, and mouldings of apartments; as it stands the weather, it is also employed for out-door work. To gild in oil, the wood, after being properly smoothed, is covered with a coat of what is termed *gold size,* made of drying linseed oil, mixed with yellow ochre. When this has become so dry as to adhere to the fingers without soiling them, or is *tacky,* as the gilder expresses it, the gold leaf is laid on with great care and dexterity, and pressed down with some cotton wool. Any places that have been missed are covered with small pieces of gold leaf, and when the whole is quite dry, the ragged bits are rubbed off with the cotton. This is by far the easiest mode of gilding; any other metallic leaves may be applied in a similar manner. *Pale leaf gold* has a greenish-yellow colour, and is an alloy of gold with silver. *Dutch gold,* which is brought from

Holland, is, in fact, only copper leaf coloured yellow by the fumes of zinc. It is much cheaper than true gold leaf, and is very useful where large quantities of gilding are wanted in places where it can be defended from the weather, by being covered with varnish; but it changes colour if exposed to moisture. It is only a cheap substitute for true gilding, useful where durability is not required, and is that which is used so profusely at present in our paper hangings. *Silver leaf* is prepared in the same manner as that of gold, but it is liable to tarnish, except it be well secured by varnish. If covered with a transparent yellow varnish, it has much the appearance of gold. *Japanner's gilding* is where ornaments are drawn in gold upon japanned work, and is often seen in folding screens, and cabinets, &c. The ornaments are formed by a camels' hair pencil, with japanners' gold size, made by boiling linseed oil with gum animi, and a little vermilion. When the size is nearly dry, gold powder or gold leaf is applied. It is to be understood, that in all cases where gold has been fixed on by means of linseed oil, it will bear being washed without coming off.

991. *Burnished, or water gilding*, is much more difficult; and as it cannot bear being wetted, is only fit for work to be always kept within doors. For this method of gilding, the wood is first covered with four or five coats of whiting and size; and that the gilding should be perfect, it is necessary that there should be a sufficient body of whiting. When these are dry, they are laid over with a coat of gold size made of Armenian bole, a little wax, and some parchment size. When the size is dry, a portion of the surface is wetted plentifully with clear water and a soft brush, and a leaf of gold is dexterously applied, so as almost to float on the water, when it instantly settles down and adheres to the size. Great care must be taken not to suffer any of the water to come over the gold, or a stain will be produced. When the whole is covered with gold leaf, the effect is what the gilders call *matt*, or the natural colour of gold not burnished. Such parts as are required to be burnished are rubbed over with a burnishing tool of agate. Ornaments executed partly matt, and partly burnished, have a very rich effect, which is seen in most picture frames.

992. *We have stated that burnished gilding cannot be cleaned with water, though oil gold may*; but the matt portion of water gilding is so like oil gold as not to be distinguished by an inexperienced eye; and it may be very desirable to know, in that case, by which of the two processes it has been executed, with a view to cleaning it when soiled by flies or otherwise. This may be ascertained by observing in some crack or crevice whether the gold is laid on a coat of whiting; and if there be no other method, a small scratch with a knife may be made in some unimportant part to ascertain the fact. On account of the impossibility of washing water gilding without injury, it is necessary to take great care to protect it from flies, or other causes of soiling it, particularly in the summer season, by covering it over with some fabric of threads woven like a very fine net, as it is observed that flies instinctively avoid anything in the shape of a net. Frames which have been executed in water gilding are sometimes required to be regilt: this cannot be done without taking off the whole of the whiting, and commencing the process again, which is expensive. When this is done, the frames may be either regilt in the water or in the oil manner; and as the last is much the cheapest, it is sometimes preferred. We have observed that oil gilding cannot be burnished.

CHAPTER V.

BRONZING.

993. *Bronzing is a method of colouring wood or plaster of Paris, so as to imitate bronze.* First, the article is to be painted of a dark colour, such as bronze acquires when it has been very long exposed to the air, or when buried under ground. This colour is produced by grinding a mixture of Prussian blue, verditer, and spruce ochre, in oil. What is called *bronze powder*, sold in the shops, is now to be applied, just before the oil paint is quite dry, to the prominent parts, where the metal is supposed to have acquired some lustre by being rubbed against. The bronze powder may be rubbed on by a ball of cotton wool, or in a similar manner. Bronzing has the advantage of wearing well, keeping clean, and giving effect to other colours.

CHAPTER VI.

JAPANNING AND VARNISHING.

994. *Japanning* is a very hard kind of varnishing that derives its name from being an imitation of what we see on the cabinets originally brought from the island of Japan.

995. *The true japan, as practised in Japan and China, is produced* by a kind of liquor or varnish peculiar to those countries; and it is said that it is of a poisonous nature, and injurious to the persons using it. It is the juice of a tree which has the appearance of

cream when it issues from an incision, but, by undergoing certain processes, and being mixed with charcoal or lampblack, it becomes dry, and of a deep black. It is then polished and varnished with some peculiar oil varnish, after having been sometimes painted and gilded. In whatever manner this japan is produced, it is evidently of very excellent quality, and the Eastern furniture covered with it is valuable on account of its containing genuine specimens of the art of decorative painting in these countries.

Formerly a great deal of this species of lackered or varnished furniture was brought from Canton in China. Although it was somewhat inferior to that of Japan, it was a beautiful manufacture, and, when introduced into Europe, was highly appreciated; but the improvements in our own productions have reduced the quantity in demand. These articles consist of magnificent folding screens, cabinets, and other things in daily use among the Chinese.

996. *Our varnishes called japans*, and which are used for tea-boards, tables, chairs, coach panels, snuff-boxes, and other articles, differ considerably from the Indian, but, when well executed, are very beautiful, and generally much better painted. Japanning is executed upon various substances, as metal, wood, papier-machée, and leather; and the process varies in some degree, according to the substances to be covered. When the substances to be japanned are not perfectly smooth, a ground is first laid of strong size and whiting, in order to obtain a perfectly level surface.

997. *In the japanned tea-boards*, of which such vast quantities are manufactured at Birmingham, as the sheet iron of which they are made is sufficiently level and smooth, no ground is necessary, and as the metal can endure a process by heat which other substances cannot, the mode of japanning is different. From the common black japan grounds in iron or copper, the work is painted over with drying linseed oil, and a little lampblack; and when it is moderately dry, it is put into a stove heated to such a degree as to change the oil black without burning it. The heat should be augmented slowly, and continued for a long time, in order to harden the coat of japan. This kind requires no polishing.

998. *When substances not metallic are to be japanned*, a different process must be followed. Here the japan is composed of shell-lac dissolved in spirits of wine, which, when dry, forms an extremely hard coating. Besides the use of the ground or priming of size and whiting mentioned, another was the saving of the japan; but these grounds are generally more or less liable to crack, and are omitted in the best work. The colours required are mixed with the shell-lac varnish, and sometimes with gum animi, and nut, or poppy oil. After the painting is completed, the whole again receives two or more coats of shell-lac varnish, and is then polished with a rag and oil, dipped in tripoli or rotten stone, finely powdered; a cloth, with oil alone, is used to finish with. In this way the beautiful papier-machée tea-boards are japanned and painted; likewise snuff-boxes, waiters, &c. Heat is always more or less necessary to harden the japan, but except in the case of metals, it must be sparingly used.

999. *Japanning is sometimes made to imitate tortoise-shell.* This colour is produced by boiling together linseed oil and amber till the oil becomes very thick and brown. The more transparent parts of the tortoise-shell are imitated by first laying on, thinly, spots of vermilion, tempered with shell-lac varnish, or with drying oil. When the vermilion is dry, the whole is brushed over with the deep brown varnish.

1000. *A varnish for wood that will resist the action of boiling water* is made in the following manner, and is much used in Russia for varnishing their wooden bowls for holding food: Boil a pound and a half of linseed oil in a copper vessel, suspending in the oil a small linen bag containing five ounces of litharge and three ounces of minium, both pulverized, taking care that the bag does not touch the bottom of the vessel. Continue the ebullition till the oil becomes of a deep brown colour, then take out the bag, and substitute another bag containing a clove of garlic; renew this garlic seven or eight times, and put in the whole quantity at once. Throw into the vessel a pound of yellow amber, after having melted it in the following manner: To a pound of well-pulverized amber add two ounces of linseed oil, and place the whole on a strong fire. When the fusion is complete, pour it boiling hot into the prepared linseed oil, and let the whole continue to boil for two or three minutes. Let it rest, decant the composition, and preserve it, when cold, in well-stopped bottles. To lay this on, the wood must be polished; and first a slight coat of some colour mixed with oil of turpentine must be given: a coat of the varnish is then laid on with a sponge; when this is dry, another coat is given, and so three or four coats, as may be found necessary, taking care that one coat is dry before another is added.

CHAPTER VII.

LACKERING.

1001. *Lackering is a thin varnish given to brass work*, such as handles of locks, door plates, &c., to prevent their tarnishing.

1002. *Brass work may be relackered* in the following manner : the metal should be just warmed, and the following lacker laid over it evenly with a soft brush ; or small articles may be dipped in it. Put an ounce of turmeric, two drachms of annotto, and two drachms of saffron, into a pint of alcohol ; agitate it occasionally during a week, and then filter it into a clear bottle. Add to this three ounces of clean seed-lac, and shake up the bottle now and then during a fortnight.

1003. *A lacker to give tin, or articles covered with silver leaf, the appearance of brass.* Melt, in separate vessels, two ounces of gum-lac and eight ounces of amber ; mix them well together, and add half a pound of drying linseed oil. Digest in a pint vial a little saffron in half a pint of oil of turpentine ; strain this liquor, and add to it some gum tragacanth and annotto, finely powdered. Mix this last compound with the former, and shake them well. It is by this varnish that leather is made to appear as if gilded, after it has been covered with silver leaf.

CHAPTER VIII.

HISTORY OF FURNITURE.

1004. *General remarks.*—Before we proceed to describe the various articles used as furniture in modern dwellings, a short history of the subject, considered rather as a matter of taste, with some general observations, will be requisite, in order to prepare the reader for understanding and appreciating the various kinds.

1005. *Our object in giving the following descriptions and woodcuts of the household furniture* used at present is, that young housekeepers may acquire, by their means, such a general knowledge of the subject as will be useful in enabling them to inquire after, and to select, those articles which are indispensable. Not only is the expense of furnishing a house so considerable that regard to economy is deserving of attention, but much of our comfort also depends upon the selection being judiciously made in the first instance. Perhaps almost all the articles we are about to describe may be known, in a general way, to most persons, yet it cannot but be useful to have them enumerated, classed, and brought before us, in one view, that attention may be drawn to them in a precise and methodical manner : a task which has not yet been performed in any work of this kind.

We may likewise observe that all the woodcuts of the articles have been made from drawings of the different objects actually in use and on sale at the present period, and not from designs ; consequently, they exhibit the forms now in general use in this country.

1006. *It would be in vain to attempt tracing the history of furniture back to the remotest periods,* as there are no materials for this purpose ; but the wants of man being nearly the same at all times, we may easily imagine the general nature and practice of this part of domestic economy in the rudest ages, from what we at present perceive among nations yet uncivilized.

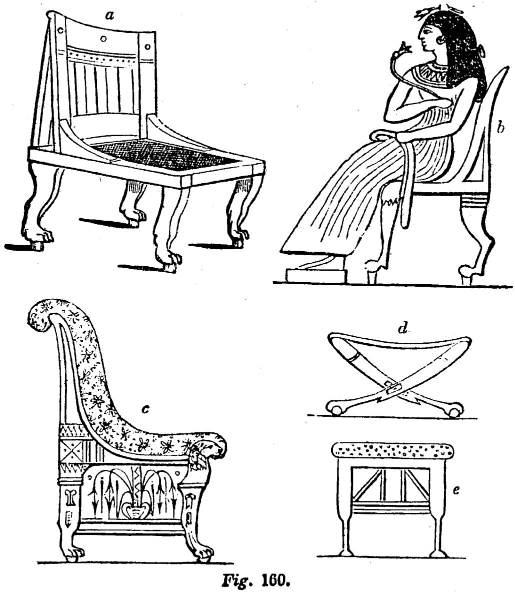


Fig. 160.

1007. *From the discovery of paintings and sculptures in tombs cut in the rocks of Egypt,* and from other researches, we have been lately made acquainted with much of the domestic habits of the ancient Egyptians ; and it is as surprising as unexpected to have thus brought before us the forms, at least, of furniture of the time of the Pharaohs. The decorations of ancient furniture frequently consist, in part, of what is now termed the *grotesque style* of ornament, which is composed of a whimsical introduction of carving or painting, representing parts of animals mixed with foliage, and a variety of other objects in which the imagination is permitted to revel without any regard to probability. In the late excellent work by Sir Gardner Wilkinson, on the Antiquities of Egypt, we see, among many other things copied from paintings on the tombs, representations of Egyptian furniture ornamented in this way; some of the chairs, in particular, scarcely differing from those which come from the modern upholsterer. They appear to have been made of costly wood, carved, and ornamented with inlaying of ivory, ebony, silver, and other precious materials. *a, fig.* 160, is an Egyptian chair from Wilkinson, having a curved back, the seat formed of some substance woven, probably split cane, and the legs shaped in imitation of some animal with claws, precisely like those executed at present; it is evident that the cabinet-makers of that time had acquired the art of putting them together so firmly as not to require the assistance of cross-bars. *b* represents an Egyptian lady seated in a chair, nearly of the form of those in a modern drawing-room. *c* is a fauteuil carved in the same style, and having a stuffed seat and back of printed cotton, linen, or leather. *d* is a stool which folded like our camp stools, and which was much used in their houses, often covered with cushions. *e* is another stool of a very usual form.

1008. *There can be no longer any doubt that these fashions were borrowed by the Greeks* who visited Egypt, though they were afterward much improved by the refined taste of that remarkable people. From the Greeks they reached the Romans, and have descended to us after a period of 3000 years. The custom of employing the parts of animals in the ornaments called grotesque is, therefore, clearly of Egyptian origin, if not still more ancient, although the combination of those with foliage and a variety of other objects is the produce of the fine imagination displayed in the Grecian and Roman schools.

1009. *The term grotesque is derived* from the Italian *grotta*, some antique subterranean chambers discovered in Rome having been found to have their walls painted with ornaments in this style. These had not been originally built below the surface of the ground, but had been buried by the gradual accumulation of soil from the ruins of buildings. However at variance with truth and nature are the combinations called "grotesques," they have been found to give delight in all ages, the most exquisite taste having been exercised in selecting and bringing together the most beautiful forms of objects, although in the most capricious manner. Caprice, and even a degree of extravagance, appears, indeed, essential to this style, which aims partly at exciting surprise by the oddity and whimsicality of the inventions. Still, it must be acknowledged that it was practised by the ancients, and occasionally by the moderns, under the regulation of good taste founded upon a perception of the beauty of form.

1010. *What we know of the furniture usually called antique*, that is, of the ancient Greeks and Romans, is derived from their sculpture, and from the classic writers; but most of all, from the numerous articles of this kind dug out from Herculaneum and Pompeii, now preserved chiefly in the museum of Portici, and displayed in various magnificent publications. From these sources we learn that the classical nations bestowed the same care upon their furniture as they did upon all the other objects in which fine art was employed; the same attention to style being shown in everything that has come down to us.

The employment of various beautiful and expensive woods in furniture is not modern. They were much in fashion among the Romans when luxury was at its height. Tables made of them sometimes fetched an enormous price. Cicero is said to have given a sum equal to £8000 for a single table made of cypress; and others are mentioned as equally costly. They were probably ornamented with ivory and carving. Pliny speaks in terms of great commendation of the beauty of the maple wood; and it appears that the art of veneering was known in his time. No actual furniture of this date has been preserved, with the exception of what is made of metal, and which has been found in subterranean excavations.

1011. *The furniture of different periods* has always partaken of the general taste and style of decoration which then prevailed, and it was, in this respect, connected with the architecture of each period: thus the general forms, the mouldings and ornaments, have been derived, in a great measure, from this source. We must expect to find, therefore, that the general decline of the fine arts in Europe, during the later times of the Roman Empire, affected this branch, until, at length, it sank into the general barbarism. Still, in those countries of southern Europe where good taste was once established, traces of it are still noticed by travellers, in the forms of utensils and various domestic articles.

HISTORY OF FURNITURE IN ENGLAND.

1012. From the perishable nature of the materials, and the vicissitudes occasioned by the warlike and unsettled habits of ancient times, nothing remains to us of the furniture of those ages when the nobility and gentry of England resided in castles and embattled mansions. Where security and defence were more objects of consideration than domestic comfort, it is probable that little attention was bestowed upon mere coneniences, and still less upon ornament in household furniture. When decoration was bestowed upon the furniture of the great, this was in the Gothic style that universally prevailed.

1013. It was not until after the union of the houses of York and Lancaster, when the kingdom was brought into a settled state, that refinement began to be generally manifested in the system of domestic life. Henry VIII., a prince who, with all his faults, had a magnificent spirit and a taste for the arts, employed Holbein, during the intervals of his more important avocations, to make designs for all kinds of furniture, which, in richness, far surpassed anything that had been previously seen in this kingdom. Holbein was born at Basle, in 1498, and was instructed in the arts of design by his father. His talents as a portrait painter are well known; and he was possessed of much invention, as may be seen in his ornamental works, which, however, were in the taste then prevailing on the Continent. He visited London at the request of Erasmus, who recommended him to Sir Thomas More, the portraits of whose family gained him the patronage of Henry VIII.

1014. The best kind of furniture which was used by the wealthy in England during several succeeding reigns was either of Dutch or Flemish workmanship, or in the style of those countries, as may be traced in the paintings of the old masters which represent interiors. In the oldest furniture of this kind, the legs of chairs and tables were straight, but decorated with turned ornaments, and sometimes they were spiral; they had always cross-bars to strengthen them. In the later Flemish more of the scroll-work was introduced; the legs were of rather lighter forms, and somewhat carved; and we perceive the elements of the sort of ornament which was afterward carried to such excess in the reign of Louis XIV. "Flemish chairs of that time," Hunt observes, "were wrought in ebony, walnut, cherry-tree, &c., with high backs, and stuffed in one long upright panel, or filled in with wicker-work; the seats being also stuffed, and covered with costly kinds of materials, as various as their shapes. To those may be added low arm-chairs, tastefully turned, and carved in ebony, enriched with ivory knobs and inlayings, chiefly of Italian or Flemish manufacture, with cushions or pillows on the seats. Besides these, there were some little gilt chairs for women; and long seats, with backs and arms, resembling in form the ancient settle, and holding several persons, were also much in use." "But, in this period," observes the same writer, "the splendour of the coverings of tables amply compensated for the rudeness and simplicity of the work so concealed; the most elaborate embroidery, wrought on the finest grounds, velvets and satins fringed with gold and silver, Turkey carpets, and the choicest tapestry, were devoted to these purposes." To this we may add, that this furniture is, in general, but little adapted for comfort, and has not much of form to recommend it, as far as use and convenience are considered. The backs of chairs almost upright, sloping very little, are inconvenient; they are generally heavy and clumsy; and, though often loaded with carving, this is seldom very tasteful in design, and usually coarse in execution. (See examples of them in Section VIII., Chap. X., "Chairs and Seats.")

In many articles of furniture, as in cabinets, this clumsiness often amounts almost to barbarity, notwithstanding the general rich effect produced by the carver; and the workmanship of the mere cabinet-maker is usually of a very inferior description.

1015. In our observations on architecture, we have already observed that it was in the reign of Henry VIII., and soon after the Reformation, that the ancient Roman architecture began to be introduced into this country, and to supersede the Gothic, which, previously to that time, had been universal in Europe. But, at first, both these styles were mixed together in a very rude manner: this was not peculiar to England, but was borrowed from Italy, where the same practice had long prevailed, and had produced, at last, what has been termed the *cinque cento* style. Notwithstanding the numerous faults and absurdities of this unnatural mixture, and the gross and clumsy designs produced by it, there were frequently, in the details, much taste and knowledge of form in parts—the natural result of the assistance of able sculptors, who were well versed in the study of design, and who had made good use of the various remains of antique sculpture and painting which decorate those edifices that had escaped the ravages of war and time. Thus, in the cinque cento there is often much to admire, although we cannot approve of it as a whole.

1016. We have stated that the style of design in furniture has always kept pace with that of the architecture of the period, the mouldings and ornaments being derived from that art. Thus, when Gothic architecture was prevalent here, the furniture was decorated with ornaments to be found in Gothic buildings; on the revival of Grecian architecture in Europe, the furniture partook of the change; it was then allied to the meretricious and mixed style above mentioned, from which was borrowed the twisted column, and the fanciful but rich carvings of foliage with grotesque animals, copied partly from the antique, partly from modern Italian, and partly from the Gothic. Though there scarcely exists at this time any English furniture of the time of Henry VIII., yet, on the Continent, there is abundance of the age of Francis I. of France, who was his contemporary; and it is frequently remarkable for its quaint carvings in oak, often displaying much taste and boldness of execution.

1017. In the succeeding periods, down to the time of Queen Elizabeth, the fashion of furniture was nearly of the kind above described. Elizabeth was herself fond of gorgeous and magnificent display, with little of good taste. There are but few remains of actual furniture used in England at this time; some genuine examples, however, have been engraved and published by Shaw and other antiquaries. But it is not easy to ascertain accurately the dates of what has been so preserved; and much of it was brought from Holland, Flanders, Germany, and other parts of Europe. What was made in those countries, which produced so many able painters in the Netherlands, was superior to what our artificers could supply at a time when the fine arts were in a very low state in England.

1018. Of ancient English bedsteads of the time of Queen Elizabeth, or the few succeeding reigns, a few remain. (One is represented among our wood-cuts of furniture.) Occasionally some bedsteads in the same style are now imported from the Continent, to supply the fashionable demand for this species of furniture. They are massive, but clumsy, though generally enriched with much carving in oak; in the most superb, the bed-posts are very highly ornamented. The head-board extends to the canopy, and, together with the latter, is covered with carved work; in some there were secret places for concealing money and other treasures. The bed-frame was low, and the curtains and valances usually of thick stuffs; the whole, with the ornaments, causing a great collection of dust, that disagrees extremely with our present ideas of comfort and cleanliness. It would be carrying the love of ancient things too far to bring such again into general use: and examples of them are valuable chiefly as elucidating the history of ancient manners.

1019. If we are to understand by the term "Elizabethan style," so much used at present, the style of architecture and furniture executed in this country during the reign of Queen Elizabeth, we perceive, from what remains to us of that period, that it consisted chiefly of the rude and incongruous mixture we have mentioned; and this is not, as we have shown, peculiar to England, but is to be seen, somewhat modified, in works of the same date, in Italy, France, Germany, and the Low Countries. The practice of Gothic architecture, as well as the revival of the antique, preserved a taste for ornamental sculpture, which was more or less diffused among our artificers; and we find in the domestic edifices of that time, even of the inferior kind, as, for example, in the gables, doors, and windows of the timbered houses, ornaments carved in wood, in which are evident traces of the Gothic; in mansions of importance, as in manor-houses, there are attempts to imitate the then newly-introduced Roman architecture borrowed from Italian architects, by whom it had been corrupted and debased. Yet, notwithstanding the general bad taste of the style, parts had evidently been designed originally by men of talent; and a certain spirit and beauty of line is infused in the ornamental parts, which can never be expected except from those who learn to draw and compose; thus we see a strange mixture and contrast between the powers of the artist and the absurdity of the prevailing taste and fashion.

1020. The desire of discovering something *national* to which great merit can be attached, we have reason to think, has induced many of our architects and amateurs of the present day to assign qualities to the architectural productions of Queen Elizabeth's time, not discoverable by those untinctured with this feeling; and admitting, as we do, that the vestiges of good art are often discoverable in them, the style is, after all, more interesting on account of its historical associations than deserving of imitation or adoption as national; and we should no more wish to see Elizabethan architecture or furniture perpetuated than Elizabethan costume in dress.

1021. We have observed that some difference of design is observable in the old furniture of different countries of Europe corresponding to that of their architecture. Thus the articles originally brought from China and Japan are remarkable for their peculiar paintings, varnishes, and gilding. The ancient furniture of Italy will be found, by those who pay much attention to this subject, to vary from that of Flanders and Germany. The Italian cabinets, particularly those of Florence, are often distinguished by their being ornamented with what is termed *Pietra dura*, which consists of the figures of fruit, flowers, butterflies, and similar objects, formed of coloured marbles inlaid, of which there is a manufactory at Florence, belonging to the Grand-duke of Tuscany. The Spanish and Portuguese are somewhat different from both; but this difference cannot be readily perceived without an accurate critical examination. Those who wish to study it may have an opportunity of seeing specimens, imported from each of those countries, in the show-rooms of Mr. Pratt of Bond-street, so well known by his attention to ancient armour, as well as in other collections made by dealers in London, who devote their time to this branch.

Cabinets were among the most curious and ornamental articles of ancient furniture; and upon them was frequently expended all that the art of carving and inlaying was then capable of effecting. They were used as depositories for plate, china, coins, medals, curiosities of various kinds, and other precious articles for show or use. The interior was fitted up with various drawers and cells, and sometimes contained concealed places for money or jewels, while the exterior displayed ornamental hinges, escutcheons, panels, with angle and other ornaments.

1022. *During the luxurious reign of Louis XIV.*, when so much encouragement was given to the fine arts in France, they could scarcely be said to exist in England; and out of the cinque cento or arabesque ornament of the time of Francis I. was gradually produced a peculiar species possessed of considerable originality, though extravagant, and which has ever since maintained its ground under the term "style of Louis Quatorze." Although this, like other modern styles, had borrowed something from the antique, it is remarkably distinguished from it; and it affected, in particular, the almost constant employment of graceful curved lines, with great luxuriance of foliage in fine bold relief.

1023. Although the old French furniture cannot be held up as exhibiting examples of refined taste, yet it was gay and lively, and well calculated for the purposes of the ostentatious display of wealth; and having been designed and executed by persons conversant with the fine arts, though of the French school, much of it is at least pleasing in form; while the quantity of gilding, and of all kinds of painting and showy materials, place it in strong contrast with the sombre works in oak and other woods of the preceding times, which, however, are by no means destitute of merit

1024. *The history of furniture in France corresponds with that of the fine arts in that country:* and under Louis XV. some little change is traceable: the foliage ornament became more delicate and of greater intricacy; and during the reign of Louis XVI., the attention which began to be paid to the study of the antique wrought an alteration very sensible upon all designs in the decorative arts. The cabinets of the time of Louis XVI. have a character which enables critical collectors easily to distinguish them. But the great political revolution produced an entire change in the whole of this department. Old forms, as well as old customs and manners, were rejected, and the severely classical became for a time the order of the day, in furniture as in costume. The result was extraordinary. All that species of taste which had been so much cultivated in the preceding times, and which had become peculiarly, and almost exclusively, French, was banished, and the purely antique, or Greek and Roman, was substituted. The French artists likewise carried this to a high degree of perfection, and the designs of Percier and Fontaine, with others of the same school, must be still looked up to as possessed of excellence perhaps not equalled elsewhere. The refined taste of these artists was somewhat perverted, or, rather, wrongly directed, by their patron Bonaparte, whose love of ostentation preferred the gorgeousness of the Roman emperors to the simplicity of the Greek. Of late, the styles of Francis I. and Louis XIV. have been again revived in France; and old French furniture of all kinds, which some years ago was almost thrown away, and might have been purchased for a trifle, is now eagerly sought after and preserved; and its being copied and imitated gives employment to the skilful artisans of the present day.

1025. *But to return to the history of furniture in this country.* Little is known of English furniture during the troublesome times that succeeded the reign of Queen Elizabeth. Notwithstanding the number of old mansions that exist in England, only a small part of the furniture of the same date as the buildings exists, owing to the destruction occasioned by the civil wars, the frequent change of proprietors, with the alterations produced by fashion.

The introduction of mahogany as a material produced a considerable change in this part of domestic economy. The beauty of its colour and grain was such, that it did not appear to require so much enrichment by carving; and the bright polish which it admitted of caused it to be preferred to every other wood: hence we find our notable housewives, from 1760 to 1800, priding themselves upon the lustre of the mahogany produced by frequent rubbing. The use of cloth made of horse-hair for mahogany chairs then became general. Tables were made exceedingly plain, and the carver was scarcely employed, his occupation being afterward nearly destroyed by the invention of composition and plaster ornaments for buildings. Some of the latest furniture, peculiarly English, where carving was in use, may be seen in the designs published by Chippindale, which are partly in the French style: after that, the cabinet work of this country, as far as regards taste, fell into the lowest stage of insipidity.

1026. *With the view of endeavouring to reform this wretched condition into which this branch of art had sunk among us,* Mr. Thomas Hope employed a part of his princely fortune in filling his house in London with furniture of a very superior kind, all of which was designed and executed in this country. To supply some models for improving the taste of the cabinet-makers and upholsterers, as well as that of the public, he afterward caused the whole to be very accurately drawn and engraved, and they were published in a folio volume in 1807. In this work he describes the lamentable condition in which he found this branch of the useful and fine arts; and we cannot do better than quote from the "Introduction" to this work some observations illustrative of Mr. Hope's views: "Each of the different articles of household furniture, however simple be its texture, and however mean its destination, is capable of uniting to the more essential requisites of utility and comfort, for which it is most immediately framed, and with which it can, consequently, on no account dispense, a certain number of secondary attributes of elegance and beauty, which, without impeding the chief purpose of the object, may enable its shape and accessories to afford additional gratification both to the eye and to the imagination."

"Almost every one of these various articles, however, abandoned till very lately, in this country, to the taste of the sole upholder, entirely ignorant of the most familiar principles of visible beauty, wholly uninstructed in the simplest rudiments of drawing, or, at most, only fraught with a few wretched ideas and trivial conceits, borrowed from the worst models of the French school of the middle of the last century, was left totally destitute of those attributes of true elegance and beauty, which, though secondary, are yet of such importance to the extension of our rational pleasures. Furniture of every description, wrought by the most mechanical processes only, either remained absolutely void of all ornament whatever, or, if made to exhibit any attempt at embellishment, offered in its decoration no approach towards that breadth and repose of surface, that distinctness and contrast of outline, that opposition of plain and of enriched parts, that harmony and significance of accessories, and that apt accord between the peculiar meaning of each imitative or significant detail, and the peculiar destination of the main object to which these accessories belonged, which are calculated to afford to the eye and mind the most lively, most permanent, and most unfading enjoyment. The article only became, in consequence of its injudicious appendages, more expensive, without becoming more beautiful; and such remained the insipidity of the outline, and the unmeaningness of the embellishments, even in the most costly pieces, that generally, even long before the extreme insolidity and flimsiness of their texture could induce material injury in them from the effects of regular wear and tear, the inanity and sameness of their shapes and appendages already completely tired the eye and mind, and left these no other means to escape from the weariness and the disgust which they occasioned than an instant change for other objects of a more recent date and a more novel construction. Thus all those sums and all that labour were wasted upon ever-varying objects of transient whim and puerile fashion, which, by being employed in the formation and in the purchase of objects of lasting perfection and beauty, might have increased in endless progress the opulence of the individual and the wealth of the community."

"If any one felt a desire to decorate his habitation with furniture of superior elegance of form and of design, unable, from the infrequency of the demand, and from the consequent inability of the artificer, to get any such wrought at home, he was obliged to procure it from abroad. Often, at a great expense, he would only obtain the refuse of foreign manufactures; and even where he succeeded in importing the choicest productions of continental industry, these only served to discourage our own artists, to diminish the balance of trade in our favour, and, by a tacit acknowledgment of our inferiority in the arts of elegance and taste, to raise the pride of foreigners at our expense." Mr. Hope adds, that, by adopting in his own case a style of furniture that should employ the talents of the "professor of the more liberal arts, the draughtsman, the modeller, the painter, and the sculptor," he wished, by a successful example, to entice the wealthy to appreciate the charms of art, and divert a large portion of their opulence from being wasted in objects of mere trivial amusement, instead of being expended in those of durable and solid gratification; and, by a patriotic encouragement and improvement of our artists and manufacturers, enable the lover of elegant refinement to procure at home those objects of superior design and execution which heretofore he was obliged to obtain from abroad. Mr. Hope possessed some knowledge of drawing, and he made the designs for the furniture which he procured to be executed, and which are engraved and published in the work above mentioned. The style which he adopted is nearly that which was in fashion in France at the time, and in the invention of which Percier and Fontaine, and other French architects and designers, had so much share. It was founded chiefly upon classical forms, such as are to be met with in antique remains, adapted as nearly as possible to modern wants and usages; and such was the difficulty which he met with in following out his idea, and such was the state of this branch of the art in England at that time, that he observes, "Throughout this vast metropolis, teeming as it does with artificers and tradesmen of every description, I have, after the most laborious research, only been able to find two men to whose industry and talent I could in some measure confide the execution of the more complicate and more enriched portion of my designs; the first a bronzist, and a native of France; the other a carver, born in the Low Countries. I need not add how slow and tedious this scarcity of workmen has rendered the completion of my little collection." It was at length, however, completed; and the novelty and beauty of the style soon had much of the beneficial effect which Mr. Hope anticipated. By the opportunity which he afforded of viewing this superb collection, the taste of the public was somewhat improved, and the manufacturer was stimulated to procure the means of imitating, in some degree at least, the example set before him. It must be remarked, however, that Mr. Hope's taste and knowledge of design in furniture, though superior to what previously existed here, were far from being perfect; and, with much that was excellent, the style, if strictly adhered to, was scarcely adapted for general use. It was too much limited to the classical style which he aimed at; and, even in that view, it contained somewhat of repetition, as must almost always be expected when the whole proceeds from a single mind; but it is only justice to Mr. Hope to state, that he was aware of this difficulty and objection, and offers his labours to the student in the arts, not as models for mere servile copying, but to show how, by applying to the same sources from which he drew his ideas, a new line of art might be opened, capable of endless improvement. It must be admitted that an immense debt of gratitude is due to the memory of Mr. Hope for this noble example of the mode in which a man of fortune may benefit and improve society, by refining taste and furnishing employment to the industrious. It had at once the effect of producing a complete revolution in our furniture, which from that time has been improved in a very great degree.

CHAPTER IX.

PRESENT STYLE OF FURNITURE.

WITH respect to the style of furniture in fashion at the present time in this country, it is difficult to say what it is, and, indeed, it does not admit of any accurate description. The classical style of Percier and Fontaine, and we may add that of Mr. Hope, the Flemish or Elizabethan, that of the time of Francis I., that of Louis Quatorze (see examples of chairs in each of these styles, in Sect. VIII., Chapter X.), the Gothic, and even the Chinese, have all lent their aid to supply ideas; and this branch has been so much improved since Mr. Hope commenced his reform, that, instead of the extreme paucity of talent of which he complained, we now possess a few able designers and carvers who are chiefly in the employment of our first upholsterers. At the present moment, however, the strictly classical style is not in vogue, probably, in a great measure, from the same kind of difficulties experienced by Mr. Hope, and its consequent expense. It is a character of the present period to possess, in particular, the revival of two styles which had been for many years laid aside; namely, that of Louis Quatorze, and that now called Elizabethan, each of which will demand a few farther observations.

1027. *The style of Louis Quatorze is known*, as we have stated, by its abundance of light ornamental scroll-work and foliage. Its elegance of form, though not of the first order, together with its admission of every species of enrichment, as carving, gilding, painting, inlaying, with coverings of the richest silks, velvets, and the choicest stuffs, admirably adapt it for the modern drawing-room. Certainly no kind of furniture equals it in the general splendour of appearance; and, at the same time, all the decorative part is of such a quality that it can be executed by artisans of the second and third grades; the figure, which demands the first, being very seldom introduced. Hence its cost is much less, in proportion to its show, than where artists of greater skill are required.

1028. *On the style usually called Elizabethan*, including that of Francis I., and the Flemish, we have already made some remarks in our "History of Furniture." Notwithstanding the influence of fashion, and taste for novelty, which are apt to warp our judgment, it is impossible seriously to admire this style in genuine examples; and we have already alluded to its general coarseness and clumsiness of form, and want of adaptation to its use, although occasionally it is rich in effect, and interesting through a certain association of ideas. It is curious to observe the steps by which certain styles, obsolete for so many years, have been revived and brought again into fashion. At first this was a subject merely of antiquarian research, which was made interesting, not merely by collecting ancient articles, but by repairing and restoring some of them to their pristine appearance. Some apartments in ancient mansions remaining entire, these were afterward supplied by ancient furniture, together with restorations and imitations of these. Next, zealous individuals went so far as to build houses in the style of the olden time, the apartments of which demanded that the furniture should correspond. These appeared as novelties; and the contrast between the rich furniture of the ancient period, and the plainness of the existing style, recommended them. By degrees this got into fashion, which is everything to the many.

We must, however, in justice to our readers, remark, that all this has arisen from the incessant desire for variety, which the existing skill of our artist is yet unable to satisfy; and hence recourse must frequently be had to copying, rather than to inventing, and to reviving old and obsolete forms, which, though bad, have a kind of novelty merely because they had been forgotten. We cannot conceive, however, that this species of taste can last; it will some day have its crisis, when art shall have improved among us; and we cannot, therefore, recommend laying out large sums in the execution of what will, we apprehend, ultimately be considered as demonstrative of an obliquity of taste. But we are aware how nearly useless it is to decry a fashion at its height.

1029. *It may be proper to state*, because it is not generally understood, in what way our shops are filled with *ancient* furniture, to satisfy the present demand; and there are many, no doubt, who imagine that in purchasing these they are obtaining genuine examples of what were used by our ancestors. The fact is, as we have already observed, that very little really English old furniture remains; and what does exist, is now carefully preserved, and scarcely ever comes into the market. The old furniture seen so abundantly at the upholsterers and brokers, as also at auctions, is imported from the Continent. Persons are sent over to travel, and to penetrate even into obscure places in Holland, Flanders, Germany, and other parts of Europe, in search of these treasures, where they still exist in their original state; and these are brought over almost in shiploads. What is portable is frequently carried and sold as it is; but a great deal is taken to pieces, and only the carved and ornamental parts conveyed. These are purchased at sales by our cabinet-makers, who dissect them, and make up the parts into articles adapted to our wants and customs, skilfully inserting the old carvings, so as to make the whole resemble an original piece of furniture. In these recompositions, considerable skill, and often taste, are employed; the most uncouth pieces are rejected, or placed so as to strike chiefly by their oddity, or by giving an antiquated air. Cabinets have new drawers, sometimes of old wood; all defects are repaired, pieces made to match others that are wanting, or too much worm-eaten; or they are metamorphosed into wardrobes. Chairs are mended, varnished, and re-covered with rich velvets or silks. Sideboards, and other useful and modern articles, are composed out of various fragments; and among these restorations we can sometimes detect even the ornaments of churches which have suffered during the suppression of convents, and other changes consequent upon political revolutions. By this ingenious means, a species of magnificence is produced, comparatively at a cheap rate; for such articles do not, after all, cost nearly so much as a similar piece of furniture would do if made and decorated with as much carving; to say nothing of the impossibility of our mechanics at present equalling the merit of much of the ancient carved work.

Still, we must beg to repeat, that, although such furniture has an interest from its singularity and historical associations, yet the magnificence it is calculated to exhibit is of a gloomy cast, and rather carries us back to unrefined and semi-barbarous times, than keeps pace with, and forwards, real improvement in taste, having no kind of intrinsic superiority. There are in London certain upholsterers who particularly deal in this ancient furniture, the procuring of which forms, indeed, a particular line of business; others prefer making designs of a novel kind, avoiding exact imitations of any old styles. This subject will be exemplified in the wood-cuts of furniture.

CHAPTER X.

FURNITURE OF THE PRINCIPAL APARTMENTS.

1030. A complete list of furniture will be found at the end of this section; and the following pages will contain descriptions of all the principal articles, with remarks calculated to facilitate an acquaintance with their various qualities.

Sect. I.—WINDOW CURTAINS.

1031. Window curtains add much to the comfort and elegance of apartments; considerable taste and judgment are exercised in designing them of the most agreeable forms, and adapting them in the most judicious manner for the several places to which they are destined. Their use is either to add warmth to the apartments by excluding the draughts of cold air; to exclude the rays of the sun, which, in summer, are injurious to furniture; to keep out insects; or to prevent persons seeing into the house; and, according to these several purposes, and the nature of the apartments, the quality of the materials, and the manner of hanging them, must be determined.

1032. *In this country, particularly, window curtains are necessary to exclude the cold air,* which presses in from the windows, especially in winter, when the fires are burning, however close the sashes may be made. But there is another cause for the cold proceeding from windows, which is not generally thought of. The warm air in the room, which always occupies the upper part next the ceiling, coming into contact with the glass, is cooled by it, and, immediately descending in consequence, diffuses itself through the lower part of the room, and is felt as a cold current coming from the windows, although none may have entered that way. Curtains check this by partly preventing the warm air from reaching the glass, and partly by directing the current sideways. Curtains likewise hide the unsightly appearance of the shutters with their fastenings, when closed. In warm climates they are used rather to moderate the sun's rays, or to prevent the intrusion of flies; and this is their principal use with us, independent of their ornamental appearance in the summer season; then, figured muslins are often employed alone.

1033. *Light, which is so favourable to the life and health of living beings, is very prejudicial to furniture, by destroying its colours.* It may be observed that those portions of the furniture of a room, particularly when of dyed materials, on which the sun is permitted to shine, will be much faded, while those parts which have not been so exposed may retain their original brightness.

1034. *The effect of the sun's rays upon oil colours* may be mentioned as an exception to this rule; for pictures painted in oil, which are put away with their faces turned to the wall, change much more than when hung up and exposed to the light; it may also be observed, that those parts of walls which have been long covered by pictures or mirrors have changed and become darker than the rest: oil paint, therefore, does not suffer from the sun's rays. Water-colour drawings, however, suffer much from being always exposed to the light; and, when valuable, should be defended by a silk screen, to cover them when not required to be seen.

1035. *The simplest kind of window curtain*, which may be used in the bedrooms of small houses, or in cottages, consists merely of two pieces of dimity, printed calico, muslin, or other material, of the proper length and width, nailed to the top of the architrave, or to a piece of wood fastened up on purpose, as in *fig.* 161, *a*, and kept back in the day by being looped up on each side, by a cord fixed on the sides of the window. This curtain may, if thought proper, have some kind of border at the top, with or without a fringe, as in *fig.* 161, *b*.

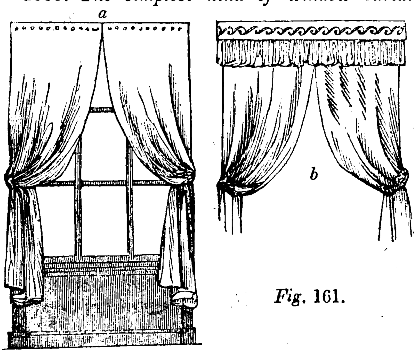


Fig. 161.

Another simple mode is to have the curtain in one piece to draw up by means of lines and pulleys, as in *fig.* 162. To effect this, a pulley is fixed at each end of a flat piece of wood as long as the window is wide; and another pulley is let into the wood, so as to divide the lath into two equal parts. The curtain is nailed to this wood, and pieces of tape are then sewed down the curtains at the two sides, and also just under the middle pulley, and there a number of rings are fixed. Through these rings are passed three cords, which go over the pulleys, and are then fastened together; by means of these cords the curtains can be raised or lowered at pleasure. The boards, with the pulleys, may be concealed by a lath covered with a border, and having a small valance; these are called by upholsterers *festoon* curtains, and were very general before the French manner was introduced of making them slide on a rod.

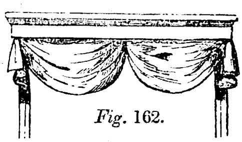


Fig. 162.

1036. *The general mode of hanging curtains at present*, in the better sort of rooms, is by having rings at the top of the curtains, passing over a rod stretched across, by which each half of the curtain is drawn to one side of the window, as in *fig.* 163, A. This curtain rod may either be visible, or may be concealed by a cornice, valance, or drapery. When it is intended to be visible, it is made thicker, of wood or brass, and is then termed a *pole*: when it is not to be visible, it is made thinner, of iron or brass. The curtain pole is supported at each end by an iron bracket screwed to the architrave of the window, as in *fig.* 163, B.

1037. *The best method of causing the curtains to open* is the following: on each end of the brass curtain rod, *a*, *b*, *fig.* 163, C, are pulleys, one at *a*, and two at the other end, *b*, *c*. A line, *d*, passes over the pulley *b*, then over that at *a*, and after going over the pulley *c*, returns down by *h*, to join *d*, by passing over the wheel in the little brass rack which is placed at *e*, and screwed on the architrave, or otherwise fixed. Each corner of the curtains, where they meet, is attached to rings, *f*, *g*, which slide on the curtain rod. By considering the motion of this line over the pulleys, it must be evident that when it is drawn down by pulling at *h*, the curtain attached below the rod to the ring, *g*, must move towards *c*, and, consequently, open; while, at the same time, the other curtain, fixed above the rod to the ring *f*, must also open by moving in a contrary direction

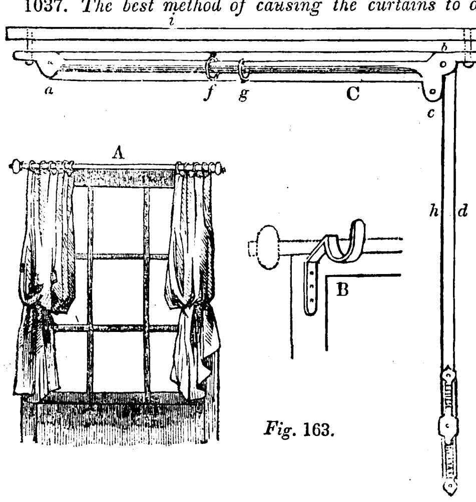


Fig. 163.

Each end of the curtain is fixed to the under side of the projecting lath, *i*, by screws. This curtain rod and pulleys may be made of hard wood instead of brass. It is to be observed, that each curtain must be large enough to lap over the other some inches in the centre, to exclude the draught.

1038. *Besides the rod on which the curtain slides, there is generally a piece of the same material with the curtain, called a valance,* suspended before it, to conceal the rod, and likewise the soffit, or under side, of the architrave. This valance gives great richness and finish to the window; but when the rooms are low, they should not be deep, as they then hide much of the light: on the contrary, when the windows are very lofty, they are often useful in moderating the too great glare of light. Valances are contrived in a vast variety of modes, on which depends, in a great measure, the style of the window. Sometimes they are made in the form of festoons, and are then, by upholsterers, termed *draperies:* the festoon itself is called the *swag*, and the end that hangs down is termed the *tail:* see *fig.* 164. These are frequently ornamented with fringes, tassels, and cords, in various ways. This, which is the former French style, was introduced some years ago, as being much richer and more elegant than ours; at present it is less used, and what are called *piped* valances are more generally put up; these harbour less dust, from the folds being perpendicular. Lately, massive brass rods and large rings have been much in fashion; also, rich gilt cornices over the valances.

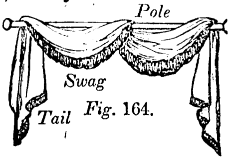


Fig. 164.

1039. *The materials for window curtains* must necessarily vary with the apartments where they are to be used; but, independent of the difference of expense, the choice of their qualities depends upon several considerations. In forming graceful drapery, the material is of great importance. It is impossible to form them well of stiffened materials, such as highly-glazed calicoes, which will not, of themselves, fall into graceful folds, and must consequently have a stiff appearance. Pliability of the material is essential; and, for this purpose, silk and fine cloth are considered the best substances. In drawing-rooms, plain coloured satin, or figured damasks, bear the first rank for richness. Lutestring and tabarets next, though they do not make so good drapery. Salisbury flannel, fine cloth, or cassimer, are sometimes used. For eating-rooms and libraries, a material of more substance is requisite than for drawing-rooms; in these, moreen is most usually employed. When chintses are used, they should not be much glazed.

1040. *One inconvenience in the elegant French draperies* was the great skill and taste required to put them up well; and it is said that the cutting out of this part of upholsterers' work was kept as much as possible a secret, and seldom taught, even to their apprentices. A book, called the "Upholsterer's Accelerator," gives rules for this purpose.

1041. *The manner of looping or fastening up the curtains in the day* is varied, by hanging them over a large ornamented brass pin, by an ornamented brass band, or by silk cords and tassels. It requires some taste to dispose the folds properly, and some housemaids excel others in this part of their duty. The colours of window curtains should harmonize with the rest of the room, as well as with the richness of the materials. When we say harmonize, we do not mean they should correspond, or be the same, but that there should not be any violent contrasts, and that the colours should agree with each other. As the sunshine causes the colours of window curtains to fade, they should, when convenient, be taken down in the summer, and muslin curtains only kept up.

1042. *The designs for window curtains* have been almost infinite; but it must be allowed that our neighbours the French have, until lately, displayed more taste in this department of domestic decoration than our upholsterers. The present fashion for plain or piped valances renders this easier. We proceed to give some examples of the usual style of window curtains.

1043. *Fig.* 165 is an example of a window curtain with cornice and valance, in the style very prevalent in the present day. The cornice is carved and highly gilded, from which descends a deep rich fringe. There is a double set of curtains; one of some of those rich materials mentioned above for the evening, and another of figured muslin for the day.

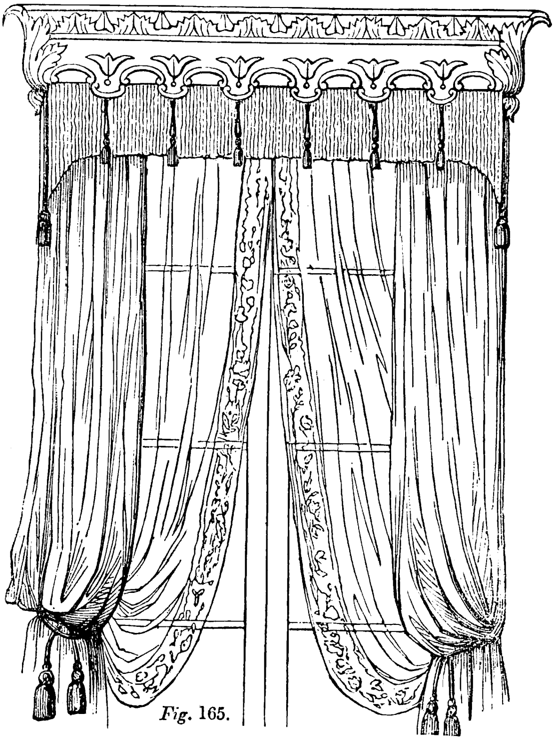


Fig. 165.

Fig. 166 is another design for a cornice and a piped valance.

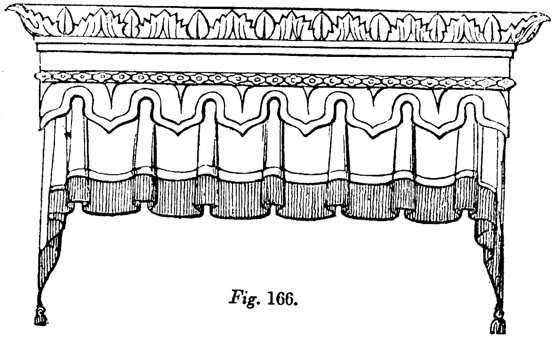
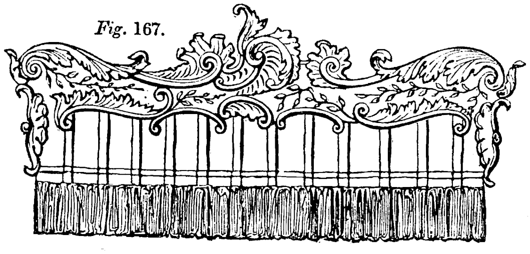


Fig. 166.

Fig. 167 is a cornice and valance in the style called of Louis XIV., now much in fashion. The cornice is wholly gilded, and the valance may be of rich silk and fringe.

Fig. 167.



Figs. 168, 169, 170 are various designs for window curtains and valances in the style of the French draperies.

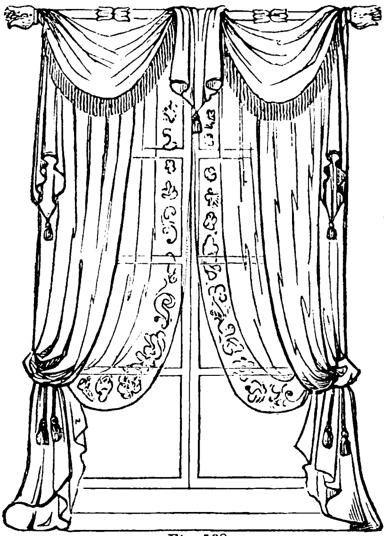


Fig. 168.

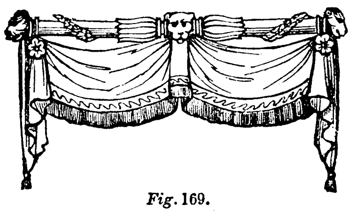


Fig. 169.

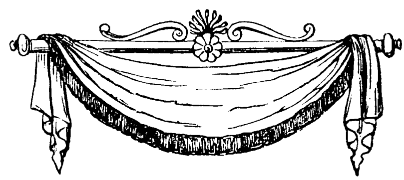


Fig. 170.

Fig. 171, is one now a good deal used, with the cornice plain, and the brass curtain rod visible.

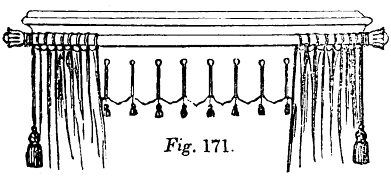


Fig. 171.

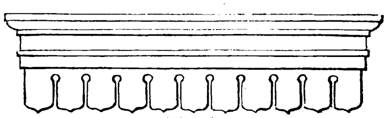


Fig. 172.

Figs. 172, 173, 174 are cornices and valances suitable for bedrooms.

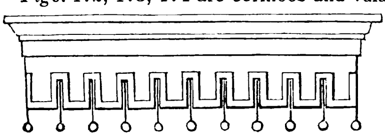


Fig. 173.

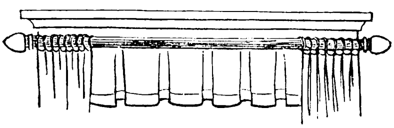


Fig. 174.

1044. *Muslin curtains* are almost always used in the best rooms in addition to tn usual thick curtains. They serve to shade and protect the colours of the others from the dust and sun, and have a clean and rich appearance. The muslin is richly flowered in large patterns, and many persons in summer take down the principal curtains, leaving only those of muslin: these are useful to keep out the flies when the windows are open. Curtains for this purpose are sometimes made of an open netting, which is very durable.

Sect. II.—window blinds.

1045. *Window sun blinds* are either for excluding the sun's rays, or for preventing any one passing from seeing into apartments; at the same time permitting a view from within. For the first purpose, they are either outside or inside blinds.

1046. *Outside blinds* have been already treated of in p. 80.

1047. *For inside sun blinds*, the Venitian are sometimes used, when it is requisite to exclude the sun very effectually. These consist of a number of thin laths lying horizontally, generally painted green, and having two pieces of tape stretching across them from top to bottom, by which they are moved, and open to any degree, so as to let in more or less light. These, when placed inside, do not shut out the rays of the sun so completely as when put outside the sash; and, though they are more accessible, they have the inconvenience of darkening the room too much.

1048. The most usual kind for the inside are *Holland* blinds, which are either plain rolling blinds without springs, or spring rolling blinds. The Holland is a particularly strong linen, woven on purpose, the usual width of windows. The common roller blind is simply nailed on to a wooden roller, the lower end of the blind being kept distended by a lath passing through a broad hem. The roller at the top turns upon pivots at each end. At one end is a wooden or brass pulley, over which a smooth cord passes in a groove, and extends also over the small wheel of a pulley-rack fixed on the head of the sash, and which is so constructed that the cord can be tightened when it becomes slack. By pulling this endless cord the blind is raised, and is pulled down by a short cord and tassel.

1049. *Spring rolling blinds* have a wire spring inside a tin roller, which acts so as to turn it, and the blind is raised up by merely pulling a cord: these are much more expensive than the common roller-blind, which has the advantage of greater simplicity, and being less apt to be out of order.

1050. Sun blinds are likewise made of *linen painted as transparencies;* and some of these are extremely beautiful, representing scenes in nature, either landscapes, interiors of buildings, or arabesques, and are particularly convenient when it is desirable to exclude the view of disagreeable objects. They are put upon rollers in the same manner as other blinds, being painted in varnish that does not crack in rolling.

1051. *Short blinds* to prevent seeing in, generally reaching half up the lower sash, are sometimes made as low curtains, of muslin, with a frill, and stretched on a brass rod across the window; but the better houses have either Venitian blinds of short perpendicular laths, or blinds made of woven wire, or pierced zinc, put into a mahogany frame. Woven wire makes an excellent blind, being desirable, and admitting of being ornamented by painting in oil upon it. They are not apt to be out of order, as is the case with Venitian blinds, without great care.

Sect. III.—CARPETS AND RUGS.

1052. In no country are carpets in such general use for covering the floors as in England. In Asia, where they were first invented, they are seldom used except to sit or sleep upon. Before the use of carpets the floors of the best houses in Europe were laid with oaken boards in the manner called *marquetcrie,* and they were generally kept highly polished with wax, which sometimes caused them to be unpleasantly slippery. It is scarcely yet a century since the first appearance of carpets in this kingdom; and at present it is computed that in England and Scotland there are two hundred millions of yards in constant wear.

1053. *The manufacture of carpets was introduced* into France from Persia by Henry IV., and a magnificent royal manufacture exists at present at Aubusson, in the south of France, where carpets of the most superb description are made, in the manner of velvet, and also in that of the tapestry of the Gobelins. They are generally ornamented with designs after the antique arabesque. But these luxurious articles are necessarily confined to the opulent; and a great majority of the people of the middling classes in France scarcely know the use of carpets, which are so general with us, tiled floors being the most common among them. Of late, however, the great influx of English has caused carpets to be introduced into public hotels and lodging houses, from which they are spreading more generally.

Near to Brussels there is a manufactory, where every kind of carpet is well imitated, from Persian to Scotch. In America carpets are universally used as in Britain. The best carpets are composed all of dyed wool: some have parts made also of hemp. They are wrought in fanciful patterns, varying in their style according to the place of manufacture.

1054. *Carpets are of two kinds:* that of double fabrics, consisting essentially of two distinct webs woven at the same time, and firmly decussated together by the woof threads. Hence the form of the pattern is the same on the two sides of the cloth, only the colours are reversed, so that what is green on one side becomes, perhaps, red or black upon the other, and *vice versâ.* The smaller the figures the more frequent the decussations, and the firmer and more durable the fabric. The other kinds have a raised pile on one side like that of velvet.

1055. *Turkey and Persian carpets.* This excellent manufacture originated in Persia, Hindostan, and Turkey, from whence many were formerly imported into Europe, as they are now occasionally, being brought chiefly from Smyrna. They were long unequalled for richness of fabric and pattern, though at present the manufactories on the Continent produce some that are not inferior. These kinds are woven with a soft pile somewhat similar to velvet, and some of the richest of the Persian have floss silk mixed with the wool. The manufacture of Turkey carpet was brought to England in 1750 by two workmen from France, and through the exertions of Mr. Moore, secretary to the Society of Arts, was, after some difficulty, brought to great perfection. These are very frequently used in good dining-rooms, being exceedingly warm and durable, but from their great weight, are difficult to shake. They are made in one piece, sometimes even eight or ten yards long, and five or more wide.

1056. *Brussels carpets* are not made in large squares, but in pieces about seven eighths wide. The basis is composed of a warp and woof of strong linen thread; worsted threads are also interwoven, which are formed into loops by means of wires; and these form the pattern, the linen threads not being visible on the surface. When well made they are very durable, and being at the same time elegant, they are at present much in request for the good apartments, the kinds mentioned previously being much more expensive. They, however, vary much in quality: the best kind ought to weigh 1¾ lb. per yard; but of late they have been manufactured in a slighter manner, and often do not weigh 1¼ lb. per yard. There is also a *Tournay* carpet very similar. The names of our carpets do not always denote either the present or the original place of manufacture. Our Brussels carpets are made chiefly at Kidderminster. What are called Kidderminster carpets are mostly made in Scotland and Yorkshire; and it is not known that what we call Venitian carpeting was ever made in Venice.

1057. *Wilton carpets* differ from the Brussels in this: when the wires upon which the loops are formed are drawn out, the worsted loops are cut through with a sharp knife, and then they form a pile in the manner of plush or velvet. The basis is linen. This manufacture was introduced into this country through the exertions of Lord Pembroke; and they have the advantage of being executed in very beautiful designs. In the *Royal Wilton* the pile is raised higher than in the common Wilton.

1058. *Velvet pile carpets* are a kind lately introduced, resembling the texture of the Wilton, but superior in richness of pile and the colours. They are sold at from ten to fourteen shillings a yard. Nothing can surpass their beauty and rich effect, and they are of English manufacture.

1059. *Axminster carpets*, so named from the town in Devonshire where they are chiefly manufactured, are woven in one entire piece, and are executed in very beautiful designs, several persons being employed at the same time in working the coloured patterns. The manufactury was established in 1755. The warp and shoot are of strong linen, and numerous small tufts of differently-coloured worsted are fixed under the warp and secured by the shoot. The process of weaving them is tedious: hence the carpets are necessarily expensive, and the whole quantity manufactured is not considerable.

1060. *Kidderminster carpets* are composed of two woollen webs, which intersect each other in such a manner as to produce definite figures. In carpets of two plies the warp and woof appear on the same side, and, of course, on the two sides the colours are reversed, as the warp or woof appears. Three-ply carpets have lately been made, in which the woof shows the figure. These carpets are made in squares, to suit rooms of various sizes. There are various qualities according to the price, which varies from 1*s*. 6*d*. to 3*s*. 6*d*. per yard. The cheapest are very loosely woven, having the woof much thinner than the warp; these soon wear out: the best are closely woven, and have the warp and woof of equal strength.

1061. *Common Scotch carpets* are among the cheapest kinds, and are often confounded with the Kidderminster.

The three imperial Scotch carpet, which is coming much into vogue, is reckoned by many to be little inferior, in texture, look, and wear, to the Brussels, though much cheaper. It is made chiefly at Kilmarnock.

1062. *Dutch carpet* is a very strong and cheap carpeting, lately introduced. It is yard wide, about three shillings a yard, all wool, and superior in wear to Kidderminster, but only woven yet in stripes and checkers.

1063. *Venitian carpets* are of the simplest kind, the texture of which is plain: a striped woollen warp on a thick woof of thread made of hemp, cotton, or woollen; and the warp is so thick as to cover entirely the woof.

When the warp is hemp this cuts the woof, and occasions the carpet not to be durable: a cotton warp is better; the best Venetian carpets are all of wool. A superior sort is called damask Venitian, which partakes of the character of Venitian and Kidderminster. Venitian carpeting is used chiefly for bedrooms and stair-carpets, the dust adhering less to them than to others.

1064. *Carpets made entirely of hemp* were at first imported from Russia, but are now made here: they are extremely cheap and durable, but they have this disadvantage, that, when soiled by the feet, they cannot be cleaned completely by the usual brushing given to a woollen carpet: they are, however, useful in passages, offices, or places where a cheap carpet is required merely to deaden sound, and where the appearance is not important. They are sometimes sold as low as 6*d*. a yard, yard wide.

1065. *An excellent covering for the floors of offices and business rooms* is now made of cocoanut fibre. It is woven open, to let the dust pass through, and it is extremely durable and cheap: 2*s*. a yard, yard wide.

1066. A coarse kind of carpet for covering stair-carpets is likewise made of *New Zealand flax.*

1067. *Drugget* is a coarse woollen cloth, sometimes all wool, and sometimes the woof wool and warp flax thread. They are stronger, and have less nap than baize, and, among other uses, are employed occasionally as floor-cloth or cheap carpeting, or to cover carpets, for which purpose they are woven from a yard and a half to two yards and a half wide.

Milled drugget is a fabric lately introduced: being painted in rich colours, and very thick and strong, it forms a very good substitute for carpets in small apartments. It is madè yard wide, yard and half, and even two yards: the price very low.

1068. *In laying down carpets,* the most complete way is to fit them into all the recesses of the room; but this is also the most expensive, since not only all the carpet seen when laid down is charged for by the upholsterer, but likewise all that is cut to waste, which, in some apartments, is a good deal. Where economy is an object, the carpet may be square or oblong, according to the shape of the room, but not fitted into the recesses; and the boards round the sides may be left bare, or be painted in oil, or covered with oilcloth, baize, drugget, &c.; or, lastly, as a still more economical mode, there may be a border only of carpet round the room, and the middle part may be covered with a drugget, painted or not, which will look as if the latter covered the middle of a large carpet; and this has the advantage, particularly for bedrooms, that it is easily taken up to be shaken and dusted. With respect to the economy in not fitting carpets to rooms when square or oblong, they can have the wrong side turned up for a time to save the other side, which cannot be done when the carpets are fitted in; and they may likewise be reversed in their position, which will make them wear more equally. Thus a square carpet may have its position changed eight times, and an oblong one four times; whereas a carpet fitted to the room cannot be altered in its position, except the apartment should be exactly symmetrical, which is seldom the case.

1069. *In the wear of carpets* much depends upon the manner in which they are kept clean: if the dust is suffered to accumulate too long, they require to be beaten with much force, which breaks the threads. In some cases they are scoured; but this is very apt to injure their texture. It is important to the preservation of carpets that the boards of the floor be well laid; if they have not been properly seasoned when they were laid down, they sometimes turn up at the edges, and occasion ridges, which will cut the carpets, and cause them to wear there soonest. As soon as a carpet begins to wear, its position in the room should be altered, that every part may be worn alike. Thick and heavy carpets do not require to be nailed down; but those that are thin usually require nailing in sitting-rooms, otherwise the edges curl up and are inconvenient; but if they are well nailed at first, and stretched, after a month or two they will lie flat with fewer nails, so that they may be easily taken up to be beaten. The air of a sitting apartment is materially injured by the dust being suffered to accumulate under the carpet. Every time it is swept a cloud of dust rises and mixes with the air; and, although this is scarcely visible, it proves injurious to the lungs. Carpets in bedrooms are seldom nailed down, and never ought to be, that they may be frequently beaten and brushed.

1070. *The size of the patterns* should be suited to that of the apartments. Large patterns are only fit for large apartments, and small patterns are more easily mended: those with geometrical figures have this advantage, that pieces may be let in where parts are worn, which is more difficult in irregular patterns. It is also economical to have several of the carpets in the house of the same pattern, as those of bedrooms, passages, &c., that one may mend another.

1071. *The colour of carpets* should be well attended to; and much taste is required to choose patterns and colours that are the most suitable for the apartments where they are to be put down. In this fashion will generally be followed; but it is very necessary to consider also the nature and use of the apartment, and style of the furniture. In the richest carpets, intended for the best apartments, the style is usually gay and splendid: for parlours, the Turkey and Persian patterns, having a richness of effect without any conspicuous or distinct figures, are preferred; and for sitting-rooms and libraries, something of a quiet, though not too dark character, is preferable. Carpets with only two colours are often very elegant; but they easily show any stains on them, and, consequently, do not wear so well as when there is a sprinkling of a few more colours intermixed, the spots of colour assisting to disguise those arising from stains. It should be observed, likewise, that some colours are more liable to fade than others.

Those who would be thrifty should have their carpets mended with the needle in time, when they begin to wear; and this may be done somewhat in the manner of embroidery, making use of proper coloured worsteds to make out the pattern: a precaution, however, which is seldom taken.

1072. *Hearth rugs* are to save the carpet near the fire, where it is most liable to be worn, and likewise to afford greater warmth and softness to the feet at that place. They vary much in style and price, and should be chosen to suit the carpet in colour and degree of richness; but they are too well known to need particular description. Where economy is much an object, a piece of carpet of the same pattern as that of the room may be used, with some border sewed upon it.

1073. *Door Mats.*—These articles, used for wiping the dirt from the shoes, are made of various materials. Those placed in the entrance of the hall are of a coarser and rougher kind; others, of a finer sort, are placed at the foot of staircases, and at the entrance of apartments. A very coarse mat, of German origin, called here the *chain* mat, is made of tarred rope, or of cocoanut fibre, *fig.* 175, which is very durable, and calculated for places where much dirt is made: first a rope goes round the outside, to form the boundary of the mat; and the same kind of rope fills up the interior, in zig-zag lines, being fixed with cord in that position, or in any other pattern that may be suggested. As there are interstices between the ropes, the dirt falls down in the cavities, and when these are full the mat is easily cleaned by lifting up and shaking. It is obvious that persons in the country, who wish to be economical, could easily construct mats upon this principle, either of old rope, plaited straw, or any similar material.

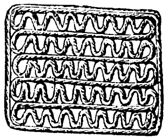


Fig. 175.

1074. The most serviceable coarse door mats are made of cocoanut fibre; a finer kind is made of the same, with worsted-coloured borders, woven so as to have a brush-like appearance. A very cheap kind is likewise made of straw, or of a kind of tough grass. Fine mats to put before the doors of apartments are made of Indian grass, and are called *grass mats;* and a still finer kind, or, rather, *rugs*, are made of the skins of sheep with the wool on, dyed and prepared. Besides these, there are merino fringe mats, fancy and worsted mats, Lapland skin, &c.

1075. *The skins of sheep and lambs, with the wool on, are made into rugs* by a patent process, which we shall describe as one that may be found useful in certain situations. The skins, with the wool on, are thoroughly cleansed from all impurities and foreign matter that may adhere to them by washing in running water, and by scraping the flesh side, in the usual manner, by the knife, and by cutting off all the extraneous and ragged parts, when they are ready to be tanned; for that purpose they are stretched upon frames, and laid upon trussels with the flesh side upward: an infusion of sumach, in the proportion of one pound to a gallon of water, is then poured over the skin, and the tanning matter is worked into the pores of the skin by the aid of the knife. When dry, the reverse, or wool side of the skin, is next placed upward, and thoroughly washed with a strong alkaline lye, or soap and water, and afterward in clean water, by which means the grease and filth are removed; when dry, the skin undergoes a second operation of tanning with sumach, as before mentioned, and, after being dried, its harsh and rigid surface is rendered smooth and soft by rubbing it over with pumice-stone. In order to dye it of any colour, before it is taken off the frame its face or woolly part is dipped into a bath of the required tint, prepared in the ordinary manner for dying wool; the washing must now again be repeated to get rid of the excess of colouring matter which adheres to it. The skins are then dried, and trimmed to the proper shape.

SECT. IV.—FLOOR-CLOTH, AND OIL-CLOTH COVERS.

1076. *This name of floor-cloth is applied to a manufacture of cloth painted over with oil colours*, so as to be impenetrable to wet: and the oil-cloth coverings used for tables, &c., are made nearly in a similar manner. A stout canvass is chosen, in the first instance, for floor-cloth, and this is sometimes of very large size, amounting to 210 or 220 square yards, which is the reason of the large premises required for this sort of manufacture. The canvass is stretched on a strong wooden frame, and, after being well sized, is rubbed and smoothed down with pumice-stone. Four coats of stiff oil paint are then laid on successively, on one side of the canvass, suffering each first to dry, and then three coats on the other side. After this paint is quite dry, the cloth is detached from the frame, in order to be printed in the manner of calico printing: for this purpose it is rolled up on a roller, and unrolled as required for the process. In giving the surface pattern, stencilling was formerly employed; but printing with blocks is now generally practised. The colours employed in good floor-cloth are always white-lead mixed with ochre, umbers, and the usual earthy pigments ground in linseed oil, and mixed with a little turpentine. In spurious oil-cloth whiting is sometimes mixed with the white-lead, but such cloth cracks and does not wear well. It is obvious that the number of blocks must depend upon the pattern: the greater the number of colours, the more expensive will be the manufacture. It is reckoned that every square yard of good floor-cloth should weigh 3½ or 4½ lbs., and hence the quality of the cloth may, in part, be estimated by the weight. Good cloth, when used for covering verandas, or other places exposed to the weather, ought to last nine or ten years; whereas, cloth of a spurious kind will decay in one year. The best cloth has even been occasionally used in some places for gutters, water producing no injurious effect upon it.

1077. *Floor-cloth is better for being kept for some considerable time before it is used*, the paint getting harder, and it, therefore, is charged for partly according to its age; new floor-cloth being cheaper than that which has been kept a year or two. That for passages is charged according to the yard run; yard wide is from 2*s.* 6*d.* to 5*s.* Half a yard wide, in the Persian or Turkish style of design, 1*s.* 6*d.* per yard; five eights 1*s.* 7*d.*

Floor-cloth to cover a room is charged by the yard superficial, according to its quality, that depending upon the strength and goodness of the canvass, the number of coats of paint, the number of colours in the face, and the age of the cloth.

1078. *Floor-cloth is very useful in some apartments*, on account of its impenetrability to water, and its drying so soon after being wetted; but water should be sparingly used in cleaning it, and still more should soap, for this latter will cause the paint to come off by dissolving the oil with which it was made. If not too much dirtied, floor-cloth may be kept clean by wiping it with a damp cloth, and afterward rubbing it well with a dry cloth, and then with a brush till it shines.

1079. *There is a great variety of styles in the patterns of oil-cloth.* Some are made to imitate marble casements; some wainscot boards, and some carpets of various kinds. Those are best which have several colours, and the pattern rather small. When the pattern is large, defects are sooner perceived; but, again, in those which have a large pattern to imitate marble, defects may be repaired by a house painter.

1080. *Matting* is used in some cases instead of carpets. The best are India mats, which are used to lay over carpets, particularly in summer, from their being cool. They are durable.

1081. *Oil-cloths for covering tables* are made on fine canvass; one side, after having received the proper number of coats of oil paint, is printed with blocks; and the other side, next to the table, receives only one coat of paint, which, while wet, is strewed over with flock made of cut wool, so as to resemble green baize.

Sect. V.—Tables and Stands.

1082. *Dining-tables* are necessarily of various sizes and forms, to suit the apartments, number of guests, and other circumstances. Various methods have been contrived for increasing the size of tables on occasion, and of causing them to occupy less space when out of use. One of the most usual is the common dining-table, made of mahogany, with a fixed centre part, and folding leaves or flaps supported by fly-rails and legs to draw out, or put back when the table is placed at the side of the apartment. These tables may be square or round, as *fig.* 176. A variety of them, called a *cottage* dining-table, has the fixed centre not above 18 inches wide, to take up as little room as possible when put away.

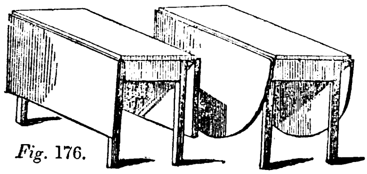


Fig. 176.

1083. *A square table may be increased* to an oblong one, by having fly brackets, as in *fig.* 177, on which may be laid loose flaps, one of which is represented in its place in the figure. These flaps are fixed in their places by pegs that drop into holes in the brackets; and they may be strengthened by projecting iron straps let into the table below the top. A thin rail may be put on with hinges to fold down, and conceal the flaps when the table is to be square.

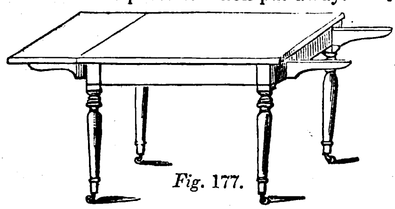


Fig. 177.

1084. *When a very long dining-table is required*, the usual method is to have the table that generally stands in the centre of the dining-room, whether square or round, as *fig.* 178, so contrived that it separates in two, as in *fig.* 179, and having loose flaps placed between supported by slides, called lopers, that draw out, forming a series of joists; the whole still resting only upon the four legs of the original table: this method is extremely convenient, as it prevents any

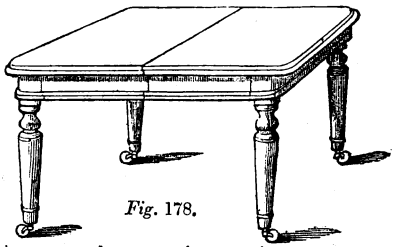


Fig. 178.

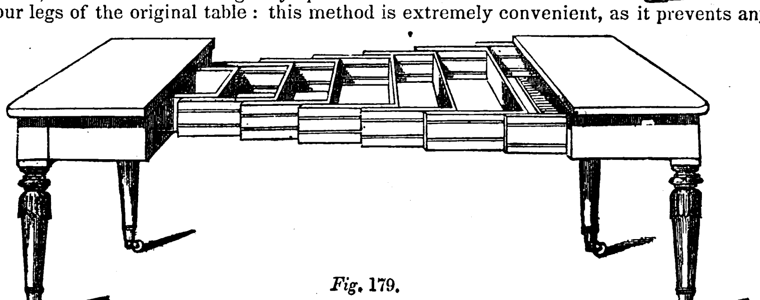


Fig. 179.

more legs coming in the way of the guests. These are sometimes termed *telescope tables*. In this manner a table may be made nine feet long, and without requiring any additional support; and one advantage of this construction is, that it obviates the inconvenience which frequently arises when the feet are numerous, and the floor not perfectly level. The flaps, when not used, are kept in cases made on purpose, and placed in an adjoining room, or a receptacle may be contrived for them in a sideboard. It is essential that the case in which they are kept should have openings to admit a free circulation of air, otherwise the flaps are apt to warp or decay, and slips, lined with green baize, should be fixed in the case to prevent the flaps rubbing against each other, or being scratched in taking out and putting in. On particular and temporary occasions, when no proper tables are at hand, boards laid upon *tressels* form a good substitute, as in *fig.* 180.

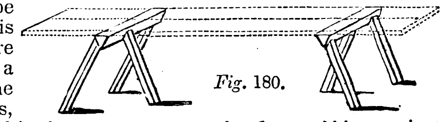


Fig. 180.

1085. *Pembroke tables* are well-known convenient furniture, frequently used as small breakfast or dining tables, *fig.* 181. It is requisite that they should be made of well-seasoned mahogany, otherwise, from the lightness of their structure, they soon become

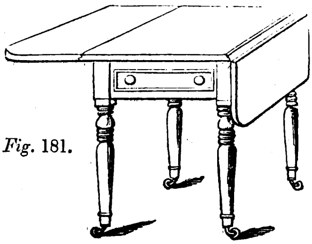


Fig. 181.

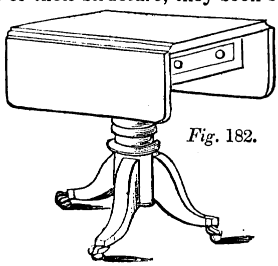


Fig. 182.

rickety: on this account, frequently, they can be most depended upon after they have been used for some time. It is now generally found best to execute them more substantially than formerly, when their lightness was thought to add to their elegance, as in *fig.* 182, which is a Pembroke table of a firmer kind, with pillar and three claw feet: this, as has been stated, makes the table steadier on an uneven floor, than when there are four feet.

1086. *Large round tables*, as *loo-tables*, *fig.* 183, are made with the pillar extremely strong. *Fig.* 184 is a square table with a similar pillar.

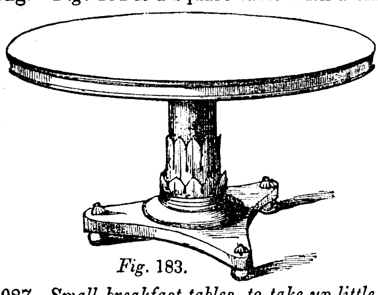


Fig. 183.

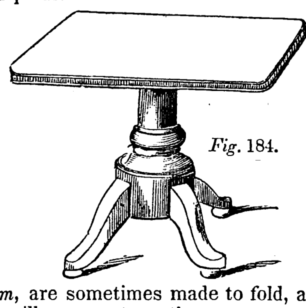
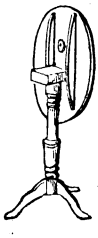


Fig. 184.

1087. *Small breakfast-tables, to take up little room*, are sometimes made to fold, as in *fig.* 185. Made larger, and with the supporting pillar very stout, they may serve for small dining-tables, as *figs.* 186, 187.

Fig. 185.



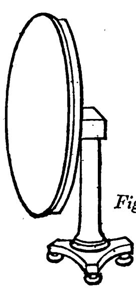


Fig. 186.

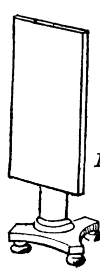


Fig. 187.

1083 *Library-tables* require to be made very firm and solid. The top is usually covered with leather for writing on. *Fig*. 188 is one with four legs turned and carved as required. Large drawers are convenient for holding portfolios or a large atlas.

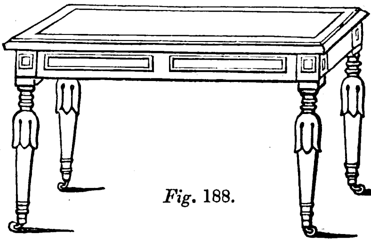


Fig. 188.

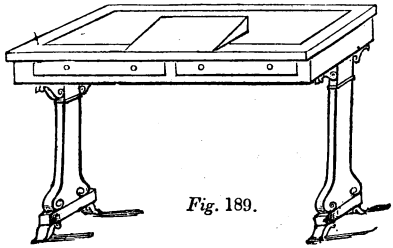


Fig. 189.

Fig. 189 is one of a more elegant construction. A moveable desk may be used for writing on.

Fig. 190 is a pedestal library table; the numerous small drawers are convenient for holding papers. Part of the top may be made to lift up as a desk, to write on; and a shallow drawer may pull out on the right to hold ink, pens, &c., and also a shelf may be made to draw out on the left, to increase the size of the top on occasions. It would be a convenient addition, though not usual, to have a cover hinged to the back, as represented in the cut, so as to shut over the top entirely, for the purpose of securing everything on it occasionally with a lock, without disturbing or putting them away, and this cover, when laid back, would be useful to give more room for holding papers. This table might likewise be made with doors to cover all the drawers, in which case, one lock and key would serve the whole, or one side might be fitted up for portfolios or large books, maps, &c. It is needless to observe that this place may be made more ornamental if required.

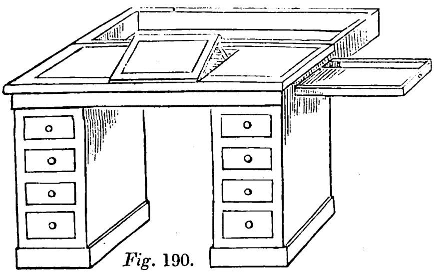
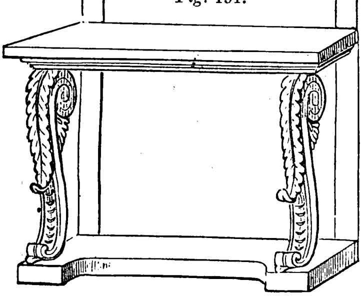


Fig. 190.

Fig. 191.



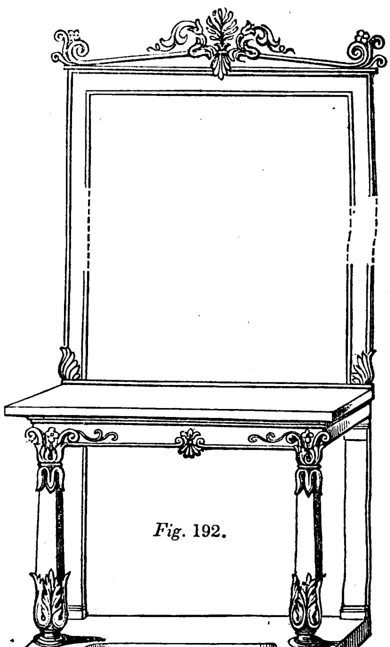
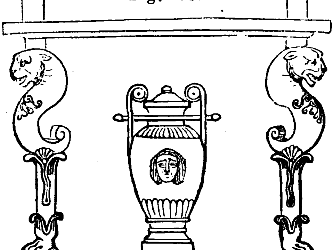


Fig. 192.

Fig. 193.



1089. *Pier-tables* are those which are placed against the piers between the windows, the tops are generally formed of some precious marble or scagliola. When the slab of the pier-table is supported by what is termed in architecture a *consol*, it is called a *consol-table*, as in *fig.* 191. Pier-tables are likewise supported by short columns or grotesques, as in *fig.* 192 and 193, and sometimes they contain cabinets or book-shelves. Frequently ornamental vases, or other objects of vertu, are placed upon them. If there are mirrors in the apartment, they are best placed over the pier-tables, as in *fig.* 192, because the light from the windows, coming full on the face, is reflected in the mirror. When the style of Louis XIV. is adopted in the apartment, the pier-tables and mirrors must be in the same style.

1090. *Card-tables* were formerly made, as *fig.* 194, with the top to fold, one half of which was supported by two of the legs, which were made to turn out. *Figs.* 195 and 196 represent a modern and improved construction, by which they can likewise have the top to fold, but may stand upon a single pillar. The folding top is made to revolve upon the frame, until it comes at right angles to its former position, when it exposes a well in the frame, in which the cards, &c., are kept; and it is then opened, being supported by the frame, which it entirely covers. These card-tables are, therefore, capable of every kind of embellishment as well as any occasional tables, and there is nothing in their appearance to distinguish them particularly from other tables.

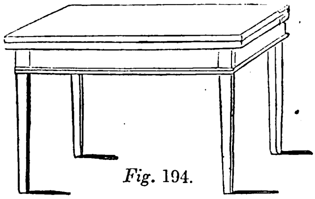


Fig. 194.

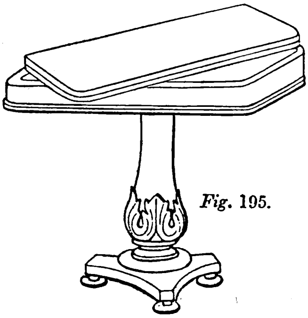


Fig. 195.

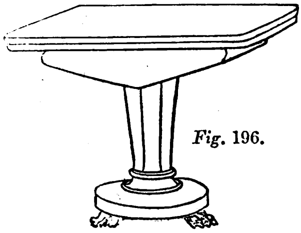


Fig. 196.

1091. *Sofa-tables* are elegant small tables for the drawing room, of a convenient form, as their name implies, to be placed near the sofa, and, for this purpose, are long and narrow. They are always made of fine woods, and considerably enriched by carving,

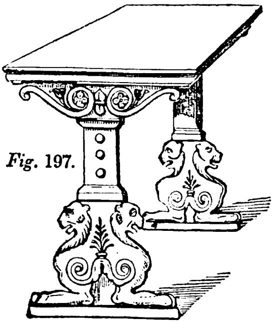


Fig. 197.

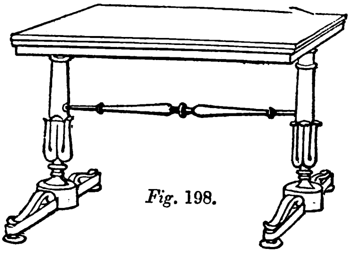


Fig. 198.

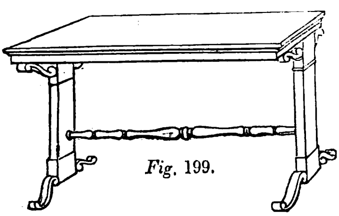


Fig. 199.

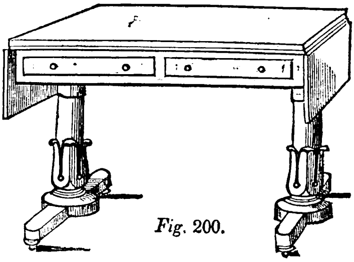


Fig. 200.

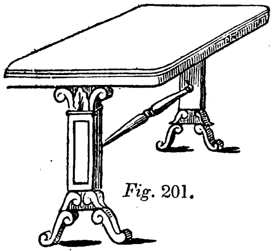


Fig. 201.

inlaying, or other modes of ornamenting. *Figs.* 197, 198, 199, 200, 201, are various tables now in use of this kind. They are sometimes termed *occasional tables*, and made also circular or octagonal, and supported by a single stem, as *figs.* 202, 203, 204. Some have been lately introduced with the tops of slate, richly painted or japanned with various fanciful ornaments, slate having the advantages of not warping, and bearing the necessary degree of heat for a superior japanning process.

1092. *Billiard-tables* are frequent pieces of furniture in the villas, where they are used for exercise. They are usually placed in a room devoted to that use. As

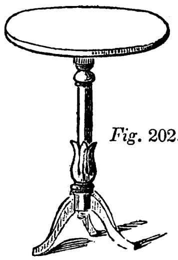


Fig. 202.

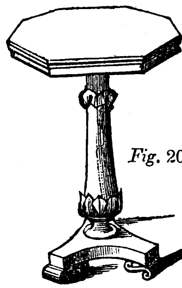


Fig. 203.

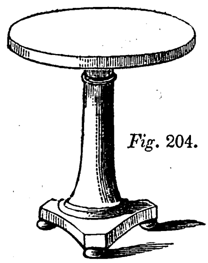


Fig. 204.

it is of great consequence that the table-top shall be quite level, great care is employed in fixing it. Sometimes spirit levels are attached to it, with screws for adjusting the top to a perfect level. They are usually made of mahogany, covered with green cloth; but they are also made of cast iron, and of slate.

Figs. 205, 206, 207, 208, are tables in the style of Elizabethan furniture.

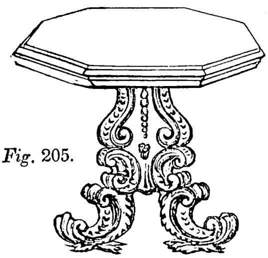


Fig. 205.

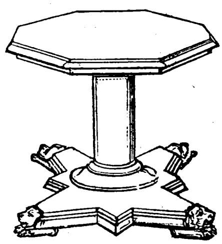


Fig. 206.

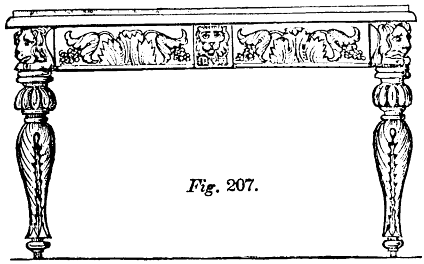


Fig. 207.

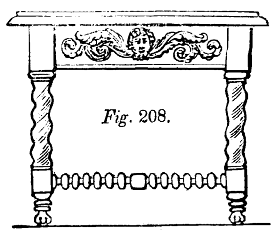


Fig. 208.

1093. *Ladies' work-tables* are small tables for holding the lighter articles of their work, and are generally fitted up with convenient places for cottons, needles, pins, scissors, &c. They are sometimes plain, of mahogany, with small drawers, as *fig.* 209, or with a silk bag fluted with a fringe, as *fig.* 210, fixed to a frame that draws out, for holding various articles of needle-work that are in progress.

1094. *Fig.* 211 is a larger one, made in the style of a sofa-table; and *fig.* 212 is a very small one of a circular form.

1095. *Fig.* 213 is a work-table combined with one for writing or drawing, and contains, besides the usual bag, a desk to raise up for reading, with convenient places for writing or drawing materials, with a sliding shelf at the side.

1096. *Fig.* 214 is a small work-table, the top of which is made to rise up to get at the

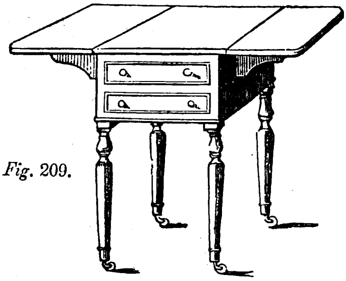


Fig. 209.

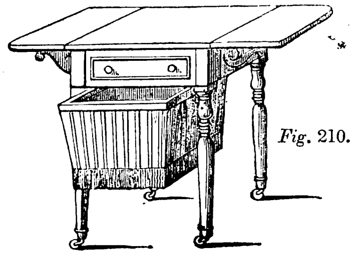


Fig. 210.

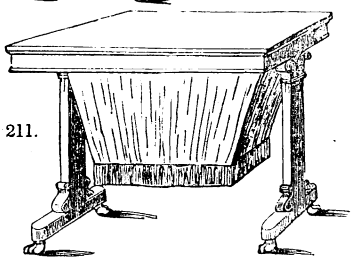


Fig. 211.

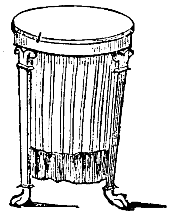


Fig. 212.

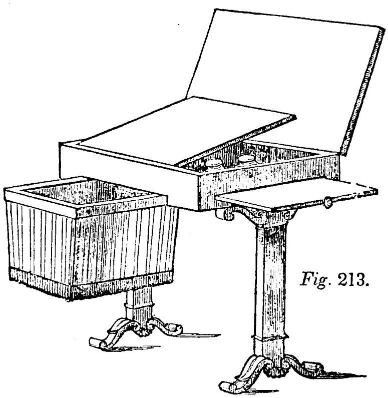


Fig. 213.

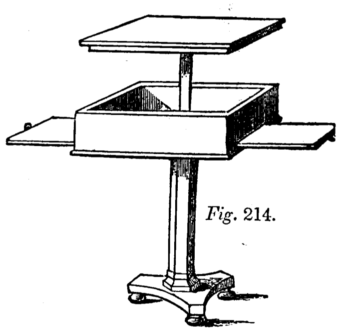


Fig. 214.

things kept in the table, without disturbing what is on the top: the top may be made in the manner of a revolving card-table, to produce the same effect.

1097. Extremely small stands for holding work are occasionally useful; *fig*. 215 is one of the least possible size; and *fig*. 216 is another convenient stand.

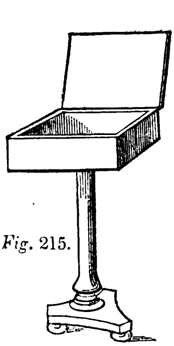


Fig. 215.

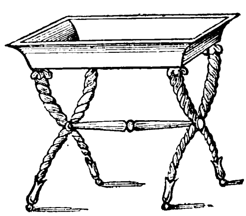


Fig. 216.

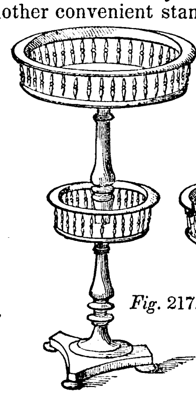


Fig. 217.

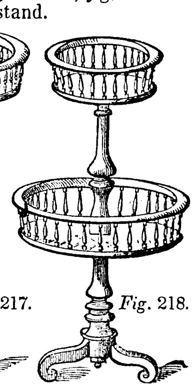


Fig. 218.

1098. *Work-boxes and baskets* are made of an infinite variety of forms, and are recommended to be large enough to hold a moderate supply of work and all its requisites, without being of such a size as to be inconvenient for carrying about or lifting with ease. They should contain divisions or partitions, like the work-tables, to keep every thing in its place; but sometimes an error is committed in over partitioning, which creates trouble instead of avoiding it. The contents of such boxes or the necessaries for work, are too well known to require enumeration in this place.

1099. *Basket-stands, figs.* 217, 218, are now much in fashion.

1100. *What-not* is a whimsical appellation for a very convenient stand of several stories. *Figs.* 219, 220, 221, are various forms of them. The latter, in particular, admits of great elegance.

Fig. 219.

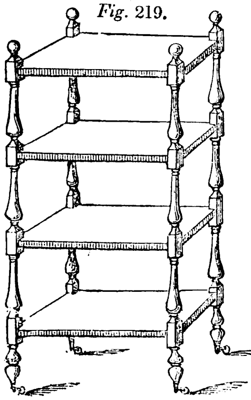


Fig. 220.

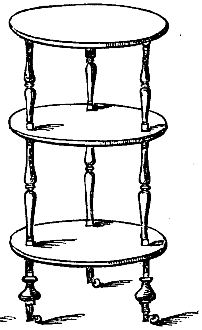
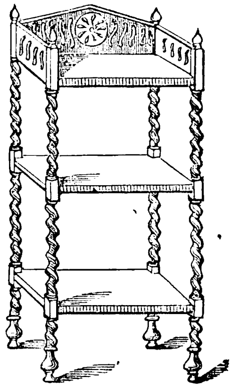


Fig. 221.



1101. *The tea-poise* is a small stand for keeping various kinds of tea in the drawing-room, ready for use. It is sometimes made with a rising top, and the various canisters are arranged within. *Figs.* 222, 223.

1102. *Small stands of very elegant forms* are useful appendages to furniture, for placing ornaments of sculpture and other objects upon, as well as to serve instead of tables on occasions that take up little room; for example, the want of a stand to hold a candlestick in a perpendicular place is often much felt. *Fig.* 224 will answer this purpose, as it is made to raise or lower. *Fig.* 225 is intended to support something heavy. *Fig.* 226 is a light stand of bronze or cast iron, resembling an antique tripod. *Figs.* 227, 228, 229, 230, are various stands of marble or scagliola to support objects of vertu.

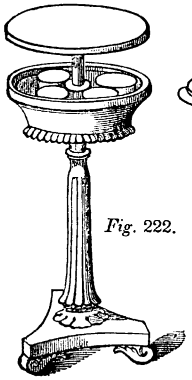


Fig. 222.

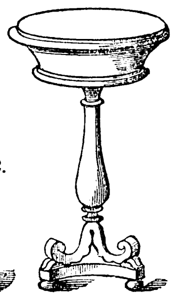


Fig. 223.

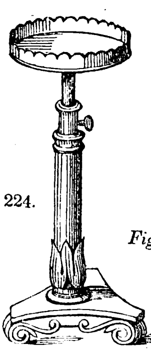


Fig. 224.

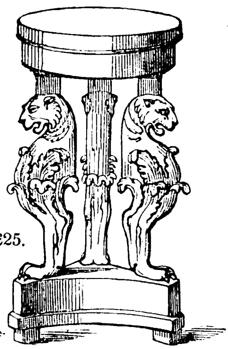


Fig. 225.

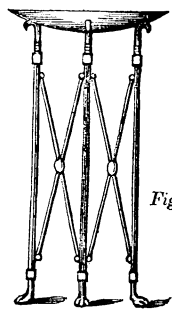


Fig. 226.

1103. *Music-stands* are usually made with branches to hold candles, and to rise and fall like a desk. *Fig.* 231.

Fig. 227.

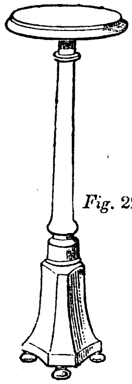


Fig. 228.

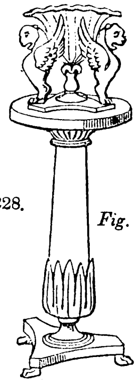



Fig. 229.

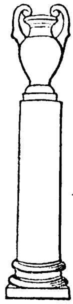



Fig. 230.

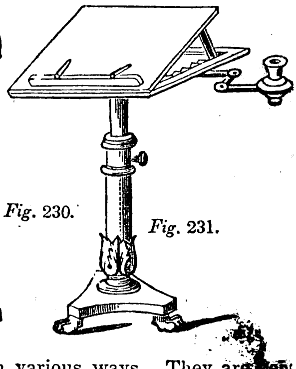



Fig. 231.

1104. *Flowers are employed to decorate apartments* in various ways. They are kept either growing in flower-pots, or in water, after having been gathered. The common red earthen flower-pot with a saucer is well known; but there are likewise some made of finer earthenware, a more ornamental kind. The latest improvement is by making them in form of a handsome vase, the lower part of which forms the recepta tacle for the water, which was first done by Wedgewood. *Fig.* 232 represents a sec tion; *a*, *b*, is the lower part containing the water; into this is placed the flower-pot itself containing the earth, and the appearance of a saucer is done away with. *Fig* 233 is the improved form given to these flower-pots at the lately-established potteries at Lowesby, in Leicestershire, and are painted in the style of the Etruscan and other antique vases. Large flower-pots in rooms are usually placed within a box of wood on concealed casters. When flowers are kept in bean-pots, they begin to droop and fade after being twenty-four hours in water: a few may be revived by substituting fresh water, but all may be a little restored by putting one third of the stems into warm water: by the time this water has become cold, the flowers will be erect and fresh; then cut off the ends stems, and place them in cold water, by which they may be kept a day or two A great many flowers may be completely dried, with all their colours preser burying them for some time in hot sand. In this process, the flowers are placed in a vessel capable of bearing heat, and hot sand is poured around them, but so as to disturb their shapes. They are then kept in an oven gently heated till they are thoroughly dried. Groups prepared in this way are sold in Covent Garden market, and are very pretty.

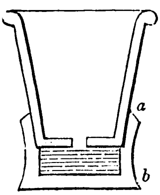


Fig. 232.

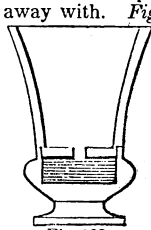



Fig. 233.

1105. *The flowering of bulbous roots* in water-glasses is likewise an agreeable manner of ornamenting apartments.

It has been lately discovered that many plants, particularly ferns, may be kept growing in an apartment, without any watering, by being planted in a box, and enclosed in glass. Plants have even been brought from India, in a growing state, by this contrivance, though the effect appears to be contrary to our usual experience.

1106. *Flowers should never be kept in bed-chambers* or nurseries, as they give out carbonic acid during the night, and consequently injure the air of the apartment.


Fig. 234.

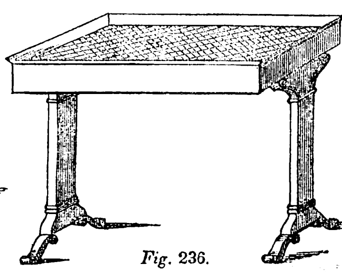



Fig. 236.

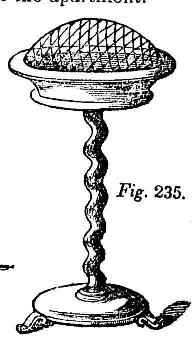



Fig. 235.

1107. *Flower-stands*, called *jardinières*, are for keeping cut flowers fresh for some time, by putting them into wet sand, kept in a japanned tin tray that fits on the top of the stand. This is covered with a trellis-work of wire or pierced tin, in the apertures of which the stems of the flowers are put to keep them upright.

Fig. 234 is a small stand of this kind to be placed on a table. *Fig*. 235 is a small one to stand on the floor. *Fig*. 236 is a larger one. *Fig*. 237 is a stand for a flower-pot. *Fig*. 238 is a stand for several flower-pots. *Figs*. 239 and 240 are smaller stands for flower-pots. In *fig*. 240 the pots are concealed by moss.

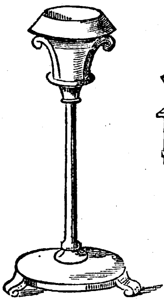


Fig. 237.

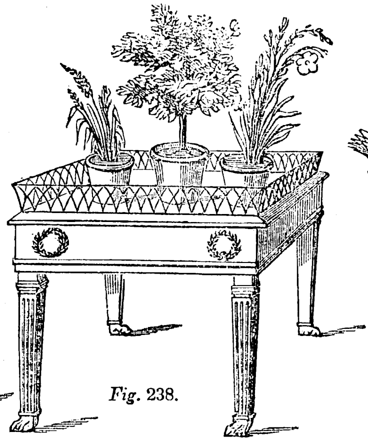


Fig. 238.

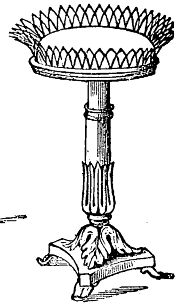


Fig. 239.

Fig. 241 is an economical stand for cut flowers, made of tin and wire painted. When full, it forms a pyramid of flowers.

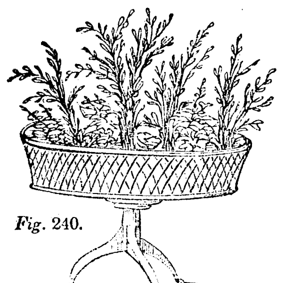


Fig. 240.

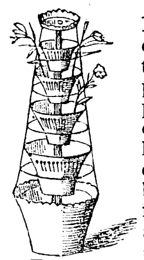


Fig. 241.

1108. *The pot-pourri*, so called by the French, is made by combining the odours of various flowers, by putting their petals into vases or china jars placed in apartments. For this purpose, a great variety of flowers are employed, as orange flowers, rose leaves, pinks, marjoram, thyme, lavender, rosemary, camomile, melilot, sweet basil, balm, jasmine, &c. These are mixed together, and some salt is added, and well stirred among them to preserve them; the perfume will last for many months; and sometimes odoriferous gums are added, as benzoin, and, in short, any sweet-smelling substances, as cinnamon, musk, &c., which may compound such a perfume as is most agreeable. The jars are kept covered, except when the perfume is wanted.

An English pot-pourri is described as consisting of violets, jasmine, lavender, clove-gilly flowers, rosemary flowers, knotted marjoram, balm of Gilead, damask roses, orris root, gum benjamin and storax, musk, cloves.

Another, orange flowers, clove-gilly flowers, damask roses, knotted marjoram, lemon thyme, rosemary, mint, lavender, rind of lemon, cloves, all chopped and salt between. If the whole cannot be salted at once, put them in as they can be had.

Sect. VI.—Sideboards.

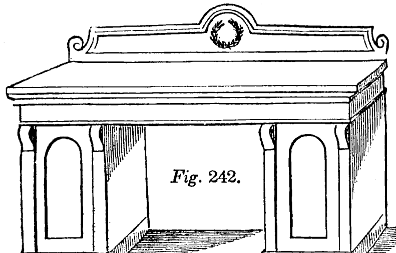


Fig. 242.

1109. *Sideboards* are generally made of fine mahogany, and more or less enriched with carving and other ornaments. Small sideboards are often of the kind called *pedestal sideboards*, *fig*. 242, having on each side doors enclosing shelves or drawers for holding plate, liquors, or other similar articles; at the bottom may be a deep drawer with partitions. Some have likewise drawers under the top. *Fig*. 242 is one in a very plain style. In the centre, underneath, is placed an open wine-cooler within, where that is used.

Fig. 243 is a sideboard of a more considerable size, and without shelves, as the last. They are usually made in this manner in large rooms, as they thus admit of great variety of ornament, and the table may be supported by columns, termini, caryatides, or

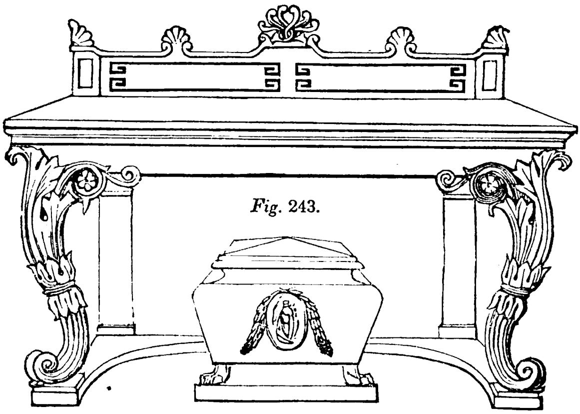


Fig. 243.

other appropriate objects. Beneath is a *cellaret*. or a receptacle for wine or liquors, &c., or it may be a wine-cooler. The cellaret is frequently made in the form of an antique sarcophagus. Sideboards are sometimes made with deep drawers to hold a cellaret. At present, the Louis Quatorze style is much employed for sideboards, or they are enriched by some ornaments in that style.

Fig. 244 is an example of the manner in which a sideboard is frequently made up out of dissected parts of Elizabethan furniture. The foliage of the carving in oak is in a very rich style; but the figures are uncouth, as they usually were in that period.

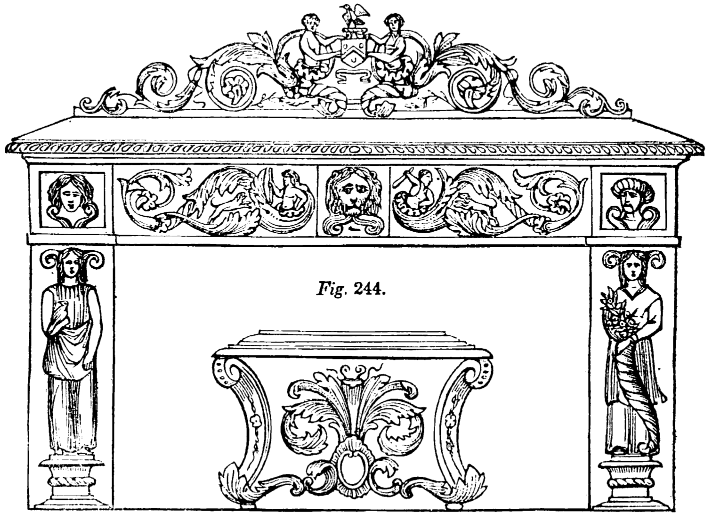


Fig. 244.

1110. *Chiffonnière* is a French term applied to certain low moveable pieces of furniture, serving as closets. They are generally made of an elegant form, and ornamented so as to suit a sitting-room, or even a drawing-room. Since fixed closets are out of fashion, these are particularly useful in small parlours, where they are often placed on the recesses on each side of the chimney, as a substitute for closets and a sideboard, and serve to hold wine, liquors, biscuits, or other refreshments; and on the top, and on a shelf supported by small pillows or brackets, are placed decanters, glasses, or ornaments. In large apartments, as in libraries, ladies' sitting-rooms, and even in drawing-rooms, they are very convenient for holding a number of things that are often wanted; and the top may be ornamented with flowers, vases, ornamental china, minerals, or beautiful objects of art or nature. In drawing-rooms they may be used instead

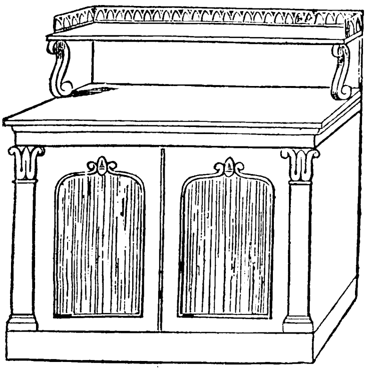


Fig. 245.

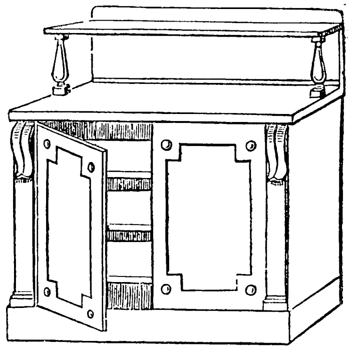


Fig. 246.

of pier-tables. *Figs.* 245 and 46 represent examples of the smaller kind, and *fig.* 247 is one larger for a drawing-room.

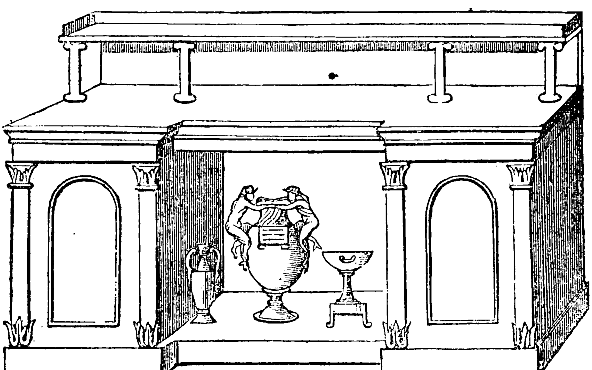


Fig. 247.

1111. *Moving sideboards, or wagon tables, figs.* 248, 249, are useful, when introduced into some convenient part of the dining-room during dinner, for holding various articles that may be wanted, or for placing plates, dishes, &c., upon to be taken away together; these tables being placed on casters to move easily and with no noise. *Figs.* 248 and 249 are usual forms of this piece of furniture.

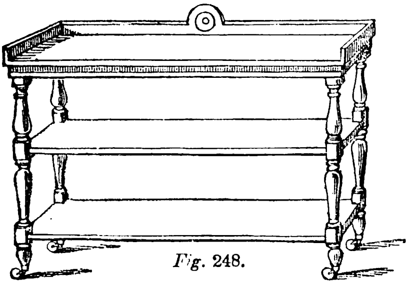


Fig. 248.

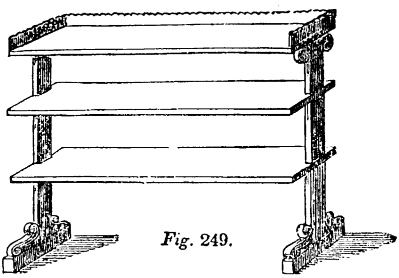


Fig. 249.

1112. *Rising tables, figs.* 250 and 251, are a late improvement. By a particular contrivance in the pillow, which is hollow, the top may be made to separate into three parts, so as to have the advantage of a dumb waiter; and when required to form a simple round table, the upper shelf can be depressed, and the lower one raised, so as to form only one top.

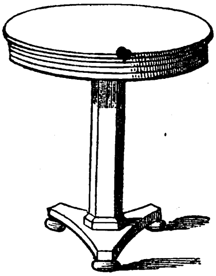


Fig. 250.

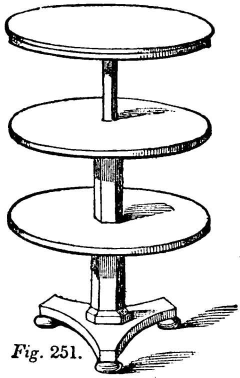


Fig. 251.

Fig. 252 *is a rising wagon-table;* by depressing the upper shelf, and raising the lower one, the whole forms an ordinary side table that may always remain in the room

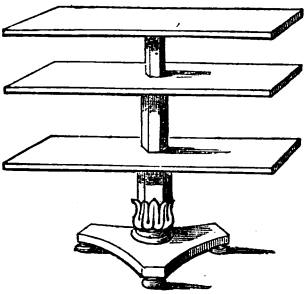


Fig. 252.

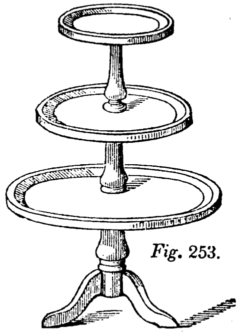


Fig. 253.

1113. *Dumb waiters, fig.* 253, are well known as a piece of furniture formerly much in use, and extremely convenient, but, being now out of fashion, and superseded by the rising tables, is rarely to be procured except at the broker's. The shelves should be made to turn round, which renders them particularly convenient.

1114. *A tray-stand, fig.* 254, formed of two frames and girth to fold up, is useful for supporting a tray during dinner in small apartments. To make this serve as a camp-table, or for pic-nic parties, an additional board may be provided with one leg fixed to it by a hinge to fold. This may be connected with the tray-stand by having two pins to insert into holes in the rail of the stand, with hooks and eyes to keep it fast. This board being of the same width as the stand, may pack up with it conveniently.

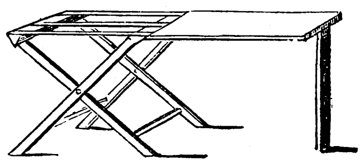


Fig. 254

Sect. VII.—sofas.

1115. *Sofas are articles of furniture that are not merely luxuries: they conduce much to comfort;* and, in our artificial state of society, are sometimes essential to health. The name is derived from *Sophi,* a title given to the Emperor of Persia. The sofa appears to be originally an eastern fashion, probably taken from the divan, which is a part of the floor raised a little above the rest in Turkish and Persian houses, and having a continued seat along the wall, covered with mattresses, about three feet wide. Persons of distinction have this seat covered with scarlet cloth, silk, or other rich stuffs; and there are likewise pillows stuffed with cotton, and covered with similar stuffs, to lean upon. As it is not the custom, in these countries, to use chairs, it is upon these they sit. It may be interesting to remark, by-the-way, that, although the custom we have mentioned is still general, yet we are informed by Mr. Spencer, the late traveller, that some of the Turkish grandees are beginning to evince a preference for European customs and furniture; and, instead of sitting on the ground and eating only with their fingers, are now making use of tables, chairs, knives, forks, and spoons, and furnishing their apartments with costly looking-glasses, chiffoniers, secretaries, chests of drawers,

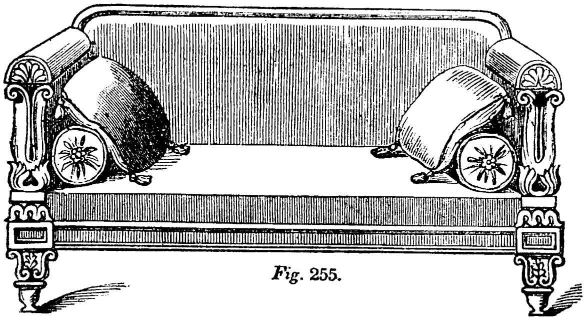


Fig. 255.

&c.; and he suggests, as a profitable speculation, sending cargoes of furniture to Constantinople and other large Turkish towns.

Sofas with us are usually made of mahogany, enriched with carving, and covered with hair cloth, chints, or silk. *Fig.* 255 is a drawing-room sofa in the Grecian style.

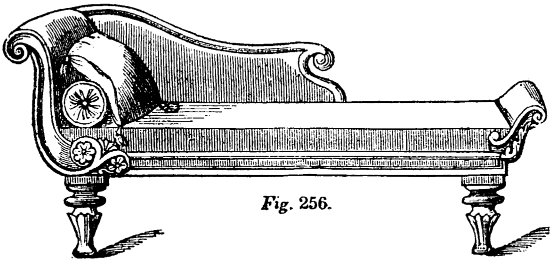


Fig. 256.

Fig. 256 is a couch sofa, which is somewhat less expensive.

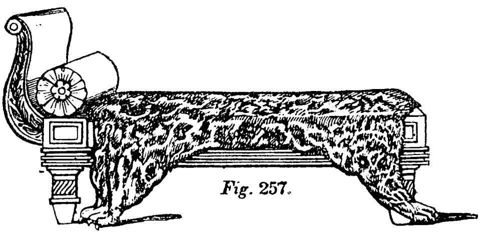


Fig. 257.

Fig. 257 is one in the antique style, where a leopard's skin is used as a cover.

Figs. 258 and 259 are modern French *settees.*

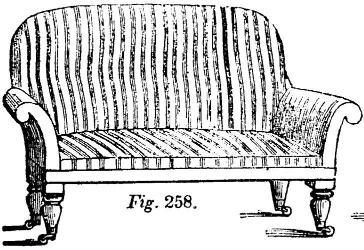


Fig. 258.

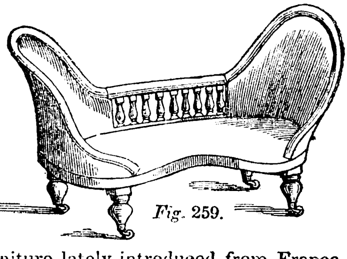


Fig. 259.

1116. *Figs.* 260 and 261 are pieces of furniture lately introduced from France, and called *conversation chairs*. They are made to hold only two persons.

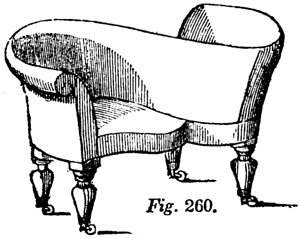


Fig. 260.

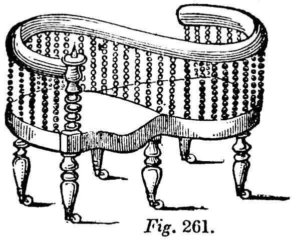


Fig. 261.

1117. *Ottomans* are stuffed seats placed along the walls in the Turkish manner, as in *fig*. 262, or they may be insulated, and placed in any part of the room, as in *fig*. 263. They are found extremely agreeable and convenient, and help to break the formality of the more important furniture. They are particularly useful in picture galleries, music-rooms, ante-rooms, &c.

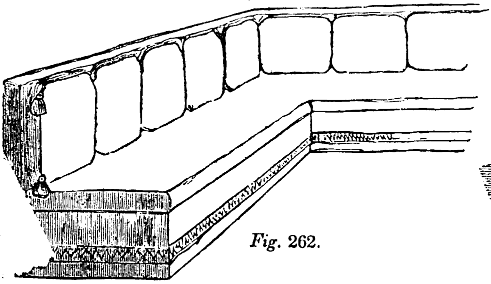


Fig. 262.

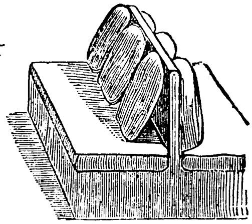


Fig. 263.

SECT. VIII.—CHAIRS AND SEATS.

1118. Scarcely any article of furniture has undergone so many changes, and admits of such variety of forms, as chairs. The use of a chair being for a seat, there are certain principles which should regulate its form, though these have been frequently ill understood, or interfered with by the fashion of the day. Independently of the elegance, the forms of chairs, on which depends the easiness of the seat, may not be an object of great consideration to persons who sit but little ; but to those who are in the habit of sitting for many hours at a time, it is of the first importance that the shape of the chair be such that the weight of the body may not press unequally upon it. These principles appear to have been well understood by the ancient Egyptians and Greeks, since the forms of their chairs were simple, but admirably adapted to their purpose.

1119. *The French artists, with Mr. Hope, in copying or imitating the antique style*, produced some of the best chairs, the forms of which are still retained, or have given hints for the most perfect now in use.

Figs. 264, 265, 266, 267, 268, 269, 270, 271, 272 are chairs in the antique style.

Figs. 264, 265, 266, 267 are from the designs of the late Mr. Hope, and are remarkable for their graceful shapes, and the comfort which they afford. The last five are arm-chairs. *Figs*. 264, 266, and 267 have been much imitated for parlour chairs, and in some respects improved upon.

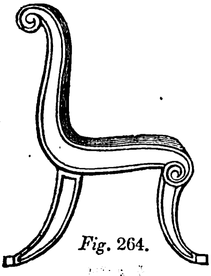


Fig. 264.

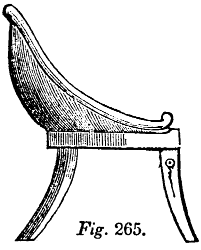


Fig. 265.

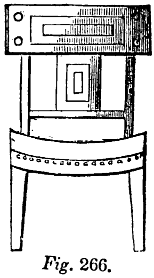


Fig. 266.

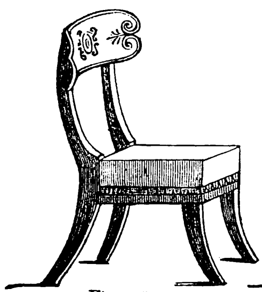


Fig. 267.

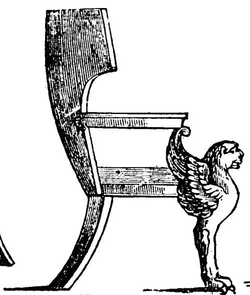


Fig. 268.

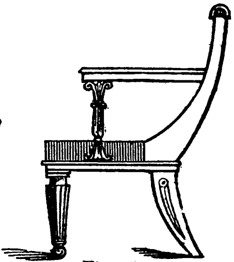
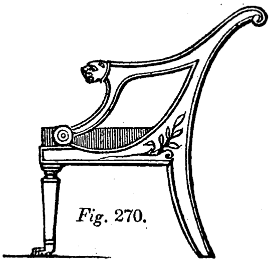


Fig. 269.



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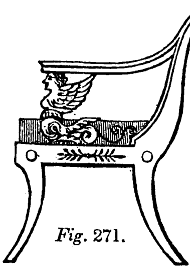


Fig. 271.

Fig. 272.

Fig. 273 is a group of furniture in the antique style from Mr. Hope's design.

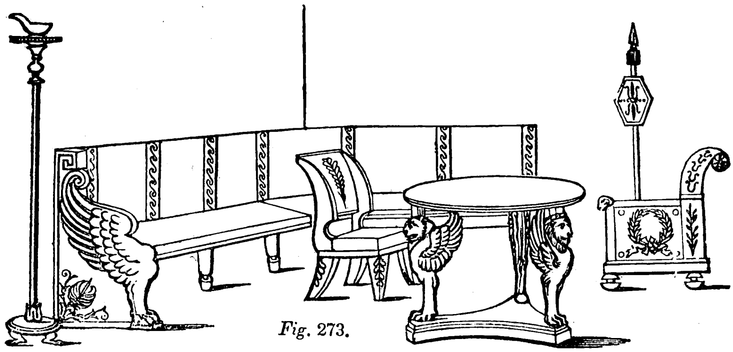


Fig. 273.

1120. *Chairs judiciously designed should have* few sharp angles or straight lines, but should exhibit graceful curves, affording easy backs to lean against with, firm feet; and, in general, should be too heavy to lift and move about easily.

1121. *The seats of chairs* are generally stuffed with horse hair, or are made of split cane woven, or of rushes. In purchasing chairs it is necessary to ascertain whether the stuffing is really done with horse hair, as hair of very inferior kinds is frequently substituted, and sometimes it is mixed with wool, or even straw. The framing is also sometimes done with unseasoned wood, and becomes loose and rickety, on shrinking, by drying. It is therefore generally bad policy to purchase those that are offered on very low terms, as there is usually some imperfection.

1122. *In the cheapest kinds of chairs the legs* are held together by cross bars and rails; but in the best chairs these are omitted, the stoutness of the materials and goodness of the workmanship permitting the legs to be sufficiently strong without.

It is the custom to ornament the front legs of chairs by mouldings, and sometimes carving is added, whereas the back legs are plain. Some have objected to this difference, but it appears justified for several reasons. The front legs of mahogany chairs are usually made straight, as they are found inconvenient when curved, and when straight mouldings can be turned upon them by the lathe at a cheap rate; whereas the back legs, being curved, that the chair may stand firmer, cannot easily be turned, and carving on them would scarcely be seen: nor does there appear to be any reason why the front and back legs, being so different in shape, should be ornamented in the same manner, good taste requiring that labour shall not be thrown away. In light chairs for the drawing-room the front legs, as well as the back ones, are generally curved and decorated with mouldings, but they are usually made of woods that can be bent after they are turned, which mahogany does not admit of.

1123. *It will be most convenient to class chairs* according to the apartments in which they are placed; since this regulates not only their forms and style, but likewise the materials of which they are made.

1124. *Parlour chairs* are almost always made of mahogany, frequently French polished, with the seats stuffed with horse hair, and covered with morocco leather, plain or tufted, red, green, or blue, or with hair cloth. They should have little carving, should be of solid construction, and of forms agreeable to handle and move. The backs should not be too upright, but should be curved, and slope back, to afford an easy position to the body.

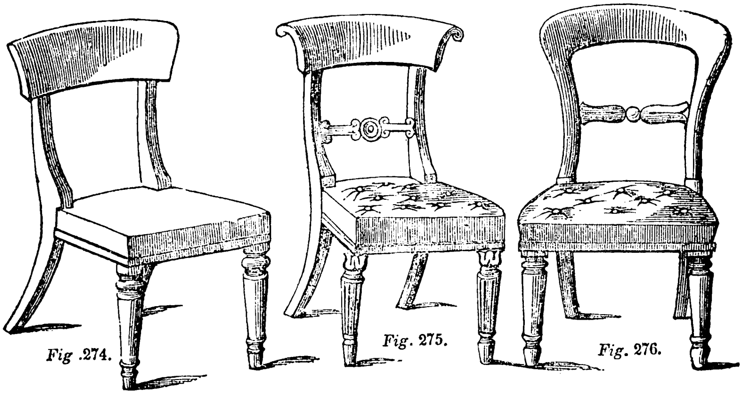


Fig. 274. *Fig.* 275. *Fig.* 276.

Figs. 274, 275, 276, 277, 278 are some of the most approved forms now in use. They should rather be a little massy and heavy than light. Those which are ill made and cheap are apt to break down when leaned upon, an accident not unattended with serious danger. Some have the backs stuffed in part.

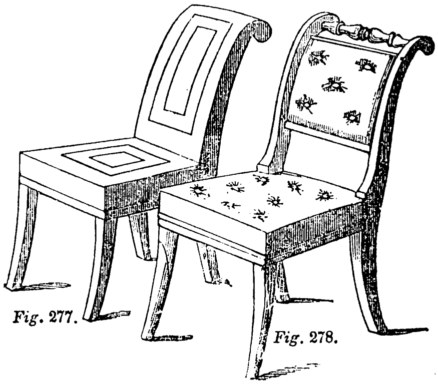


Fig. 277. *Fig.* 278.

1125. *Easy or arm chairs—Fauteuils.* Much pains and invention have been bestowed in contriving the forms that give the greatest degree of repose and support to the body in easy chairs; and this is not to be considered as mere luxury, since it is really of great importance that, after fatigue, the most perfect rest shall be enjoyed, as well as where delicate health demands indulgence. At the principal upholsterers a great variety of these may generally be seen, distinguished sometimes by the names of the inventors.

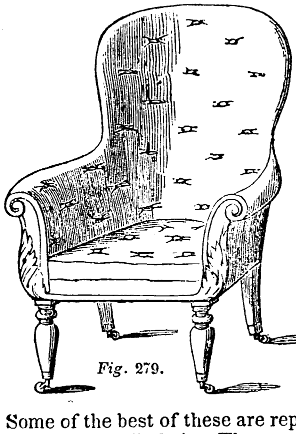


Fig. 279.

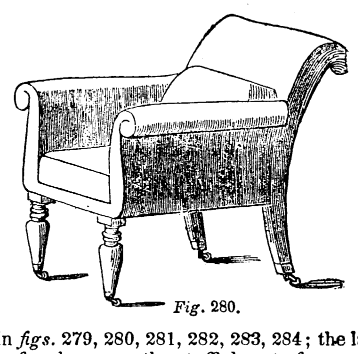


Fig. 280.

Some of the best of these are represented in *figs.* 279, 280, 281, 282, 283, 284; the last is called the shell chair. They are generally of mahogany; the stuffed part of morocco

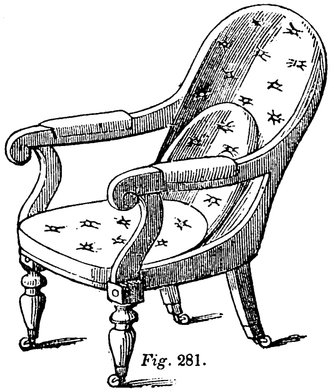


Fig. 281.

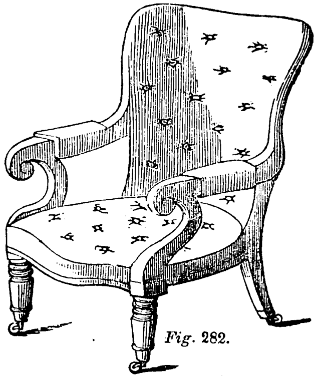


Fig. 282.

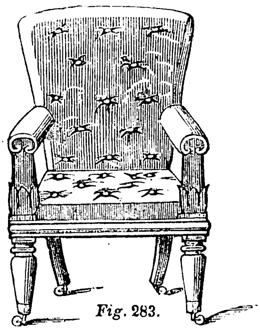


Fig. 283.

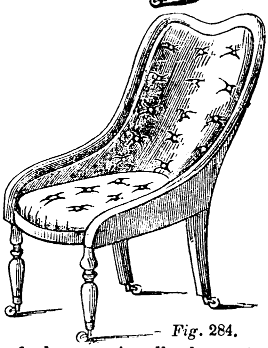


Fig. 284.

leather, filled with the best horse hair, and tufted: occasionally the seats contain spiral steel springs for greater elasticity.

1126. *Drawing-room chairs.* *Figs.* 285, 286, 287, 288, 289, 290 admit of more carving and other ornaments than those for the parlour, and they are made of a lighter construction. Mahogany is sometimes the material; but now more frequently satin-wood, rose-wood, tulip, and other rare woods. Sometimes also they are beautifully japanned, or painted and gilded. The seats are covered with rich silk, and flowered satins, painted velvets, superfine cloth, worsted worked, or chints, and at present it is the fashion to go to considerable expense in these chairs, when of the ornamental kind. Mixed with the more massy drawing-room chairs, it is now the custom to have a variety of others of a much simpler kind, and extremely light, usually termed *conversation* or *gossiping* chairs. These have the seats mostly of split cane or of rush. *Fig.* 291 is a chair of this kind of a French pattern: *fig.* 292 is Italian: *figs.* 293 and 294 are Swiss forms. Occasionally, some drawing-room chairs have the seats very low and the backs high; in short, more whim and caprice is shown in chairs than in any other article of furniture.

1127. *Library chairs* vary much with the taste and habits of the possessor, but have usually the plainness and solidity of those of the parlour or eating-room.

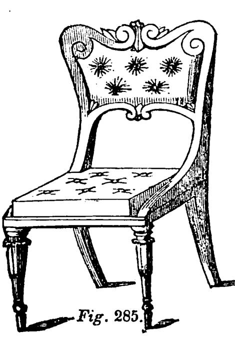


Fig. 285.

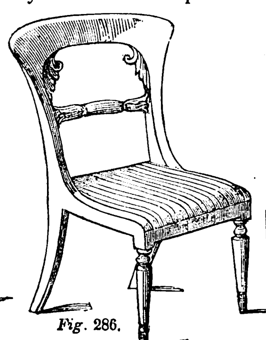


Fig. 286.

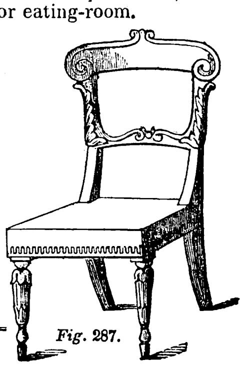


Fig. 287.

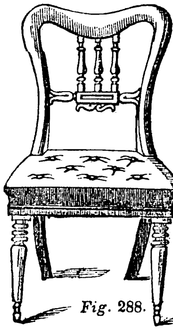


Fig. 288.

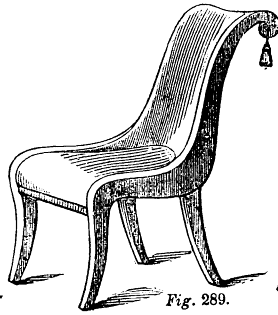


Fig. 289.

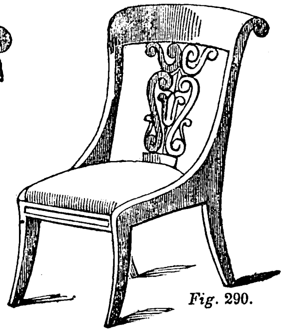


Fig. 290.

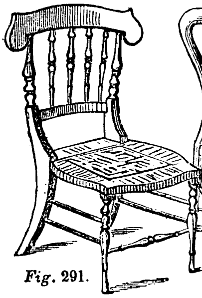


Fig. 291.

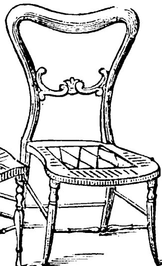


Fig. 292.

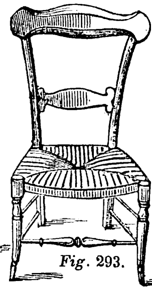


Fig. 293.

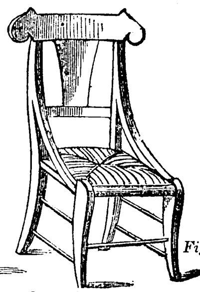


Fig. 294

Figs. 295 and 296 are library or *summer chairs*, with cane back and seats.

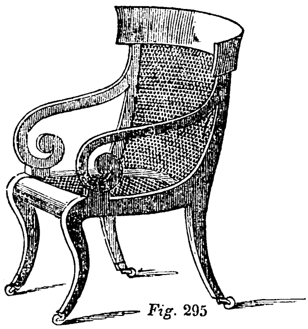


Fig. 295

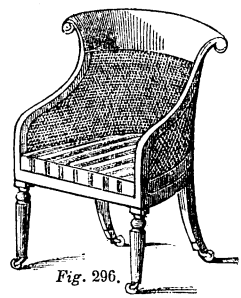


Fig. 296.

Fig. 297 is called by upholsterers the *classical chair:* it is useful in the library, and possesses the advantage by the seat being made to revolve; the person sitting in it

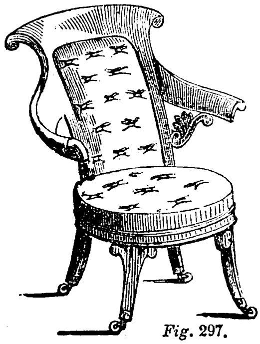


Fig. 297.

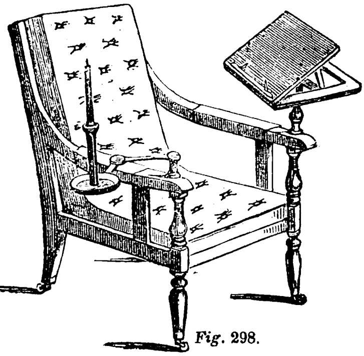


Fig. 298.

may very easily turn himself round to speak to any one without shifting the place of his chair.

Fig. 298 is a *reading chair*, furnished with a stand for a candle and desk for a book.

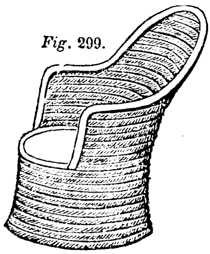


Fig. 299.

1128. *The beehive chair, fig.* 299, made of straw, has been long used in Wales and Scotland, as well as in some places in the north of England ; but it is only of late that they have appeared among our fashionable furniture. They are, however, warm and cheap, and are admired by some persons for their simple, homely, and snug appearance.

1129. *Figs.* 300, 301, 302, 303 *are examples of the so-called Elizabethan or Flemish chairs*, at present brought so much into fashion again. Some of them are remarkable for their high backs and low seats. The chairs are formed of oak or ebony, and the backs and seats of cane are stuffed and covered with rich silks, as damasks, tabarets, &c., or figured velvets, and sometimes ornamented with embroidery and fringes. In general, they had cross bars to strengthen the legs, although at present these are frequently omitted.

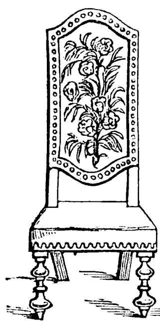


Fig. 300.

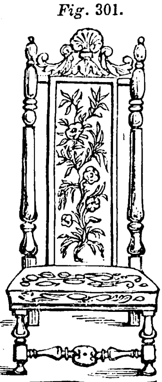


Fig. 301.

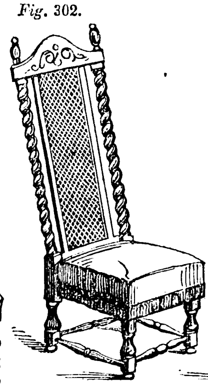


Fig. 302.

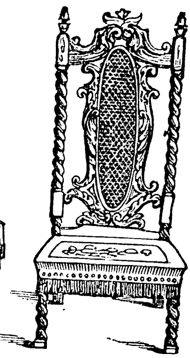


Fig. 303.

1130. *Figs.* 304, 305, 306 are chairs in the same style, but with the backs lower Some of these are ornamented with a profusion of rich carving.

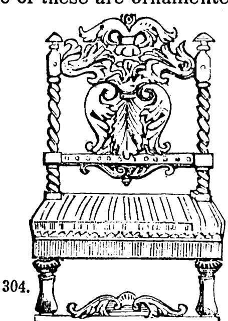


Fig. 304.

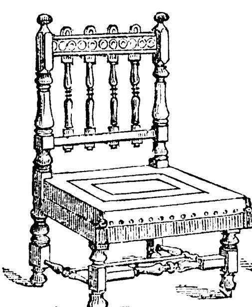


Fig. 305.

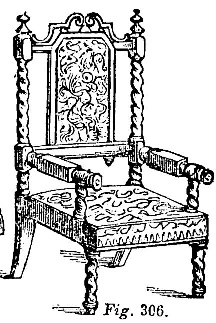


Fig. 306.

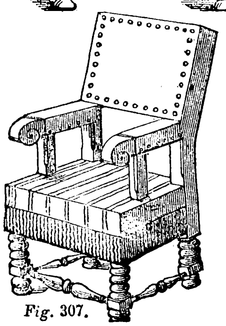


Fig. 307.

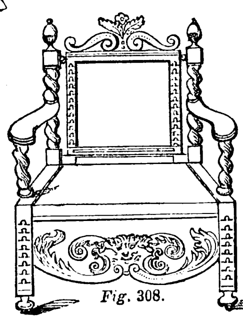


Fig. 308.

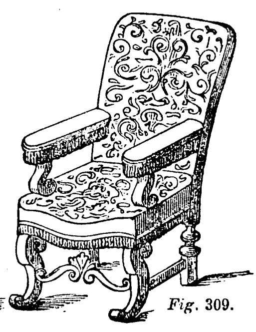


Fig. 309.

1131. *Fig* 308 is an arm-chair of the same kind, the back and seat covered with red leather. *Fig*. 307 is a plainer chair, the back covered with stamped leather, put on with large brass-headed nails, the seat of striped stuff. *Fig*. 309 is a rich arm-chair of the time of James I., gilded, and covered with rich damask and fringe.

1132. *Fig*. 310 is the top of one of these chairs, to show the style of the carving more plainly.

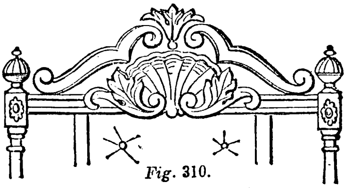


Fig. 310.

1133. We omit chairs *in the Gothic style*, as they are never used, except the house itself be in the same style; and we may observe that this style is, in general, very ill adapted for domestic furniture, and except it be designed by artists of great taste, and who are very well acquainted with Gothic architecture, and what little remains of ancient furniture, attempts at imitation are generally very miserable, besides being extremely expensive.

1134. *Figs*. 311, 312, 313, 314 are chairs in the *style of Louis XIV*. In these, frequently, a great part of the chairs is gilded, and the seats and backs covered with rich silks, figured stuffs, and velvets.

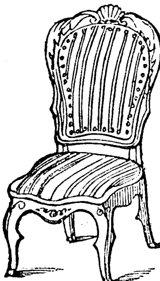


Fig. 311.

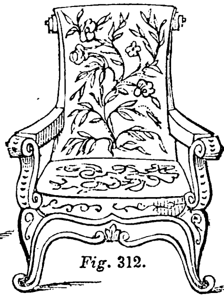


Fig. 312.

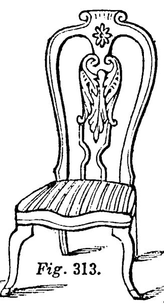


Fig. 313.

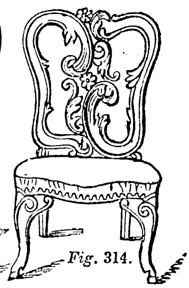


Fig. 314.

1135. *Drawing-room seats*, of a detached kind, are useful, in addition to the usual sofas and chairs, to place in any part of the room, for two persons to converse, or for similar uses. *Figs*. 315, 316, 317, 318, 319, are fashionable forms in the antique style. *Figs*. 316, 317, 318, and 319, sometimes called X-seats, may be of cast iron, or may contain a slight iron bar in the middle of the mahogany legs to strengthen them.

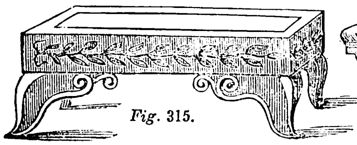


Fig. 315.

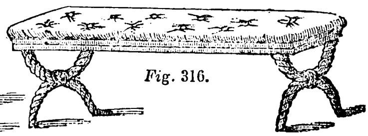
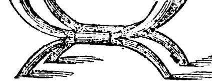


Fig. 316.

Fig. 317.


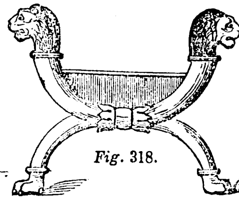
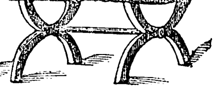


Fig. 318.

Fig. 319.


1136. *Music-stools* are made to raise or lower by means of a screw in the stem, *figs*. 320, 321.

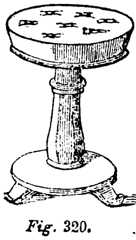


Fig. 320.

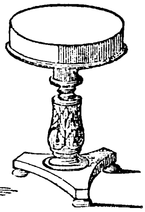


Fig. 321.

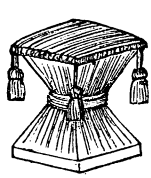


Fig. 322.

1137. *Figs.* 322, 323 are stools of a simple kind. *Fig.* 323 is a stool that generally forms a box, the lid of which is the seat; and it is often adorned with embroidery.

1138. *Footstools* are likewise necessary pieces of furniture, particularly where there is nursing of children: they are of many kinds. *Figs.* 324, 325, a usual form for the drawing-room; and *fig.* 325 is called an Ottoman footstool.

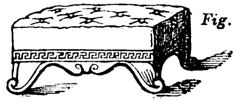


Fig. 324.

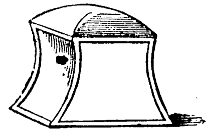


Fig. 323.

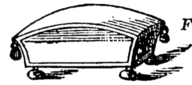


Fig. 325.

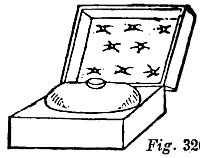


Fig. 326.

1139. *French foot-warmer.* This is a box containing a tin vessel, in which hot water is put, being carefully wadded round to keep in the heat; the lid is also wadded, *fig.* 326. This will keep warm some hours when shut, and is very useful to keep the feet on, when occasion requires it.

Sect. IX.—bookcases, bookstands, and writing-desks.

1140. *Bookcases.* The most economical bookcases are simple shelves, filling up the side of a room, or a recess in it. When bookcases are detached pieces of furniture, and large, they are usually made with the lower part deeper, for folios and other large books, as in *fig.* 327; and this part may be shut up with close doors, one part containing drawers for prints or portfolios, or shelves for folio books. The projection of this lower part serves as a shelf to rest books upon. The upper part is generally fitted up with shelves to contain books of the quarto, octavo, and smaller sizes. There is usually more or less of architectural style in the design and ornament; though much of this should be avoided, and a plainer style, or one agreeing more in richness with the rest of the furniture, should be introduced in preference. The shelves should be made moveable, so as to be fixed at various distances from each other, according to the sizes of the books, which should be so arranged as to fill up the space nearly. A few wooden false books are useful to supply the place of those which are taken out, to prevent the rest from falling. In the country, bookcases may do very well without glazed doors, or with doors having only wire-work to secure the books; but in the large cities of Britain, close doors are indispensable, if it is desired to preserve the books from smoke and dust, which prove extremely destructive to them in the course of a few years. The wire-

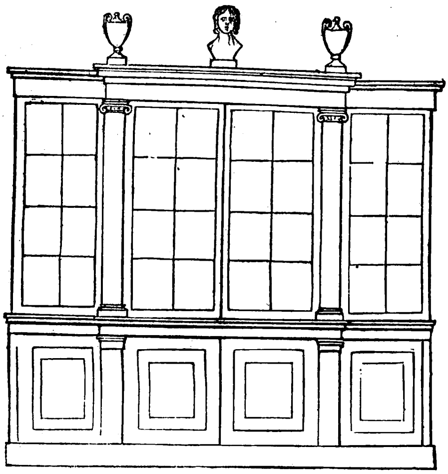


Fig. 327.

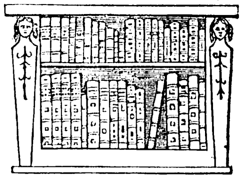


Fig. 329.

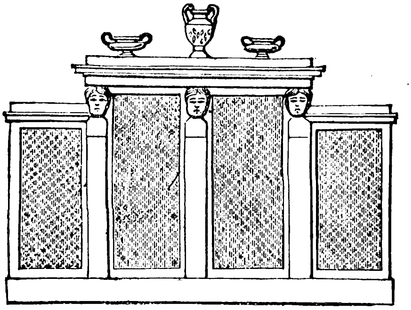


Fig. 328.

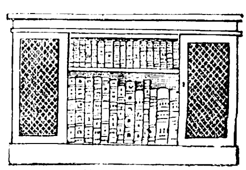


Fig. 330.

work, with silk behind, preserves the books, but it has the inconvenience of not allowing us to see the titles without opening the doors. *Fig*. 327 is of the kind called by the upholsterers a winged bookcase. *Fig*. 328 is a lower bookcase, termed a *dwarf bookcase*, which is convenient when the room is low, or where it is wished to have all the books easily accessible. *Fig*. 329 is *a small pier bookcase*, to put between windows in the manner of a pier table; or a place for books may form part of a chiffonnière. *Fig*. 330 is one of a similar kind, but with cabinets for minerals, coins, &c., forming a part of it. *Fig*. 331 is *a small bookcase* for a ladies' room. *Figs*. 332 and 333

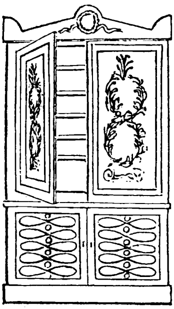


Fig. 331.

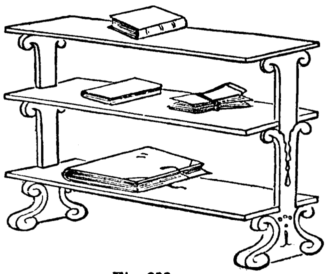


Fig. 332.

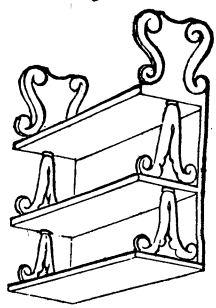


Fig. 333.

are *moveable bookshelves* on casters, very convenient in a library. *Fig*. 334 are the *well-known simple bookshelves*, consisting of a few boards and string, which serves well for a nursery, &c.

1141. *Bookstands* are useful articles of furniture, in tending to prevent the injuries which books are liable to receive if laid loose on the tables. They may be made in a great variety of forms and sizes, according to the particular views and wants of individuals. *Fig*. 335 is a very simple bookstand for placing on a table to hold a few books to be referred to. It should not be so large as to be too heavy to be easily lifted by the two handles; or, if made larger, it may be placed upon a stand with castors. *Fig*. 336 is one of more elegant construction, commonly placed upon drawing-room tables. The drawer serves to hold letters, cards, or other papers. *Fig*. 337 is a very convenient kind of bookstand for authors who have occasion to consult a number of books at the same time; the books are placed upon the face of a low conical wheel, and kept open by little brass fasteners, as in music-stands; and, as this wheel may be turned round upon its stand by the least touch, it is easy to refer to the several books without lifting them from their places.

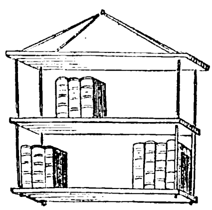


Fig. 334.

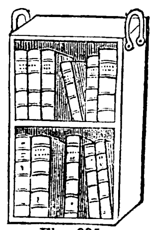


Fig. 335.

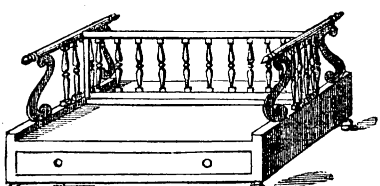


Fig. 336.

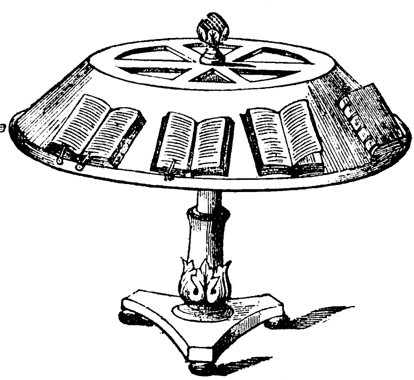


Fig. 337.

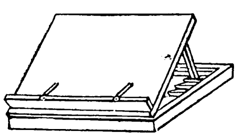


Fig. 338.

1141. *The reading-desk*, *fig*. 338, is made to place upon a table, and may be raised to any required angle by a frame and rack. Two leaf-holders, of brass, are made to turn upon the edge of the stop lath, for keeping the book open. Another variety is repre-

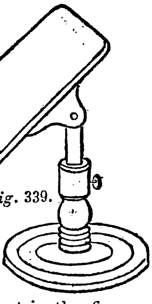


Fig. 339.

sented by *fig.* 339, which may be elevated or lowered, as well as raised to any angle. This is a very convenient invention for the purpose.

1142. *A portfolio stand, fig.* 340, is particularly useful where prints or drawings are kept in portfolios: by laying the portfolio flat on a table, frequently the contents receive injury. The flat piece at the bottom of the portfolio is made to fold up when the stand is closed to put away, and there is a contrivance to prevent its opening too far. There are various forms of it; but that in the figure is the simplest.

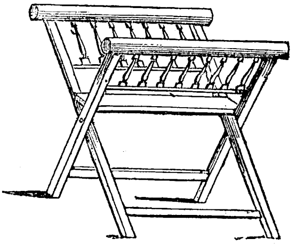


Fig. 340.

1143. *Library steps* are necessary to raise any person so as to reach books at the top of the bookcases. They are sometimes made to close together and imitate some piece of furniture when not in use.

1144. *Writing-tables* and *writing-desks.* The French terms of *bureau*, *escritoires*, and *secrétaires*, are synonymous for these useful pieces of furniture; and our best contrivances of this kind have been originally borrowed from our neighbours. *Fig.* 341 is the well-known bureau, which is now seldom to be found, except at the broker's, but was, not long ago, in very general use, frequently with a neat bookcase over it, and was very convenient, and by no means inelegant, though at present out of fashion The

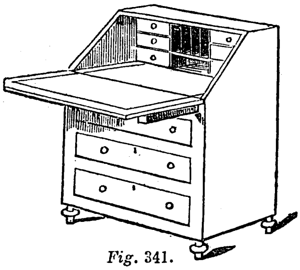


Fig. 341.

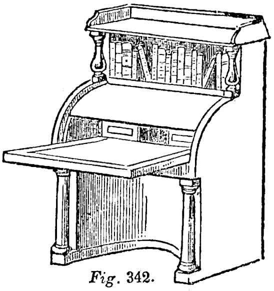


Fig. 342.

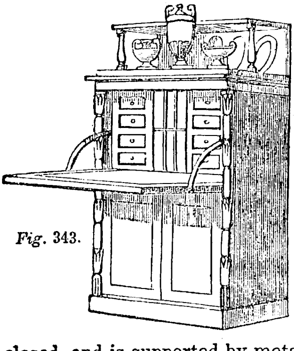
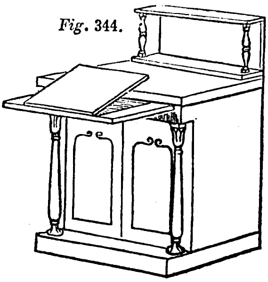


Fig. 343.

flap for writing upon is made to fall down, and is supported by two runners below that draw out; and within are various small drawers and cells for papers. The large drawers serve as an ordinary chest of drawers. It would seem that the sloping appearance of the flap had been objected to; for we find various contrivances to get rid of this. One is *fig.* 342, in which the small drawers and cells are concealed by a cover made of a number of slips of mahogany, so connected that they draw down in the form of the quarter of a cylinder; and the writing part is made to draw out straight. It may be farther decorated with a place above for books, or for various ornamental things, and the front with columns, consols, &c. *Fig.* 343 is an article of this kind in very general use in France, made to project less into the room; the writing flap goes up perpendicularly, forming part of the front when closed, and is supported by metal quadrants or other contrivances.

Fig. 344 is a writing-table calculated for a ladies' apartment, in which the writing part consists of a shelf that pulls out, having upon it a leaf that lifts up, and may be made to rest upon the table-top, which may be of marble; this will give the necessary slope for writing. The body may contain drawers concealed by folding-doors, or shelves serving as a chiffonnière, or be filled up in any other mode that may be wished for. *Fig.* 345 is a contrivance now much used for writing on, called a *Devonport*, from the name of the inventor. It consists of a desk placed upon a pedestal filled with drawers. The desk is of the same width and depth as the pedestal; but is made to slide forward, when to be written upon, in the manner shown in the wood-cut, to give room for the knees. A sliding shelf may draw out at the side, to hold papers or other things; and over that is an inkstand that turns out and shuts in by a hinge at one end. The desk is covered with leather, and has a fence round the top; the drawers are placed at the end instead of the front, for the convenience of being got at when one is writing.

Fig. 344.



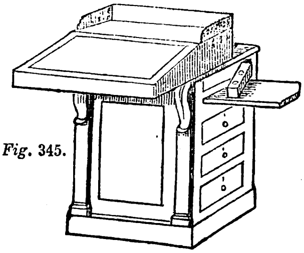


Fig. 345.

For those who wish to stand while they write, a desk is made, as in *fig.* 346; or in a

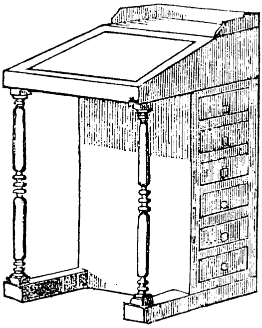


Fig. 346.

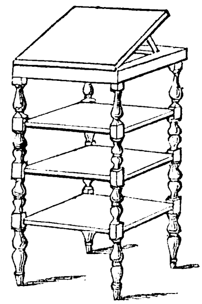


Fig. 347.

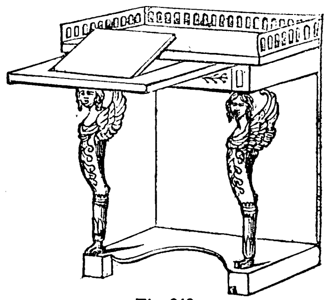
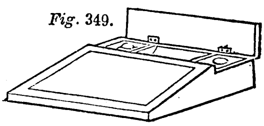


Fig. 348.

less expensive form, as in *fig.* 347, which is a *what not*, with a rising flap. *Fig.* 348 is a writing-stand for a lady's boudoir.

The small writing-desks to place on a common table, *fig.* 349, are too well known to need description.

Fig. 349.

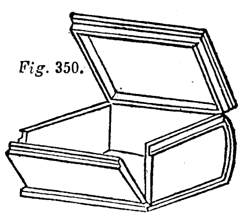


Care should be taken to choose a proper situation for writing-tables or desks, with respect to the light, which should come in from the left.

1145. *The preservation and arrangement of papers* is an affair of great importance, which, when neglected, often occasion great trouble and anxiety, and which might be obviated by a little method.

1146. *Rumford* or *pamphlet cases*, *fig.* 350, are extremely convenient for holding papers, as they may be placed on shelves like books, and labelled on the back. They are usually procured from the bookbinder, are sometimes made of pasteboard, and bound to look like books; but a cheaper kind, quite as good, is made of thin wood. A cheap substitute may be easily made by small portfolios, with linen or cotton guards to keep out the dust. *Receipts* are best fixed on the leaves of a blank paper book, with a little gum, exactly in the order in which they are received, instead of tying them up in bundles, as they often are, in which it is difficult to find one. The drawers of a library-table afford places for arranging papers, or for keeping them in small portfolios. For this purpose, the fronts of the drawers may be made to let down in the manner of a pianoforte, to get at the papers more easily.

Fig. 350.



1147. *A small pedestal case*, with shelves or drawers within, *fig.* 351, will be useful, where there is no library-table, for keeping papers in Rumford cases, or in folios. When persons have acquired a taste for arrangement (a very useful one), many similar methods may be contrived, in which facility of reference should form a principal feature. A little money will be judiciously laid out in having proper conveniences for arranging and preserving papers.

1148. *Fire-proof closets and boxes.* The principle upon which these should be constructed is, that they should be made of such materials as are not only incombustible, but as little as possible capable of being heated. Metals are not combustible by ordinary fires; but, as they are susceptible of being made extremely hot, they are not proper for this purpose. If the joints are not perfectly close, so as perfectly

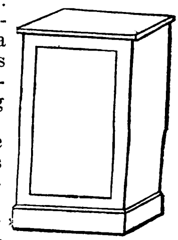


Fig. 351.

to exclude the external air, papers and other inflammable substances will be burned and consumed in them in case of a fire; and, should the joints be quite tight, papers in them will at least be charred and rendered useless. By referring to our Section "On Heat," the nature of the subject will be understood; and it will be seen that brick, soft stone, layers of pumice, charcoal, and other porous substances, are the best non-conductors of heat. Fire-proof boxes should, therefore, be constructed of these materials, which may be cased with sheet-iron merely to keep them together. Air is, as we have shown, a good non-conductor; therefore, two boxes of non-conducting materials, with an empty space of a few inches between them, will be far safer than any single box. The inner box should rest upon pieces of pumice, and should not touch the external one anywhere; or the space between the two boxes should be filled with pumice. No one unacquainted with these philosophical principles should be intrusted with the construction of a fire-proof closet or box

Sect. X.—SCREENS.

1149. *Folding screens*, *fig*. 352, to keep off draughts of cold air, seem to be of Chinese or Japanese origin, if we may judge from the paintings with which they used to be decorated. They are now little used, since the finishing of our houses has been so much improved. Still, there are cases where they are found to add much to comfort, particularly in defending those who are obliged to sit between the door and the fire, where there is always more or less of a current of air. These are to turn the direction of this current, for they can have no effect in destroying it. They have sometimes peculiar hinges, by which they can be folded both ways.

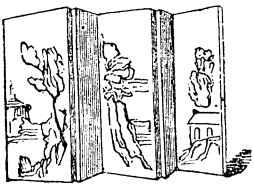


Fig. 352.

1150. *Fire screens* are very necessary where open fires are used, and in England they always form a part of the furniture. In dining-rooms they are particularly wanted for those who sit with their backs to the fire; and various contrivances have been made to prevent the unpleasant effects of this situation. The simplest, and one that frequently answers the purpose, is a flat mat worked of willow, that is hung on the back of each chair requiring such a defence, *fig*. 353.

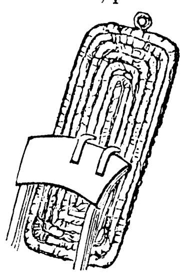


Fig. 353.

1151. *A cheval fire screen* is one made of mahogany, filled in with moreen and other materials, *fig*. 354, and made to slide up in the stand.

Another variety, *fig*. 355, is made to be increased both in width and height by additional sliding pieces.

1152. *Fire screens for drawing-rooms* are less wanted than formerly, since, from the great improvements in chimney fireplaces, it is not so necessary to sit very near the

Fig. 354.

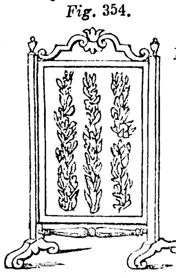
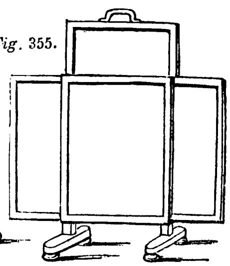


Fig. 355.



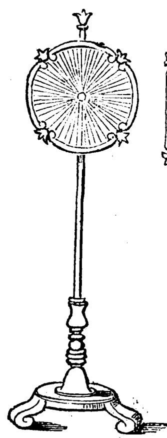


Fig. 356.

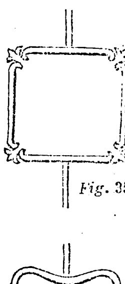


Fig. 357.

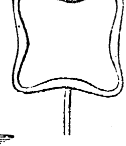


Fig. 358.

Fig. 359.

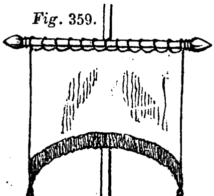
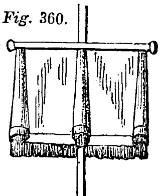


Fig. 360.



fire. When they are employed, they are made light and elegant, and are generally only large enough to screen the face. *Figs*. 356, 357, 358 are examples of forms in common use, which may be of mahogany, the screen covered with silk, paintings, &c. *Figs.* 359, 360 are very simple screens made by suspending a piece of silk on a brass or wooden rod. It is requisite that the base of all fire screens should be strong and solid, as well as somewhat heavy, that they may not easily overset.

1153. *That a pane of glass should form a fire screen is a remarkable fact.* It appears that, although the heating rays, as well as the light of the sun, can readily pass through glass, as is evident from green-houses and ordinary windows, yet the calorific rays from the fire are almost entirely stopped by glass. On this principle, a piece of window or plate glass can form a fire screen by enclosing it in a frame; and this is both agreeable and convenient, since the fire may be seen through it. The only inconvenience is its liability to be broken.

Sect. XI.—sculpture, paintings, etc.

1154. There are few houses where some other objects are not collected to decorate the apartments besides the mere furniture. Pictures, statues, bas-reliefs, vases, porcelain, minerals, flowers, even toys of various kinds, are introduced; and their selection distinguishes, in some measure, the taste and judgment of the possessors. The desire for being surrounded by objects of interest is both natural and useful, provided it be kept within due bounds. It has been remarked that uncivilized nations, and almost the poorest among civilized people, have more or less of this taste for decoration; and to it we owe many of the most valuable arts. When the inhabitant of the humble cottage in any country is seen to adorn his dwelling with works of art, even of the lowest kind, we may be sure that he possesses the germes of some good feeling capable of being cultivated. While the wealthy procure genuine pictures and sculpture of the best kind, those in middling circumstances may easily obtain works of great merit at a much smaller expense.

1155. *When sculpture, instead of being insulated, is attached to a surface,* it is termed *alto-relievo,* and *basso-relievo;* or alto-relief, and bas-relief. The first is, when the figures project from the wall at least half their thickness; and when the projection is less, it is bas-relief. This kind of sculpture is frequently employed in friezes, chimney pieces, and other parts near to the eye; but it seldom has a good effect, or is lost and thrown away when placed too high, as may be seen in several of our public buildings erected by architects of reputation. A considerable objection to the use of much sculpture in the decoration of rooms is the dust which it collects, and which cannot be frequently cleared away without injuring the carving. Painting, on this account, has some advantages over reliefs. The ancients have left us many exquisite specimens of bas-reliefs, both in marble and terra cotta; and many of great merit have also been executed by modern sculptors.

1156. *Plaster casts of fine sculpture* are scarcely inferior, in some of the most valuable qualities, to the original marble, and may be rendered durable by easy processes: they may be hardened, painted, varnished, or bronzed.

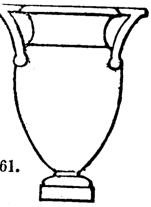
1157. *Much modern sculpture in alabaster is brought* from Florence, consisting chiefly of small figures and vases, which must be kept under glass; but the greater part of it is of very ordinary, if not inferior workmanship, and is chiefly striking for the beauty of the material, or the elaborate pierced carving. Abundance of small figures in terra cotta, or other materials, are produced by some of our own sculptors too little known; some of these have infinitely more merit as works of art, and deserve places in our best apartments.

1158. *Carvings in ivory* are often extremely valuable, and require particular care to preserve them. When exposed to the air unprotected, and kept from the sun, they become discoloured, and covered with a multitude of minute cracks; but if they are kept under glass they are not liable to this change. The cracks cannot easily be remedied; but when they have occurred, the ivory should be brushed with warm water and soap, to get out the dust that may have insinuated itself into the cracks. Exposing the ivory to the sun's rays for some time under glass will bleach them in some degree: but this may be done effectually by a cautious use of chlorine.

1159. *Ornamental vases.* As these are very frequently employed to decorate apartments, it is proper that some attention should be paid to the style of those which are selected for this purpose, since this is frequently thought to afford some indication of the possessor's taste. In no circumstance is the superiority of some of the ancient nations, particularly the Greeks, more strikingly exhibited than in the beautiful and varied forms of their vases; and although the moderns have carried some branches of the fine arts to a high degree of perfection, yet they have failed in inventing designs for vases which can bear a comparison with the antique. The germes of this fine taste are discoverable in the Egyptian and Etruscan vases, which were copied and im proved upon by the Greeks, who have left us the most splendid and perfect specimens

Athens, at one time, took the lead in the manufacture of earthenware vases; but the potteries of Samos soon rose into great repute, and, with those of Saguntum in Spain, and one or two towns in Italy, furnished the chief supply. They were formed of the purest clay, and were distinguished by their extreme lightness. To rendei them impervious, instead of a glaze they were covered with a varnish of bitumen, which admitted of a fine polish, and was, besides, very durable.

1160. *Fine examples of Egyptian and Etruscan vases*, made of earthenware, may be seen in the British Museum, of which *figs*. 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, are copies. *Fig*. 365 is a large Etruscar vase richly painted with black fig ures on the red ground peculiar to that ware.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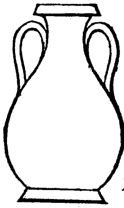
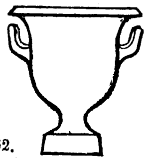


Fig. 362.

Fig. 363.


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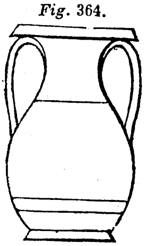
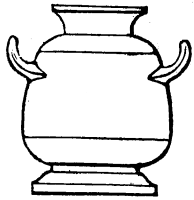
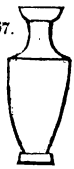



Fig. 365.

Fig. 366.
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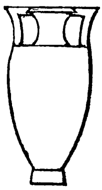


Fig. 368.

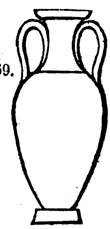


Fig. 369.

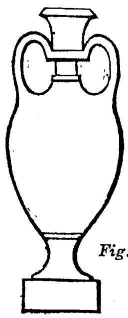


Fig. 370.

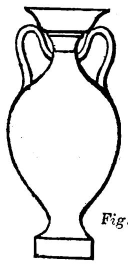


Fig. 371

1161. *Figs*. 372, 373, 374, 375, 376, 377, 378, 379, 380, *are Greek vases of marble*

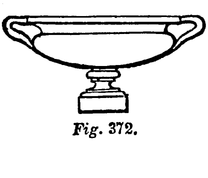


Fig. 372.

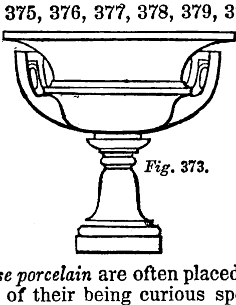


Fig. 373.

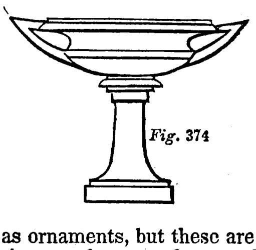


Fig. 374

1162. *Large jars of Chinese porcelain* are often placed as ornaments, but these are interesting more on account of their being curious specimens of a manufacture than from the taste displayed in them. The Florentine alabaster vases have been already alluded to, when speaking of sculpture.

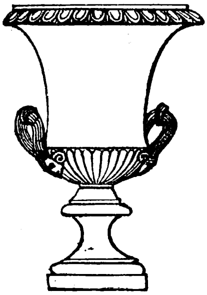
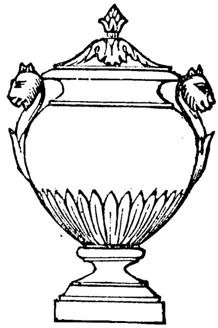


Fig. 375.

Fig. 376.



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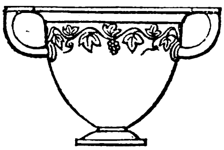


Fig. 378.

Fig. 379.

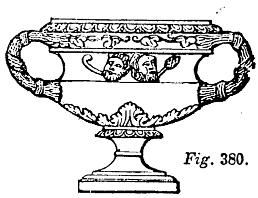


Fig. 380.

1163. *Vases of fluor spar* from Derbyshire are extremely beautiful. M. de Rozière wrote, some years ago, an interesting work to prove that it was of this substance the famous *Murrhine* vases of the ancients, so highly prized, were made; and there really appears much weight in his arguments, this substance agreeing with the ancient description more nearly than any other known material.

1164. *Paintings and drawings* form some of the most desirable ornaments of our apartments on many accounts. Oil pictures demand gilt frames; drawings do very well in frames of various elegant woods. The hanging of pictures properly requires judgment, and much depends upon the direction of the light that comes on them. A side light is the best, and the worst is fronting a window, as the gloss of the varnish forms a sort of mirror, in consequence of which they cannot be seen except the spectator stands on one side. It is mortifying to see a good picture hung in a bad light, and a bad picture had better not be hung up at all. But certain drawings are not so much injured by the effect of light, and may be placed where an oil picture would be lost.

1165. *Since it is almost impossible to find good situations* for many pictures in a moderately-sized house, the best mode is to place them in a gallery built on purpose, if they are numerous, and there justice may be done to them all. The modes of warming by steam or hot water render such an apartment agreeable on a visit paid to it in the coldest weather.

1166. *Artificial flowers* are beautiful ornaments; and are useful, since the natural ones cannot be had at all times and in all seasons; those of wax, in particular, so closely resemble real flowers, that the imitation seems quite perfect, and they well deserve patronage.

1167. *Many of those objects which are classed as curiosities* may be considered as furniture, since they are frequently employed in the decoration of apartments; the taste for collecting them has been often ridiculed, but it is not deservedly so, except when little judgment is employed, or when carried to excess.

1168. *Engravings* are little used at present as ornaments in rooms, though they were some years ago. Many, however, well deserve this distinction, although in general the effect of many engravings hung on walls is much inferior to that of pictures and drawings.

1169. *Minerals and other objects of natural history* form admirable ornaments for rooms; but they should be kept under glass, otherwise they soon spoil by the dust and smoke, and cannot be restored to their original beauty. A small cabinet, with glass doors, would be an agreeable and entertaining acquisition in almost any apartment. We frequently see in drawing-rooms elegant little tables covered with common and useless toys in porcelain, or figures ill painted on cards, for which more money has been given to the fancy shops than would have purchased works of art of great beauty and merit; while some, again, throw away money upon bad copies of old pictures that have been recently brought from the garret of the painter, after he has employed his talents in smoking and cracking them, that they may the better imitate the originals.

SECT. XII.—TAPESTRY, EMBROIDERY, AND FILIGREE.

1170. *Tapestry was much employed in ancient times* for covering the walls of apartments in magnificent houses. The term is derived from the Latin *tapes*, the cover of a wall or bed, from whence also comes the French *tapisser*, to line; and it has sometimes been applied as a general name for all kinds of hangings, whether woven or wrought with the needle, and whether silken, woollen, linen, leather, or paper; but it is now appropriated to a kind of woven hangings of wool and silk, adorned with scenic representations in imitation of paintings.

1171. *The earliest embroidery and tapestry were the work of the needle;* and we find in the Scriptures mention of rich dresses and various articles of furniture ornamented in this way with coloured silks, worsted, and gold thread. The Medes, Persians, and Babylonians were celebrated for their tapestry and embroidery; and the Egyptian women particularly excelled in this work, from whom the Israelites derived the knowledge of it. These arts were a favourite occupation of the Grecian ladies, and the labours of Penelope have become proverbial. Robes ornamented by embroidery were general among the Greeks and Romans, and this fashion has come down to modern times.

Some considerable works in tapestry, worked by the needle, had been executed in Germany, France, and England soon after the third century, particularly for Catholic churches and convents, and often by ladies of the highest rank. The most remarkable of these now existing is the Bayeux tapestry, the work of Matilda, wife of William the Norman conqueror. This magnificent example of ancient female industry is 227 feet long and 20 inches wide; it contains 530 figures, representing the various scenes of the Norman invasion, and is kept in the town-hall of Rouen as a precious relic. It is worked in different-coloured worsteds, on cloth originally white, but now become brown; the colours are preserved tolerably bright. The drawing of the figures is, as might be expected from the state of the arts when it was executed, stiff and rude, but the costumes of the time having been carefully attended to, the whole is very illustrative.

1172. *It appears that in Chaucer's time tapestry was much used in England* for decorating the walls of apartments belonging to wealthy persons, but it was worked in gaudy colours, and hence was more useful than elegant, contributing much, however, to comfort in houses where the bad finishing admitted innumerable draughts of air; but the best tapestries were only put up when the rooms were inhabited; a few of these tapestries still remain in ancient mansions. When the walls of rooms were furnished with moveable hangings, other materials, as leather, flowered and gilded in various patterns, and silk, were frequently employed.

1173. *It is not known exactly at what period the weaving of tapestry by the loom was first* practised; but the art appears to have passed from the East into Europe. Some suppose that this rich manufacture was brought from the Levant by the crusaders, and it became at length the greatest ornament of palaces, churches, and other public buildings. The French ascribe the invention to the Saracens; and hence the workmen employed in it were called Sarazins. Guicciardini states it to belong to the Dutch. The first manufactories of tapestry, of any note, were those of Flanders, established there long before they were attempted in France or England. The chief of these were at Brussels, Antwerp, Oudenarde, Lisle, Tournay, Bruges, and Valenciennes. At Brussels and Antwerp they succeeded well, both in the design and the execution of human figures and animals, and also in landscapes. At Oudenarde landscapes were better imitated, but they did not succeed so well with the figure. The other manufactories, always excepting those of Arras, were inferior to these. The manufactories of Arras, indeed, were so celebrated, that the name of this place has been frequently given to tapestry. Sully, the minister of Henry IV. of France, devoted his attention to this manufacture, and was enabled, by means of Flemish artists, to establish that of the Gobelins near Paris, which, under Louis XIV., became so celebrated as to be considered the first in the world. The name of Gobelins was taken from that of two excellent dyers, because the manufacture was first carried on in a house which had been built by them. In this place the most able artists, among others Le Brun, were employed to make designs, and to direct copies of the best pictures. When the tapestries were large they were woven in parts, which were united by the *rentrayeurs*, or fine drawers; and many of these productions are scarcely inferior to the paintings they were copied from. This art is generally supposed to have been brought into England by William Sheldon, about the end of the reign of Henry VIII., and parts of some maps in tapestry, made by Hicks, the artist he employed, were lately preserved at Strawberry Hill.

1174. *In* 1619 *a considerable manufacture was established at Mortlake*, in Surrey, by Sir Francis Crane, who received £2000 from King James to assist in carrying it on; and, according to Walpole, it was brought to great perfection. At his establishment some superb tapestries were executed during the reign of Charles I., from designs of distinguished painters, such as Rubens and Vandyke, several of which still exist, as at Hampton Court Palace, and Mary's Hall, Coventry. During the civil wars the manufacture languished, and under the Commonwealth it was abolished; nor has there been any manufacture of tapestry in this country since that time.

1175. *In the time of Queen Elizabeth, tapestry, called arras-work*, was very generally adopted in the houses of the country gentry, but this was of a course fabric, partly the produce of the loom, but also of the needle, and sometimes, it would appear, little more than painted cloths; and it was suspended on frames, which were at a little distance from the walls, and thus afforded the means of persons concealing themselves behind them. A superb set of pictures in tapestry, representing the destruction of the Spanish armada, was executed in Flanders, and long ornamented our House of Lords, until they were destroyed in the fire of 1834. Fortunately, a set of engravings had been made from them by John Pine, in 1739, and a fragment of one of them still exists in Plymouth.

1176. *The use of plaster of Paris in finishing the walls of apartments*, which began to be general in the reign of Queen Elizabeth, caused that of tapestries to be discontinued, from the facility with which architectural ornaments in relief could be produced; and tapestry is at present seldom seen except in restorations or imitations of ancient mansions. In France it is still executed at some of the great manufactories; and in that country there are preserved abundant examples of ancient tapestry.

1177. *Embroidery* is much more generally used abroad than with us for ornamenting dress. Threads of the brightest and most showy kinds are employed.

Embroidered handkerchiefs, generally carried in the hand, are universally used in Turkey, and the neighbouring nations of Asia, and are often bestowed as presents by Turkish ladies, by whom the working of them is a favourite amusement. Embroidery is also much practised at present by ladies in Germany; with this they ornament various articles of furniture, as screens, ottomans, footstools, &c. This practice has lately been fashionable among ladies in England, and German patterns, as well as all the various materials, canvass, wools, and silks, are now sold in many of the London shops.

Muslin was formerly embroidered by stretching it on an instrument called a *tambour*; the more open the muslin, the better it is adapted for the purpose; but it is now more generally worked in the hand. A great many hands were employed in embroidering muslins; and this work was chiefly carried on in the south of Scotland and north of England. Embroidery is one of the last things that one would expect to see done by machinery; yet this has been effected by M. Heilman, of Mulhausen. His invention was exhibited in Paris in 1834, and several of his machines, by which about 130 needles are worked by one grown-up person and two children, are employed in France, Germany, and Switzerland. Lately they have been introduced at Manchester. One machine, capable of doing the work of fifteen expert embroiderers, cost about £200. The machine copies the pattern by a pentagraph.

1178. *Filagree* is an ornamental work composed of threads of gold, silver, paper, or other substance, wrought together in a curious and ingenious manner. Our term comes from the Italian *filigrana*, threads and beads, because the latter were originally mixed with it. The art is of great antiquity, having been brought from Egypt and the East; and was formerly much employed in church furniture, as for decorating vases, images of saints, &c. Beautiful articles of this kind are manufactured in the Deccan, and among the Turks and Armenians. Mr. Marsden informs us that the Malays excel in this art. The best filagree is executed with threads of gold or silver, and gilt or coloured paper is also used. Making filagree was, at one time, a fashionable employment, but is now nearly obsolete.

CHAPTER XI.

FURNITURE OF THE ENTRANCE HALL.

1179. *Hall chairs, figs.* 381, 382, 383, are made in a particular style, and are always either wholly of mahogany or wainscot: they have more or less of turned or carved ornaments, and have sometimes heraldic shields or the crests of the owners. *Figs.* 384, 385 are *hall seats*. (See next page.)

1180. *Hat and cloak pins, and umbrella-stands.* It is usual to have proper places for hanging up hats, cloaks, greatcoats, and umbrellas: these should be not far from the entrance, easily accessible, yet safe. When there is little room, they are generally hung on pins fixed in a wooden rail against the wall; but, where there is space enough, stands for the purpose are better, as garments dry sooner on these.

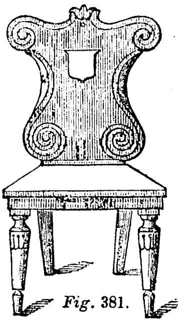


Fig. 381.

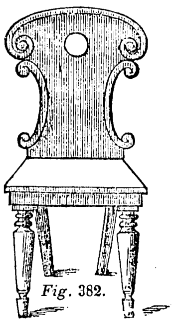
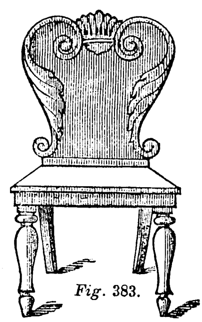


Fig. 382.



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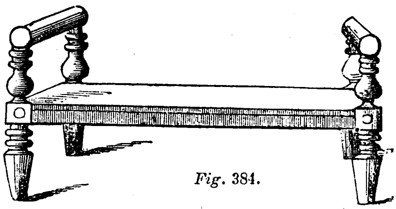

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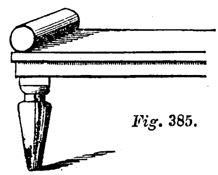
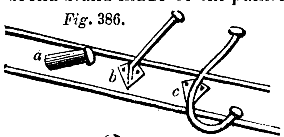
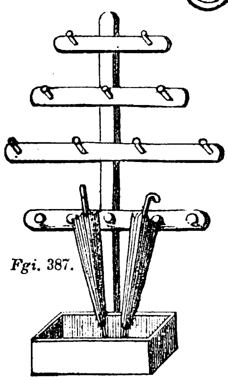


Fig. 385.

Fig. 386, *a*, represents pins made of wood, turned and let perpendicularly into a mahogany rail fixed to the wall at a proper height. Cloak pins, *fig.* 386, *b* and *c*, are likewise made of brass and of cast iron, and are screwed on to the rail, their direction pointing upward, the better to secure what is hung on them; another kind has the lower part of it turned upward to hang the hat on. Cloak and umbrella stands are sometimes made of mahogany, consisting of a stem and cross bars, as in *fig.* 387; the lowest rail has large knobs for the umbrellas to stand between, draining into the box, which has a loose japanned tin tray within. The cloaks are hung upon the three upper rails. *Fig.* 388 is a cloak and umbrella stand made of cast iron. *Fig.* 389 is an umbrella-stand made of tin painted; and *fig.* 390 is one that may be constructed of wood.

Fig. 386.





Fgi. 387.

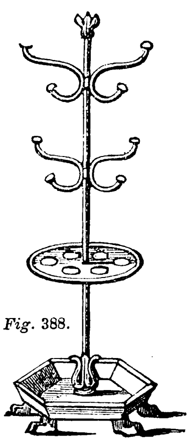


Fig. 388.

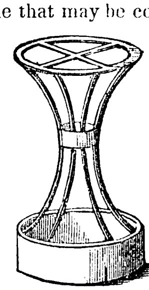


Fig. 389.

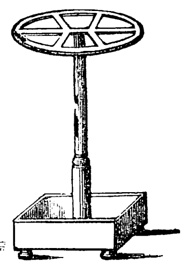


Fig. 390.

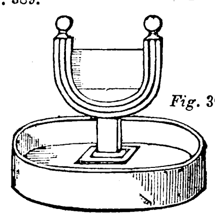


Fig. 391.

1181. *Door-scrapers* for the feet are placed at the entrance of every house, and should be in such a situation as to be easily seen. The variety of form is endless, from a simple piece of iron hoop fixed across two uprights of any kind, to those of cast iron, ornamented in various ways, and kept by the ironmongers. They should always, if possible, have a receptacle for the dirt to fall into. A portable scraper, *fig.* 391, which costs only two shillings, is useful, because it may be placed in any situation; as, for instance, in any part of the garden.

CHAPTER XII.

BEDROOM FURNITURE.

1182. The furniture of bedrooms, being of a particular kind, it appears proper to treat of it as a class distinct from that of the principal apartments.

SECT. I.—BEDS.

1183. *The subject of beds* includes the description of bedsteads, the bed itself, bed furniture, and bedding.

Bedsteads are the solid constructions or frame work upon which the bed itself rests, together with the canopy over it. Bed furniture comprises the curtains which generally enclose the bed, or which are suspended from the canopy or top. Bedding includes beds and mattresses of all kinds, whatever they may be stuffed with; also the bolster, pillows, sheets, blankets, and counterpane.

1184. *Historical remarks.*—In the first and ruder ages of mankind, it was the general practice to sleep upon the skins of beasts, as was the case with the ancient Britons, and this custom still prevails in many of the Asiatic countries, and other parts of the world. These skins, some of which were worn in the day, were spread at night on the floors of their apartments In process of time, these skins were changed for beds stuffed with straw, chaff, cotton, or other soft materials.

Bedsteads among the Greeks were of the most simple forms, consisting of a couch without any curtains: they may be often seen represented on antique bas-reliefs and in paintings, and appear to have had girth bottoms. We read also of pensile or suspended beds, by which, if necessary, the person might be rocked to sleep; these appear to have resembled our hammocks or cot beds.

Among the ancient Romans, a species of bed was used unknown in modern times, which was for the purpose of resting upon at meals: this kind of bed was called *Triclinium*, from its being usually occupied by three persons. These, in the luxurious times of the emperors, were of the most surprising magnificence; and we are informed by Pliny that they were frequently formed of ivory, adorned with plates of silver and gold, and covered by the softest mats and counterpanes. The use of feathers for beds is not modern, for Pliny informs us that they were in use among the Roman gentry, and at the inns beds were filled with the soft leaves of reeds.

In the houses of the wealthy, and even in the royal chambers of England, beds stuffed with straw or chaff were used so late as the close of the thirteenth century; the bed furniture was of a very costly description, and made of such durable materials as to last for many years; a few have descended down even to the present times, and are preserved in old manor houses. The hangings were sometimes of silk damask, or of velvet, and embroidered with coloured silk, or of rich stuffs. The testers were generally low, the necessity for plenty of air not having been then understood: the valances were generally plain, but scolloped with various forms at their lower edges. Some were surmounted with feathers. The effect of the whole was heavy, but calculated to have an air of gloomy grandeur suited to the times. Their great expense prevented their frequent removal, and the nature of the materials collected dust, and rendered it difficult to clean them so often, or so effectually, as might be desirable. Our modern light furniture is much preferable, and with care may last sufficiently.

Among the Eastern nations, beds are seldom raised from the ground. In the evening, mattresses stuffed with cotton, of which they keep a considerable number in great houses, are brought into the room, and laid down on the floor: often they have no other beds than the divan used in the day. The poorer people lie only on mats spread on the ground.

1185. German beds differ remarkably from our mode in England. They make the upper part so high by means of many pillows placed underneath, that they rather sit than lie in bed; some do not use blankets, but, instead of them, have a wadded counterpane over the sheets; and, in winter, a light feather bed, sometimes of down, is added as a *couvre-pieds*. This custom, though sometimes spoken of with ridicule, is said to be extremely comfortable in very cold countries.

1186. In England and Scotland, during the feudal period of our history, the proprietors of land lived in castles, which were not always accommodated with a number of rooms; and, when it was necessary for the greater number of the inhabitants to sleep together in the great hall, straw was brought in for that purpose, and was swept away next morning. From the following account given by Hollingshed, we may judge of the mode of sleeping in England at a later period. "Our fathers, and we ourselves, have lain full often upon straw pallettes, covered only with a sheet under coverlets made of dogswain or hoperlots (I use their own terms), and a good round log under their head instead of a bolster. If it were so, that the father or the good man of the house had a mattress or a flock bed, and thereto a sack of chaff to rest his head upon, he thought himself to be as well lodged as the lord of the town. So well were they contented

Pillows (said they) were thought meet only for women in childbed. As for servants, if they had any sheet above them, it was well: for seldom they had any under their bodies, to keep them from the prickling straws, that ran oft through the canvass, and razed their hardened hides."

1187. *General Observations on Beds.*—In the present day, when the study of physiology, and the importance of pure air, and great cleanliness are beginning to be understood, everything relating to our places of repose during the night receives particular attention from persons of intelligence; and yet much of this knowledge, so important to our health, is not sufficiently diffused. In treating on ventilation, we pointed out the necessity there was for breathing good and wholesome air; a necessity which exists in the strongest degree during the night, when we do not change our situation for many hours together. It can scarcely be necessary to repeat how pernicious to health are very small bedrooms, from the vitiation of the air by constant breathing; but the same reasons will apply to all circumstances which prevent the change of the air round about us when in bed, and which compel us to breathe over again a portion of that air which we have expired. This principle being kept in view, and thoroughly understood, it will be easy to comprehend in what manner this part of our domicil must be treated. In small bedrooms it is best to do without curtains, or at least to have them only partial, and not enclose the bed. When curtains are drawn close round a bed, it is, in fact, nearly equal to sleeping in a small room. It has been for some time the fashion to raise beds high above the floor; but in low apartments it is particularly improper to do so, since this lessens the distance from the ceiling, and keeps the person immersed in a bad atmosphere, since the expired air rises to the top of the room. In low chambers, therefore, the beds should be as near the floor as possible; but where the apartments are lofty, there is no occasion for this, and keeping the bed at a moderate height has the convenience of admitting sweeping under it. The corner of a room is a bad situation for a bed, as it cannot be got round without moving it. It should be placed, if possible, nearly at the middle of the side, but should not quite touch the wall.

Physicians remark that soft feather beds, in which the body sinks so deep as to be almost surrounded by feathers, have a relaxing effect, occasioning an undue warmth that weakens the action of the skin, and renders the individual very susceptible of cold when exposed out of doors. They recommend that, when a feather bed is used, it should be so well stuffed as to afford ample resistance to the weight of the body. On this account, many persons prefer sleeping upon mattresses only, particularly in summer. These observations, however, apply chiefly to the young and vigorous, who may sleep sound upon a hard bed; but the aged and infirm, except the bed be moderately soft, would thus pass many a sleepless night. The covering should be light. For very cold weather some have the counterpane quilted with cotton wool; eider down is better. For comfort and cleanliness, the more simple the style of the hangings the better. Much drapery confines the air, harbours dust, and is not only expensive, but requires a great deal of trouble to keep it as clean as is necessary. Dr. Franklin recommended as an improvement, to those who can afford so great a luxury, to have two beds near each other; and if one wakes, feeling the bed too hot, to go into the cool one. A large bed, admitting a removal to another portion, in some degree answers this purpose.

Health demands that all the materials of beds should be kept as clean as possible. Beds or mattresses, when impregnated with animal effluvia from the human body, and particularly in cases of sickness, are improper to sleep upon. They ought, therefore, to be frequently well aired, and likewise occasionally taken to pieces, and the materials beat, carded, washed, or otherwise cleaned. Blankets retain animal effluvia with considerable pertinacity, and ought always to be scoured after considerable sickness.

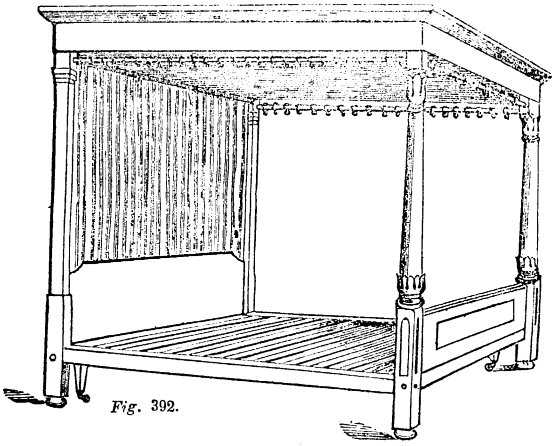


Fig. 392.

1188. *Four-post bedsteads*, as they are called, are the sort most generally used in England for the best beds. These consist of four lofty pillars, with a bed frame, and canopy with curtains. *Fig.* 392 represents a bedstead of this kind without curtains or bedding. Of the four bedposts, the two at the head are usually plain and square, because they are, in a great measure, concealed by the curtains; the other two at the foot of the bed are always more or less ornamented with turned mouldings or carving. These are generally of mahogany, but occasionally of other fine wood, as satinwood; and some have lately been made extremely elegant of porcelain. As they are made of solid wood, the thickness increases the expense considerably. The *bed-frame* is fixed to the four posts by strong screws, which must be unscrewed when the bed is taken to pieces; and a particular implement, called a bed-screw, is kept for that purpose. Sacking sometimes, but in the best beds laths, are put across to lay the bedding upon. The *head-board* is fixed across, and drops into grooves in the square posts at the head; and sometimes there is likewise a *foot-board* fixed in a similar manner to protect the feet. There is a *cornice* at the top of the bedstead, which is best made of mahogany, French polished, or wood japanned, which is cheaper, though not so durable. Cornices are at present made extremely plain, as much carving is found to harbour dust, independently of the expense. The architrave is sometimes omitted. The *tester lath* is the square lath fixed on the top of the posts, to which the valance is nailed, and to carry the curtain rods.

1189. *The drapery of beds or bed furniture* includes the curtains, valance, and head cloth. *Bed-curtains* are made of various materials, as silk, damask, moreen, chints, or dimity. Silk is, of course, the richest, but by far the most expensive, and is seldom used. Moreen, and other woollen stuffs, were much employed some time ago, partly from their rich appearance, and partly because they were thought warmer; but at present they are not so much employed, being liable to moths, and to collect dust. Chints is generally preferred, being more easily washed; and curtains of it are usually lined with a thin glazed cotton, generally dyed plain. Dimity has the advantage, being cheap, and admitting of being washed frequently. It must be observed, however, that both chints and dimity are more easily set on fire than woollen stuffs. It is said that the liability to take fire can be prevented in dimity curtains if they are dipped in a solution of alum after they are washed. *Fig.* 393 represents the bed completely fitted up. The *valance* is a piece of drapery fixed to the tester lath to hide the curtain rods. The *head cloth* is stretched from pillar to pillar at the head of the bed, and is generally ornamented by being plaited in some elegant mode.

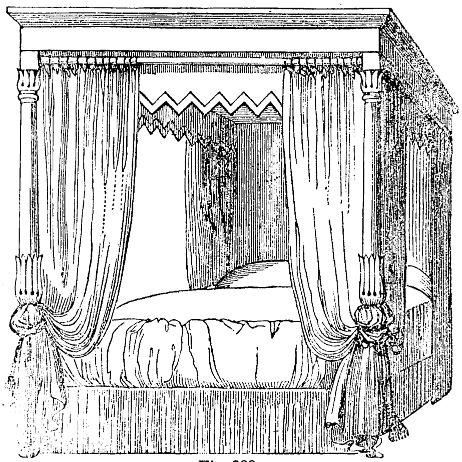


Fig. 393.

It was the fashion formerly to ornament the bed furniture with festooned and fringed valances, with highly-enriched cornices and tassels; but these were found to collect dust, and to occasion much trouble, in addition to useless expense. At present it is the fashion to contrive all the parts of a bed in a very simple manner, so as to be easily taken to pieces to clean. The valance, indeed, is now frequently put inside the curtain rods, which, instead of being concealed, are made ornamental. One advantage in having the curtain rods outside is, that the dust which collects about the rings can be swept off without soiling the bed. Sometimes, however, for economy, and particularly for summer, plaited valances may be contrived of muslin or other materials, to serve instead of cornices and other upholsterer's work, and may be ornamented with lace, riband, &c.; but this is mentioned as a temporary mode merely, or where the family can itself manage these matters. The *curtain rods* were formerly made of iron: brass is now generally used; and if they are outside, they are made of metal, and of large diameter; but they are often made of wood, if they are inside, which makes less noise when the curtains are moved. The *curtain rings* have each an eye, *fig.* 394, below the ring, into which is put the end of a small hook sewed to the inside of the upper edge of the curtain; by unhooking these, the curtains can be taken down when required. When the rods are outside the valance, they are fixed to square blocks on the top of the bedposts, or to brass brackets at the angles. The whole stands upon *castors* under each post or pillar. These are always of wood, and that the bed may be easily moved, are made large. The kind called French castors, *fig.* 395, are much better than the common ones, which are apt

Fig. 394.

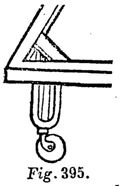


Fig. 395.

to come off and be out of order. Instead of being fixed to the posts themselves, they are fixed to an angle piece, by which they are made secure, and are out of sight. *Double screwed beds* are those in which each rail of the frame has two screws to fix it to the pillars, which is stronger than when there is only one screw.

1190. *Figs.* 396 and 397 are cornices with valances in the taste at present much in fashion, where the rods are to be concealed.

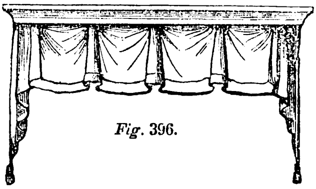


Fig. 396.

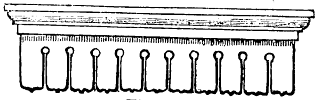


Fig. 397.

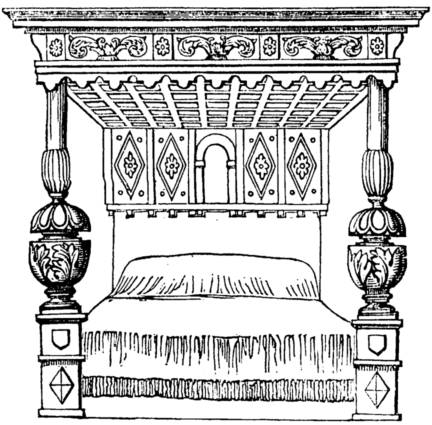


Fig. 398.

1191. *Fig.* 398 is an example of a four-post bedstead in the Elizabethan style. The whole is of oak, ceiling and head included, which are panelled and enriched with carving. The curtains are omitted to show the design better.

1192. *French beds* are remarkable for their variety of forms, and the taste which they admit of displaying. The *cottage French* pole-bed, *fig.* 399, is of very simple construction, and is now much used in this country as an economical piece of furniture. One of its great conveniences is the manner in which the curtain is contrived. This consists merely of a piece of drapery thrown over a pole which is generally fixed to the wall at the place where the bed is to stand; it can be taken down with the utmost facility, and the usual expense of making up attending other curtains is here saved. In places where the pole cannot be conveniently fixed to the wall, it may be attached to an upright piece forming part of the bed, as in the woodcut. *Fig.* 400 shows the bed, with the furniture and bedding complete. Some object to the curtain reaching so low at the head; in consequence of which one cannot well sit upright in bed, and the air is too much confined near

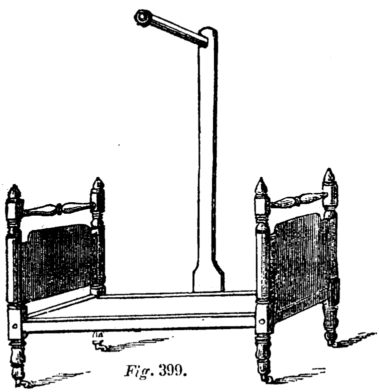


Fig. 399.

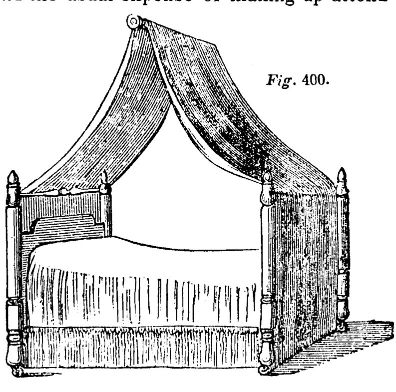


Fig. 400.

the face. This inconvenience may be removed by hanging the curtains as in *fig.* 401, though by the sacrifice of some uniformity. Many persons use them without curtains, and in small rooms they are better without, particularly for young people. Their being easily moved and taken to pieces is one of their principal advantages. The curtains are certainly more elegant than those of the tent bed, *fig.* 405, and less apt to collect dust; but they are not so convenient as those of tent beds may be, if hung with rings upon a rod at the top of the upright posts in *fig.* 406, which will open by drawing aside. They are usually painted in imitation of some expensive wood.

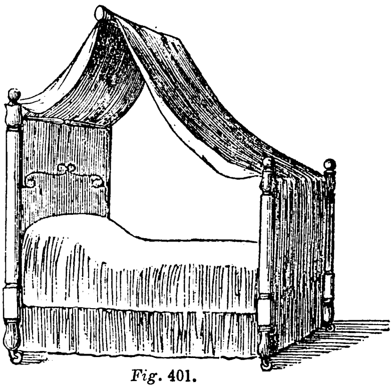
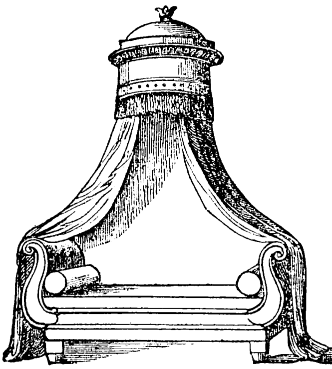


Fig. 401.

1193. More elegant French beds are made of mahogany, somewhat in the form of a sofa or couch, and have canopies and draperies of a more fanciful kind, ornamented in various ways, as *figs.* 402, 403.

Fig. 402.



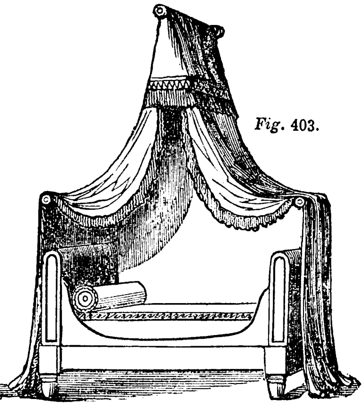


Fig. 403.

Fig. 404 is one upon a classical model.

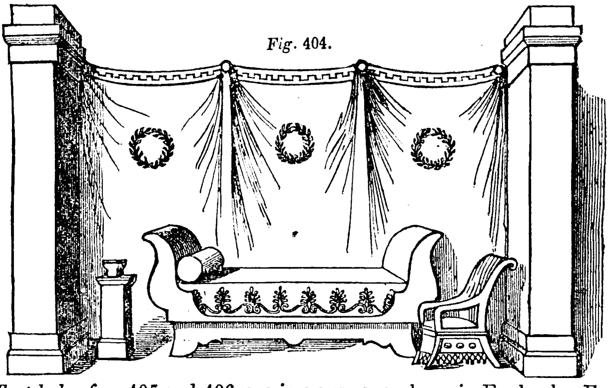


Fig. 404.

1194. *Tent beds*, *figs.* 405 and 406, are in very general use in England. Four upright posts are placed at the corners of the bed-frame, with its sacking or laths; and on the bedposts rest the tester laths, which drop on iron pins on the top, that are covered by wooden knobs. The posts at the foot of the bed are turned and ornamented in some way, but those at the head are made square and plain, as they are always covered by the curtains; into a groove in them the head board is inserted. The curtains to throw over the whole are usually made of chints; they are fastened up in the day by cords, and not drawn on rods.

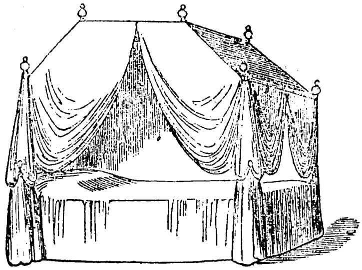


Fig. 405.

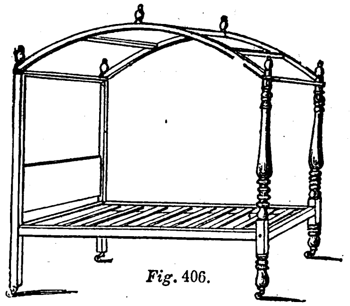


Fig. 406.

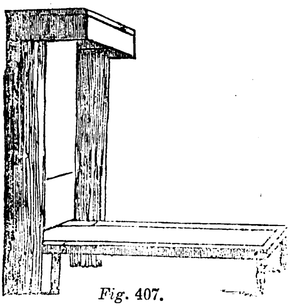


Fig. 407.

1195. *Half tester bedsteads* are another variety of beds to turn up during the day to gain room. The bedstead, *fig.* 407, when turned up, is enclosed within curtains drawn round it, and which are hung to a small tester, from which the name. They are not quite so shut up from the air as the press bedstead, but they have always the appearance of a bed. The valance may, however, be made more ornamental by festoons, fringe, or scollops. *Fig.* 408 is another turn-up bed to appear as a narrow tent bed when put up.

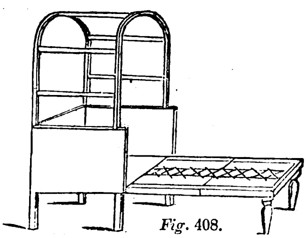


Fig. 408.

1196. *Press bedsteads* are made to shut up, when not in use, into a press which is generally low, and sometimes made to imitate a chest of drawers, or a cabinet. They are convenient in certain situations, as occupying little room, and not having the appearance of a bed; they are therefore useful in small rooms, where an ordinary bed could not be put. But they are liable to this objection, that, as the bedding is folded up in them during the day, it does not get so well aired as is requisite. Also, from the numerous joints and crevices in the wood-work, they are more liable to harbour vermin, and are more difficult to keep clean than other beds; they are therefore not to be recommended, except through necessity. If they are used, the construction that has the fewest joints in the wood-work is preferable. *Fig.* 409 represents a press bedstead turned town; the bed is placed upon the usual sacking, and the bedstead folds up in three lengths, the feet also folding down; the bed, bedclothes, bolster, and pillow, are put in over it, and when the doors are shut, the top (which is best in one piece, framed, if of deal, though usually made in two pieces,) shuts down over them. If this bedstead is to imitate a chest of drawers, instead of the folding doors, one door only must be made, having the external side to imitate drawers with handles; or, if it should be inconvenient to hinge it, it may be made a separate piece, to take off altogether in the night. Where there is sufficient room, instead of making this press bedstead so low as to be only of the height of a chest of drawers, a better plan is to make it go into a press six or seven feet high, by which only one joint is required in the bedstead, as in the half tester bed, *fig.* 407; the bed may be made in the morning, and strapped down before it is turned up, so as to be ready to sleep in on turning it down in the evening. The low press bed may also be made to imitate a dressing-table, or chest of drawers, covered with a toilet cover.

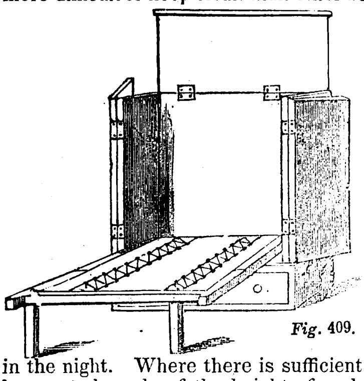


Fig. 409.

1197. *Chair beds* are convenient, as affording the means of accommodating an accidental visiter, when all the other beds are occupied. They are frequently so complicated as soon to be out of order. *Fig.* 410 represents one free from that objection, and at the same time forming a complete arm-chair. The bed frame folds up into the seat of the chair; and the mattress is made in three pieces, two of which are used in the seat,

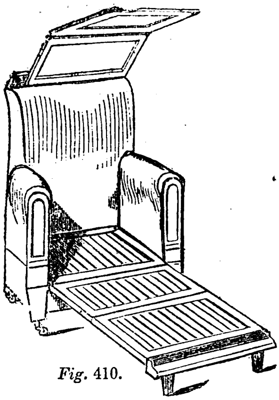


Fig. 410.

and the other one in the back. The light frame on the top is to support curtains if required, and it slides down into the back, the top being closed by a narrow-hinged fillet.

1198. *Sofa and couch beds* are made on a similar principle. *Fig.* 411 represents the framing of one so simple that it may be made by a common carpenter, of deal or any other wood: the back folds down to make the bed on the sofa. The seat is formed of a frame lathed, and having a mattress laid on it in the usual manner of a sofa; this frame being hinged, lifts up and allows the bed-clothes, together with the bolster and pillows, to be put into the well below that reaches nearly to the floor, and is enclosed all round by canvass strained to the frame. Another mattress is required for the back, in addition to that which forms the seat of the sofa; the front rail must be strong, and of sufficient depth to bear the weight of sitting on the sofa; and to strengthen it, it will be necessary to have an iron bar under the middle of the seat. The back must be lathed like the seat, to keep in its place when raised up; a strong hook and eye will be sufficient. Small stuffed pieces must be made for the ends; and the whole may be covered by a loose covering of chints, to be taken off when the bed is to be made. Sofa beds are made of other constructions more elegant, and form useful and cheap pieces of furniture.

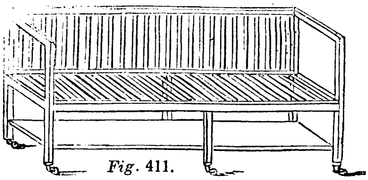


Fig. 411.

1199. *Cot beds or hammocks* are exceedingly convenient in many situations where there is little room, or when an extra bed is required. They are formed by making a wooden frame with sacking strained across large enough for one person. To the side of this canvass is attached, as in *fig.* 412, two poles, by which the cot is suspended to the ceiling by strong cords. It is easy to see how this might be made more ornamental by curtains. The great convenience is that, in the day-time, it is so portable that the whole may be easily put away. It is scarcely necessary to state that care should be taken to have the lines and hook sufficiently strong.

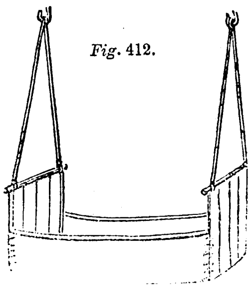


Fig. 412.

1200. *Stump bedsteads*, *fig.* 413, are the humblest in common use; they are usually made of wood with sacking bottoms.

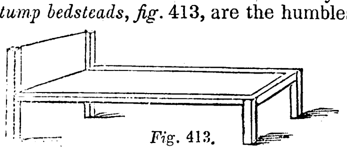


Fig. 413.

1201. *Box bedsteads* are a very ancient kind of bedstead, still used in many parts of the Continent, and in Scotland. They consist of an enclosure of wainscoting, sometimes moveable; but, however they might have been calculated for houses which were very pervious to the weather, they are not to be recommended, as they confine the air too much for health.

1202. *The folding camp*, or *tressel bedstead*, *fig.* 414, is one of the cheapest made, and has the great convenience of being easily put aside to make room when folded, consisting merely of two frames connected by the sacking. When extended, it is kept open by the head-board, which has two pins that drop into holes in the side rails, with the addition of a foot-board, made in the same manner as the head-board; there is no better bedstead for men servants or young people; and being so moveable, they are easily kept clean, not requiring taking to pieces. They may be had complete for less than £1. If required, nothing would be easier than to add curtains, in the manner of the French bedstead. They are also made sometimes of iron.

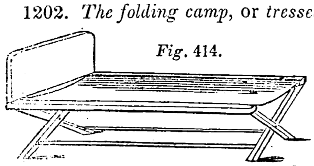


Fig. 414.

Camp bedsteads, to fold in little room, are made sometimes of iron; but the best and most elegant are of hollow brass rods, which are particularly convenient for travelling by land or sea, and are occasionally useful in the house from being easily put away. Those of brass are about twice the price of iron ones. Couches are made on the same principle.

1203. *Iron bedsteads* have now become very general, and are much more easily kept

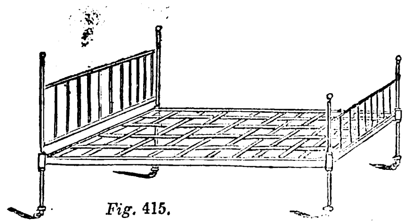


Fig. 415.

clean than those of wood. Though a little more expensive at first, they are often found cheaper in the end, on account of their greater durability. They are painted in oil; and the bottoms, instead of being of sacking, are composed of iron hooping, crossed, as in *fig.* 415. Some are made with standards for curtains, in the manner of French bedsteads.

1204. *Wire gauze is found very useful in tropical climates* as a substitute for the sacking, head, tester, and the various hangings of a bedstead, in order to prevent certain insects from establishing their domicil, and likewise the intrusion of winged insects and reptiles. To supply the place of ordinary curtains, the wire gauze is framed in panels, which are connected together by hinges, so as to allow any one of them to be opened at pleasure. The sacking, heading, and tester may be permanently fixed. A patent was taken out for this application of wire gauze by Briedenback of Birmingham.

1205. *It is necessary sometimes to take bedsteads to pieces,* for the purpose of having them cleaned; and though generally an upholsterer or a carpenter is employed to do this, yet it is proper that servants should perform an operation which is not difficult if done with regularity. An iron bed-key is requisite to undo the large screws by which the bedstead is held together, and all the parts should be marked, so that no mistake may be made in putting them together again.

1206. *Bedding.—Feather beds,* or beds stuffed with feathers, are now in universal use in this country. In these modern times of refinement and luxury, the good qualities of a bed are considered as of the first importance; and undoubtedly the restoration of strength after fatigue depends much upon the properties of this article of furniture; and health as well as comfort demands that its materials and construction should be well attended to. For the nature of feathers, and the mode of cleaning and dressing them, see Book V., Chap. V., "Materials for Furniture." The feathers are enclosed in a case of ticking. To prevent the feathers from coming through, which they are apt to do, and which occasions much of that dust commonly termed *flue*, so disagreeable in bedrooms, some rub bees' wax upon the inside of the ticking, or a mixture of bees' wax and yellow soap. This is necessary when the ticking is thin; but it is better to have the ticking so close and stout as not to require it; and to prevent the feathers from penetrating, the ticking is occasionally made double. Feather-beds, to be kept in good order, require to be well shaken every day, otherwise the feathers mat together in hard knots, that are difficult to undo and separate. When this has happened from long use or neglect, so that the beds are uncomfortable to those who sleep upon them, it is necessary to take the feathers out to have them dressed, and the ticking well washed, dried, and aired, if not renewed. The dressing of the feathers is usually performed by regular manufacturers, in which case it is necessary to take care that they do not keep back part of the feathers, which dishonest persons are apt to do. The process may be performed by any one in a house where there is a spare empty room. The feathers should be emptied in a sheet, and carefully loosened by hand, picking out all the quill parts from the light feathers. The loosened or cleared feathers are then to be returned by handfuls into the new ticking, through a part of the seam left unclosed for the purpose. It is scarcely necessary to add that this is a troublesome and unpleasant operation, from the feathery dust; while it is going on, the doors and windows of the room should be kept shut, to prevent the feathers flying all about. As there will be some deficiency of feathers by this process, and by constant use, it will perhaps be requisite to supply this by the addition of a portion of new feathers. If the feathers from the poultry are not given as a perquisite to the cook or dairy-maid, which is sometimes the case, they are often sufficient for this purpose; or these may be collected and kept for pillows, or any similar use. In this case, after being well selected, they should be put into strong brown paper bags, and well dried by keeping them several days in the oven after the bread is baked, until all smell is removed. They are then to be taken out, the quill parts cut off carefully, and the feathers cleaned according to the directions which we have given; they should then be restored to the paper bags, and kept in a dry place for use. Bed-ticking will last many years with care; in towns and smoky situations it may be advantageous to have coverings of brown holland, which can with ease be taken off and washed as occasion requires.

Formerly it was the custom to use only feather beds laid upon the sacking; but these beds were very thick, and contained much feathers. Economy and attention to health have introduced the custom of laying a thinner feather bed upon a mattress, and sometimes that upon a paillasse.

1207. *In purchasing feather beds,* the purchasers may choose their feathers, which are of various prices, at so much per pound; and they may see the ticking filled with them, having the quantity put in which they wish. If too much is put into the bed, it will feel hard.

1208. *Mattresses* are a firmer kind of beds, usually placed under the feather beds, but sometimes preferred to the latter for sleeping upon, as being less soft, and not so relaxing. They consist of a bag of canvass or ticking stuffed with various materials; but as these are not intended to be moved or shaken, they are fixed in their places by packthread put through, and tufts fixed at equal distances: the edge or border of the mattress is formed square. The materials with which mattresses are filled are usually horsehair, wool, flock, millpuff (a kind of coarse wool), chaff, straw, ulva-marina, cocoanut fibre, or coils of elastic wire. Hay and chaff are occasionally employed.

1209. *The best of these is good horsehair*, which, when of the first quality, preserves its elasticity a long time; but it is also the most expensive: in a second quality, the hair of the tails of oxen is mixed, and this is also good.

1210. *Wool mattresses* are much cheaper, but it is necessary that they should be made of good wool. The cheapest kind usually made in England are of wool rejected for manufacturing purposes, called flock, mixed with the waste from the surface in dressing blankets and cloth, which, being short, requires many tufts or knots to keep the wool properly in its place, and consequently the mattress is hard. In France, wool mattresses are very generally slept upon instead of feather beds, but these are made of long wool, which requires few tufts, and are very soft; these are beginning now to be made here, but they are expensive; and as they will get hard by constant use, and cannot be shaken up like a feather bed, they require occasionally to be taken to pieces by the upholsterer to have the wool carded and made up again, which costs eight or ten shillings. They are excellent for summer use, being less relaxing than feather beds, and not half the price.

An eminent upholsterer recommends as an excellent kind of mattress long wool and hair, not mixed together, but laid in alternate layers: this is less expensive than all hair, but nearly equal in quality. Four inches thick is sufficient for a mattress; thicker cannot be well fastened: when a very soft mattress is required instead of a feather bed, it is best to have two rather thin laid one on the other.

1211. *Mattresses stuffed with elastic iron wire* are a recent and valuable improvement. The following is the mode of constructing them: wire about the eighth of an inch in diameter, or smaller for some purposes, is twisted into coils of the form of an hour-glass, *fig.* 416, that is, like two cones joined together at their apices. The lower parts of the springs are sewed to a canvass or webbing, and their upper parts are secured in their places by packthread, tied or braced from one to the other, crossing like a net. On the tops of the springs canvass is laid, and over that a layer of baked horsehair, and then the outer covering of ticking. The springs are made at Birmingham. When the mattress is not pressed, the springs rise to their full height, which is about seven inches; but when the weight of a person comes upon it, the springs yield, and are compressed into less space. This kind of mattress, on account of its superior elasticity, is particularly well calculated for invalids, not requiring to be shaken or moved like a feather bed. It is, besides, extremely cool in summer; and in winter, if warmth be required, another soft mattress can be laid upon it. Indeed, with this mattress no feather bed is necessary, and it is therefore, upon the whole, very economical, not being above half the price of a bed. They cannot be turned, and require no making. The same method of stuffing by wire springs is used extensively for easy chairs, and seats of various kinds.

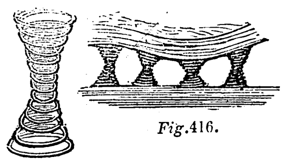


*Fig.*416.

1212. *Cocoanut fibre*, called *coir* in India, has lately been introduced as a material for stuffing mattresses, and has some qualities that strongly recommend its use. These fibres are found surrounding the kernel of the cocoanut (see our description of that fruit, Book VII., Chap. IX.), and, after having undergone a certain preparation by the manufacturer, they are sold ready to use instead of horsehair. The advantages of this material appear to be these: containing naturally a large portion of tannin, a principle which exists in all bark, and which gives to leather its incorruptibility, it will neither ferment nor decompose, like other substances, but preserves its freshness in all climates. No vermin of any kind will breed or harbour in this fibre, although the best hair and flock are liable to this in warm countries. It is therefore exceedingly durable, and free from smell. It is also very elastic, and although not equal in this respect to the best horsehair, it is yet much superior to wool, nor does it get into knots like that substance. Cocoa fibre likewise preserves its elasticity for a long time, and this may be restored after some years, by taking it out, washing in water, and drying in the sun. This material has been tried by officers in the army and navy, and has been found particularly well calculated for mattresses, couches, and cushions: it is not above half the price of horsehair. It was first introduced by Captain Wilders.

1213. The *Ulva-marina* is a species of sea-weed, or marine plant (*Zostera marina*, Linn.), and this, when properly washed and dried, has been well spoken of as a stuffing for mattresses: it is very wholesome, does not harbour vermin, and is tolerably light and soft; but if not sufficiently washed, is said to attract moisture, owing to a little salt remaining in it.

1214. *The outer chaff of the oat* is used for stuffing mattresses, and also bolsters, in some parts of Scotland. This material is carefully sifted from the smaller chaff and dust, and is renewed once a year.

1215. *The chaff of maize* is employed for the same purpose in Italy, and other countries where that grain is commonly cultivated.

Bran is sometimes used for mattresses for children.

1216. *The dried leaves of the beech-tree* are rather preferable to straw as stuffing for mattresses. Of these Sir Thomas Lauder observes, "We can, from our own experience, bear testimony to the truth of what Evelyn says as to the excellence of beech leaves for mattresses. We used always to think that the most luxurious and refreshing bed is that which prevails universally in Italy, which consists of an absolute pile of mattresses, filled with the elastic spathe of Indian corn; we mean that delicate blade from which the large head of the plant bursts forth. These beds have the advantage of being soft as well as elastic, and we have always found the sleep enjoyed on them to be peculiarly sound and restorative; but the beds made of beech leaves are really no whit behind them in these qualities, while the fragrant smell of green tea, which the leaves retain, is most gratifying. The only objection to them is, the slight crackling noise which they occasion when a person turns in bed; but this is no inconvenience at all, or if so, it is an inconvenience which is much overbalanced by the advantages of this most luxurious couch."

1217. *All mattresses lose their elasticity,* to a certain degree, by long use, and soon get so hard that they require to be taken to pieces and undressed. This is usually performed by the manufacturers, and it is more difficult to execute than in the case of feather beds. If of wool, this material must be taken out, washed, and carded. If of hair, this must be well loosened, and the dust beat and blown out with a bellows before it is returned into the new case. Great care must be taken to place the wool or hair exactly even, otherwise the inequalities will prove very unpleasant, and the fixing at equal distances with packthread, passed through at equal distances, must not be omitted.

1218. *Frauds are sometimes committed with respect to the materials of which mattresses are made*, and advice was given us by an upholsterer to recommend the purchaser who has reason to suspect fraud to open a portion of the sewing in the seam by cutting the thread, and with the fingers to pull from the very centre, between top and bottom, some of the material. Instead of the best hair mattresses, as ordered or described, it has been found that very inferior hair has been sometimes substituted; even a quantity of that from the hides of bullocks, goats, and deer, such as is used by the plasterers. In short, any description of hair that could be procured, and which is void of elasticity, perhaps mixed up with some good horsehair. In wool and flock mattresses, which latter are the cheapest, it is not uncommon to mix with the proper materials rag flocks, made from old blankets and flannels, and every kind of old woollen fabric, probably from hospitals, prisons, barracks, &c. These are torn or cut into shreds, and reduced to flocks by machinery, and carded.

1219. *A paillasse* is a very thick mattress stuffed hard with drawn wheat straw, the name being derived from the French, *paille*, straw. It is placed beneath the bed, and sometimes under the mattress, for the purpose of raising the bed, and giving it elasticity. When the bottom of the bedstead is made with laths, a paillasse is necessary, as the laths cut the mattress or bed. When two mattresses only are used, or a mattress and feather bed only, sacking is best to be under them.

1220. *Air beds* were invented by John Clark of Bridgewater, in 1813, in consequence of the previous discovery of rendering cloth impervious to air by means of Indian rubber. These beds, in fact, consist merely of a bed of the proper size of this kind of cloth, into which air has been forced by a pump through a stop-cock, till it is sufficiently inflated to serve as a bed, and then shutting the stop-cock. This case is then enclosed in another of ticking of any kind of cloth. This contrivance is capable of being particularly useful to many persons; for instance, to travellers, who, in transporting their beds, need, upon occasion, carry only a prepared bag and a force pump for air. Notwithstanding the great elasticity of air itself, these beds are not very elastic, but can never lose their elasticity so long as they are tight. They require no making up, can be got ready in a few minutes, and occupy little room when empty. The same invention is applied also to making elastic cushions to sit upon, very useful likewise to travellers; but it is to be observed that such beds will require very great care, as the smallest hole will render them useless.

1221. *Dr. Arnott's water bed* will be described under "Invalid Furniture."

1222. *The other parts of bedding*, such as blankets, sheets, and coverlets, have been treated of under "Woollen, Cotton, and Linen Manufactures," and the modes of cleaning them under "Laundry." Bolsters and pillows are usually stuffed with feathers, and the same observations apply to them as to beds.

Sect. II.—bedroom chairs.

1223. *Bedroom chairs* are most usually made light, the seats of cane or rush, and they are generally painted or japanned. *Figs.* 417, 418, 419

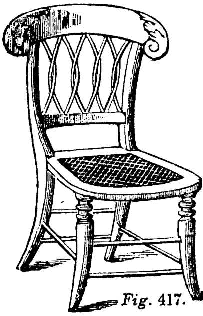


Fig. 417.

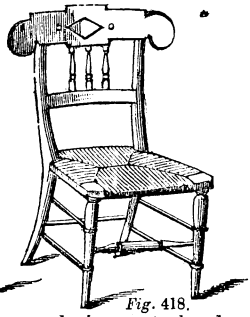


Fig. 418.

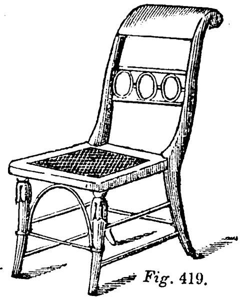


Fig. 419.

1224. *Cheap light chairs* are made in great abundance of a great variety of patterns, of beech *stained* to imitate rosewood, with cane seats; most of these are made in Buckinghamshire. Loose cushions are sometimes laid on them. These are too well known to require farther notice. When well made, they form very tolerable cheap substitutes for rosewood chairs.

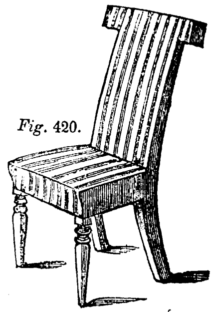


Fig. 420.

1225. *Common rush-bottomed chairs*, with the frames stained black, or painted, are by no means so good as the cane-bottomed, as the seats are liable to harbour vermin, and to be easily cut. They are much improved by painting the rush with oil paint, as then they can be washed with soap and water.

1226. *Fig.* 420 is a *devotional* chair, or *Prie-Dieu.*

Sect. III.—couches, tables, dressing-glasses, etc.

1227. *Figs.* 421, 422, 423 are *economical couches* for bedchambers or ladies' sitting-rooms: they may be made of deal, or other cheap wood, and have mattresses covered with chints, or even brown holland.

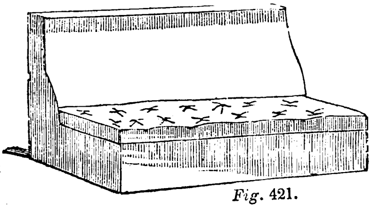


Fig. 421.

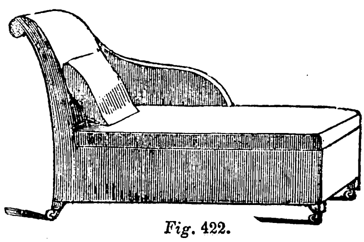


Fig. 422.

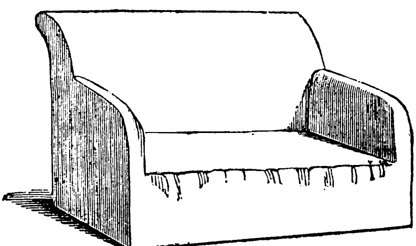
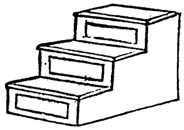


Fig. 423.

Fig. 424.



1228. *Bed-steps*, *fig.* 424, are necessary to ascend some beds that are made very high, and within is frequently placed a night convenience.

1229. *Toilet or dressing tables* are fitted up in an infinite variety of ways, from the plain table, with the toilet cover and mirror placed upon it, to the most expensive kinds, and a proper selection adds much to comfort.

1230. *Fig.* 425 represents one of the most usual plain kind made at present. As this table is commonly placed against the window for the advantage of good light, if the mirror is placed upon it loose, it is very apt to be blown down, and perhaps broken, when the window is left open. The best way, therefore, is to have the mirror and frame to slide up and down by means of balance weights, as in a window sash. An additional shelf may be made to draw out to the right, to gain room if required: at the bottom is a cushion to put the feet upon. Toilet-tables are sometimes made extremely elegant and costly, with various contrivances for holding the numerous paraphernalia

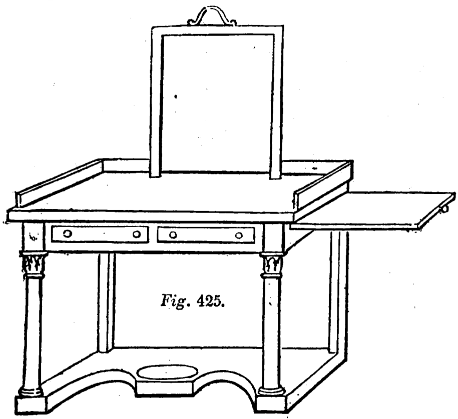


Fig. 425.

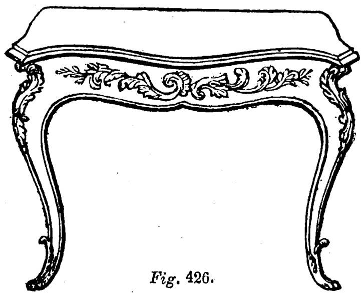


Fig. 426.

required by ladies; but we omit examples of these, since they must necessarily vary so much with the wants of individuals that no patterns can be established.

1231. *Tables in the style of Louis XIV., fig.* 426, are sometimes introduced into bedrooms and dressing-rooms as an agreeable variety. They are often of great elegance, having marble tops, and being decorated with brass ornaments, or inlaying with marquetry.

Figs. 427 and 428 are two tables in the Elizabethan style.

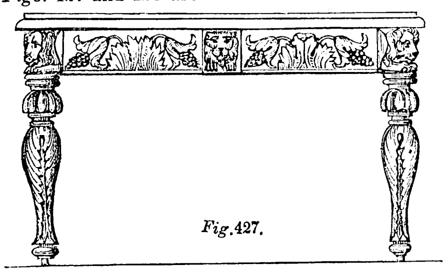


*Fig.*427.

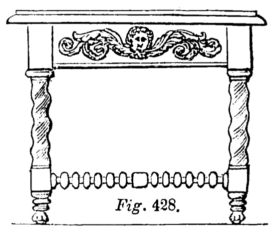


Fig. 428.

1232. *The dressing-glasses, or mirrors,* in common use are those termed *swing-glasses,* from their being moveable to any angle in a frame. *Fig.* 429 is a large *cheval glass* that

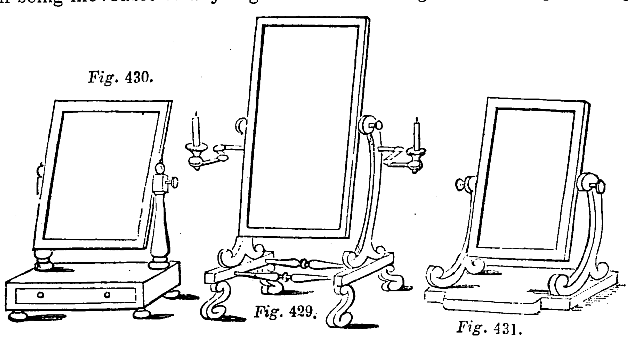


Fig. 430.
Fig. 429.
Fig. 431.

stands on the floor for viewing the whole person, with lights on each side. *Fig.* 430 is a small dressing-glass for the toilet-table, with a drawer. *Fig.* 431 is another with the drawer omitted, which is now usually done: this must be loaded at the bottom to prevent being easily thrown down.

1233. *Fig.* 432 is a *box-stool*, having the top stuffed to sit on, while the inside may ld caps, or other articles of dress, pinned to the girt in the lid.

Fig. 433 is a dressing-stool, light, with cane bottom.

Fig. 432.

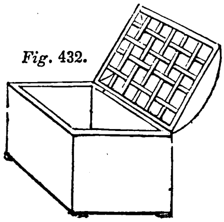


Fig. 433.

SECT. IV.—TOWEL AND WASH STANDS.

1234. *Towel and cloth airers. Fig.* 434 is the form at present most in fashion for towels. *Fig.* 435 is more convenient for airing clothes; from the mode in which the feet are fixed on, it will stand whether open or shut. *Fig.* 436 is still more convenient, as by means of a very simple hinge it may be made to fold backward, and in several different positions. *Fig.* 437 represents the hinge, which consists only of two strips of

Fig. 434.

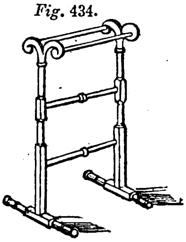


Fig. 435.

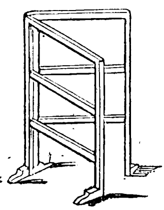
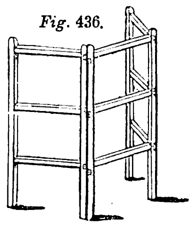


Fig. 436.



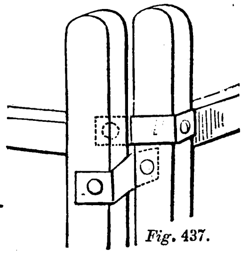


Fig. 437.

leather nailed on as in the woodcut: it may be made by any carpenter: there are four such hinges.

1235. *Wash-stands.*—These useful articles of furniture have been made in a great variety of forms, from which we select the principal varieties at present in common use.

Fig. 438 is the simplest kind of wash-stand, which may be made of deal painted, or any other kind of wood. The space below the basin, being enclosed with doors, may be used as a small cupboard. The wash-board is made high, and contains a small shelf. *Fig.* 439 is a small wash-stand which was in general use some time ago, but is now seldom found except at the brokers: it is, however, very convenient for small apartments. *Fig.* 440 is one on a similar plan, intended for the corner of a small bedroom.

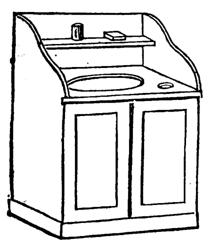
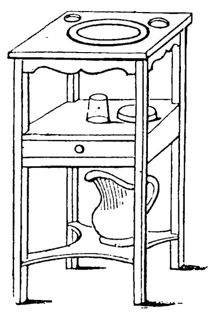


Fig. 438.

*Fig.*439.



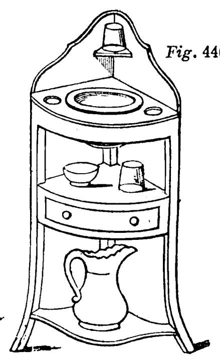


Fig. 440.

Figs. 441 and 442, wash-stands generally made at present. The top is usually made of marble, which is less apt to be injured by the alkali of the soap, which takes off oil paint, and spoils mahogany. Some kinds of veined marble, being now cheap from improvements in sawing, are very generally employed for this purpose. Below is a cir-

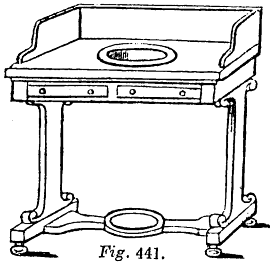
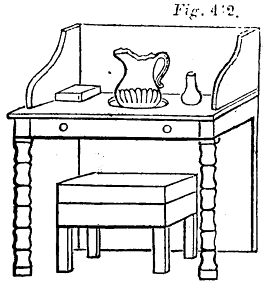


Fig. 441.

Fig. 442.



cular slab for the ewer. *Fig.* 443 is one on a similar plan, only not having the top perforated for the basin, so that it may be used occasionally also as a toilet-table. The basin and ewer may be put away upon the shelf beneath. *Fig.* 444 is a larger stand

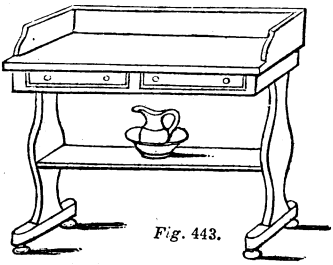


Fig. 443.

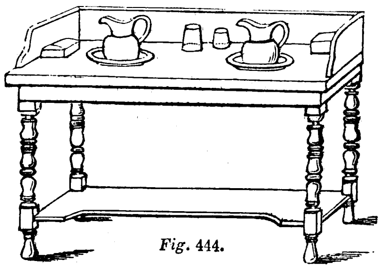


Fig. 444.

for two basins. *Fig.* 445 is a small mahogany wash-stand for a gentleman's room or library: the basin can be covered over with folding covers. *Fig.* 446 is a larger one for a similar purpose ; the lid shuts down over the basin, ewer, and the toilet apparatus. In the lid is a mirror ; and small drawers in front serve to contain various articles for the toilet. By means of handles at the ends, the whole may be readily moved from

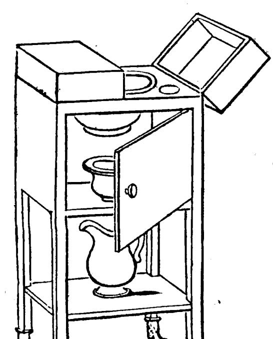


Fig. 445.

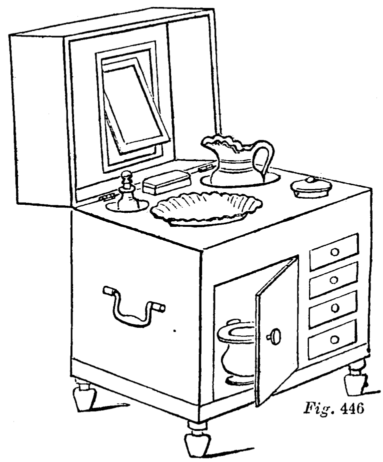


Fig. 446

place to place as required. *Fig.* 447 is a wash-stand upon a very simple construction, with a small cistern at the top, and a plug in the basin, that the foul water may go into a vessel below. There is a mirror in the lid. *Figs.* 448, 449 are small wash-stands of elegant French patterns. They are executed in mahogany, and French polished.

A wash-stand, to be complete, should have, besides the basin and ewer, a carafe for spring water, vessel for hot water, soap tray, several glasses, and it would be better did it contain the necessary apparatus for shaving, &c.

1236. *Bed cupboards and night-stands.*—These conveniences are frequently made in the form of pedestals, either round or square ; sometimes with a marble top, *figs.* 450, 451, which have a shelf in the middle. *Fig.* 452 is another variety, which has, instead of a door, sliders composed of a system of mahogany laths, so constructed as to slide round the corners, a plan which obviates the inconvenience sometimes occasioned by

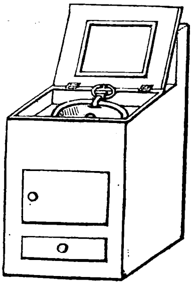


Fig. 447.

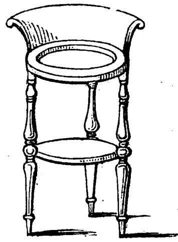


Fig. 448.

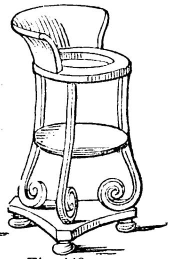


Fig. 449.

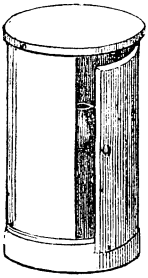


Fig. 450.

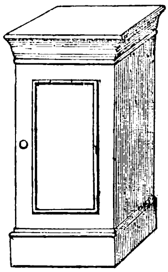


Fig. 451.

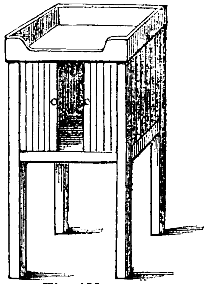


Fig. 452.

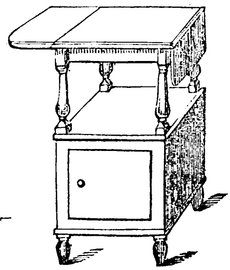


Fig. 453.

the projecting of a door when opened. A fence round the top is likewise useful. *Fig.* 453 is one in which the top may be extended upon occasion by two folding leaves. It is easy to see how the advantages of the last two may be combined.

1237. *Portable water-closets* are useful where fixed ones cannot be had, and in case of sickness; as they may be placed in a dressing-room, or even a bedroom. If ill constructed, they are a nuisance; but we can recommend the following, patented by Wiss, near Charing Cross, London. *Fig.* 454, *a*, *a*, is the cistern for water, surrounding the three sides of a box which holds the pan, *b*; the cistern is filled by lifting up a small lid, *c*, and by pulling the handle of an engine, by which the water is forced into the pan through the washer. This water, by its weight, opens the hinged valve at the bottom of the pan, and carries the contents into a pail, *e*, placed beneath. This pail has a cover with a projection that dips into a groove containing a little water, that effectually prevents any effluvia from coming out. The pail can be removed to empty it. This apparatus may be made in a variety of forms; as a seat, an arm-chair, a commode, settee, &c. The same moveable box, with the cistern and pan, may be used without a pail, and be more complete, where there is the convenience of connecting it with a pipe to go into a drain or cesspool. In this case there is a curved tube, *f*, to be joined to the pipe, which, being always full of water up to the dotted line, stops any smell from ascending.

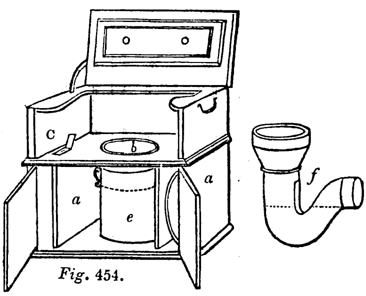
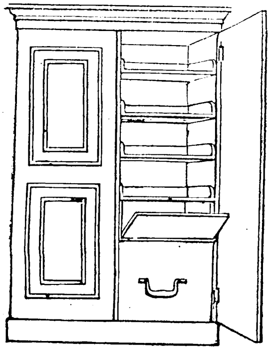


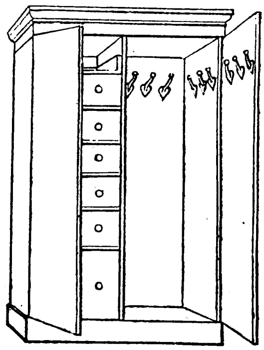
Fig. 454.

Sect. V.—Wardrobes.

1238. *Wardrobes are far more convenient for keeping apparel than the chests of drawers formerly in general use.* In wardrobes, the dresses are hung up, or laid on shelves which draw out, and are therefore not injured by folding; also, by unlocking one or two doors, the whole is exposed to view, or secured by locking them, without the trouble of employing the lock and key of each drawer. Wardrobes are made of various forms and sizes, according to the particular uses for which they are required, or the expense to be gone to, and they are accordingly constructed of various woods, as mahogany, wainscot, or deal painted.

Fig. 455 represents one of the simplest and cheapest wardrobes, being a press with folding doors and sliding shelves. At the bottom is a deep drawer for holding bonnets and caps; these are best placed upon bonnet-holders within the drawer, *fig.* 456, or hung on hooks fixed in the inside of the drawers, as in *fig.* 457. Drawers certainly ex-





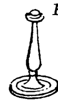


Fig. 456

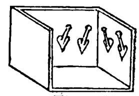


Fig. 457.

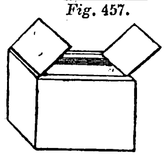


Fig. 455. *Fig.* 459. *Fig.* 458.

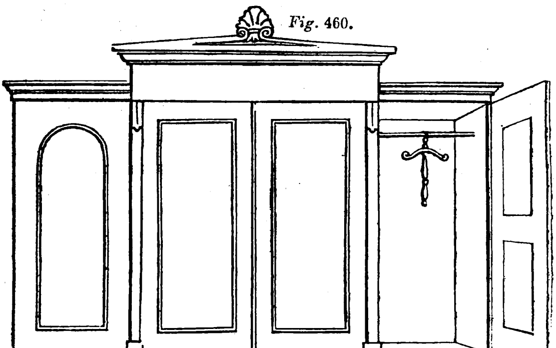
clude the dust better than sliding shelves ; and they may be equally convenient if the fronts are made to fold down in the manner of a pianoforte ; this is shown just above the deep drawer in *fig*. 455.

But the most complete mode of excluding all dust from delicate things is to have each drawer covered by four pieces of paper fixed by paste to the upper edges of the drawer. Two of these papers, which must be in width more than half that of the drawer, and consequently lap over each other, are first folded down, and over them the other two, as shown in *fig*. 458. In many cases two only will be found sufficient. The paper should be rather thin and pliable.

Fig. 459 is another wardrobe, with an upright partition in the middle ; the space on one side has no shelves, but instead pegs at the top for hanging cloaks, dresses, coats, &c. ; and cloak pins are also placed on the inside of the door to hang more things on. On the other side of the partition are sliding shelves or drawers.

Fig. 460 is a wardrobe of a more elegant design, executed in fine mahogany, and

Fig. 460.



French polished. This is termed a *winged* wardrobe, from the pieces on the side of the central one. The central part contains sliding shelves or drawers, as may be found most convenient, or the upper part may have sliding shelves, and the lower part drawers ; and the wings are for hanging dresses in ; the most perfect mode of doing this is to put the dresses on the apparatus of brass represented sliding on a rod, and consisting of a handle and cross piece, something like a cross-bow. The cross piece goes into the arm holes of the dress, and several may be suspended on the same rod : by this means each dress may be easily seen and got at without disturbing the rest. One or two of the panels of the door of this wardrobe may be filled with mirrors.

1239. *Fig*. 461 is a *dwarf wardrobe*, proper when a small one is sufficient, or where there is not room for a larger. *Fig*. 462 is a small wardrobe of a very plain kind.

1240. *Small boxes* are likewise found convenient, in addition to a wardrobe, for holding various parts of dress or soiled linen. They may be fitted up to hold bonnets, caps, &c., and may be made of light materials, or strong, of wood : in the latter case they may be of the size proper for a seat, for which they may be used, having a stuffed cushion on the top, and the whole being covered with chints. A *settee or ottoman made to open* is useful to keep ladies' dresses in, when there is not a wardrobe or room for one.

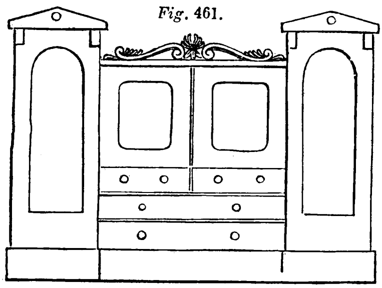


Fig. 461.

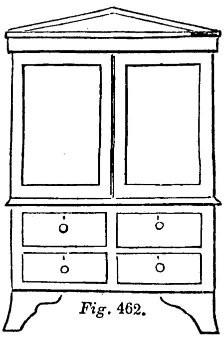


Fig. 462.

SECT. VI.—CHESTS, DRAWERS, ETC.

1241. *Chests or coffers*, often curiously carved in oak, and ornamented with hinges, escutcheons, &c., were among the ancient articles of furniture in England, and were originally almost the only contrivances for preserving clothes, books, or other valuable articles not in constant use. They were most usually separate constructions, but sometimes also formed part of the settle that stood in the chimney corner. The latter are still occasionally seen in old houses in remote parts of the country, but the greater part have been by this time chiefly bought up by upholsterers who manufacture ancient furniture. Plates of them may be seen in books on antiquities.

1242. *Travelling boxes, for caps or bonnets*, have a frame with a narrow girth crossed within, as *fig.* 463, to the under side of which the caps are pinned, so as not to touch the sides, or each other. Frills, laces, and light articles of that kind, are fixed upon the upper side of this network. Care should be taken to carry the boxes always top uppermost, and the caps will arrive at their destination without the slightest injury. The outside of the box is covered with some water-proof substance, as painted canvass.

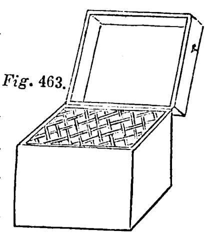


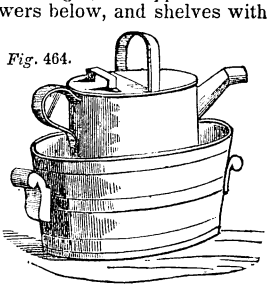
Fig. 463.

1243. *Presses for linen* are made nearly in the same manner as wardrobes, with sliding shelves and drawers. They should have the names of the contents of each shelf pasted on the edge; there should also be deep chests in it, on castors, to draw out for dirty linen; and also spaces for baskets. If there is sufficient space, one compartment might contain a desk with writing materials and paper, also washing-book, &c.

1244. *Chests of drawers* are well known, and were once universally used, till they have given way, in a great measure, to wardrobes. They are, however, still employed, and may be purchased of various qualities and prices, from deal and wainscot to the best mahogany. All the handles of the drawers are best when of the form of knobs of hard wood; brass tarnishing, and being otherwise liable to be out of order. If a sliding shelf were made to pull out from below the top on occasion, it would add to its convenience as a table. Low chests of drawers of the usual height of a table, when fitted up in this way, are useful as an occasional writing-table; or there might be a flap to fold back on the top, and come forward, being supported by lopers, as in a bureau. We mention this, because it is very desirable that the varieties of useful furniture should be increased by the contrivances of individuals, and not be left entirely to manufacturers, who go on repeating the same forms, and seldom attempting novelties of a cheap kind, however useful they might be.

1245. *The commode* is evidently, from the name, of French origin, and appears to include a chest of drawers and chiffonnière, containing drawers below, and shelves with doors above. It is a very useful piece of furniture in a good bedroom, or a ladies' sitting-room. It may likewise serve as a bookcase.

Fig. 464.



1246. *Foot-pans* are either of wood, earthenware, or metal, as tin or zinc. Small tubs are apt to open in the joints when they stand by dry for any time; earthenware is free from that objection; but as the interior, being glazed, is unpleasantly slippery, it is best to have a loose piece of board to cover the bottom, loaded with lead to keep it down. They are now frequently made, in the form *fig.* 464, of zinc painted in oil. The vessel inside is for holding water.

1247. *Baskets*, so useful, are too well known to require description; but a curious fact is not so much known, that in some countries they are so well made as to hold any liquid. Vaillant, in his travels among the South Africans, says, "Another offered me milk in baskets, a circumstance that astonished me. 'What,' exclaimed I, 'milk in baskets!' These baskets," he continues, "are very pretty, and fabricated with reeds so closely interwoven, that they will hold water:" and Barrow confirms this account of them. Several travellers have mentioned the ingenuity displayed in the manufacture of baskets among uncivilized nations.

1248. *Fire guards*, of painted wire, are so great a security against accidents from fire, that bed-chambers and dressing-rooms should never be without them; and, in general, they are proper to be used for all fires that are left for a considerable time to themselves.

1249. *The principal articles requisite for the dressing-room and toilet-table* are wardrobes; commodes; wash-stands; dressing-glasses; dressing-case, with razors; shaving boxes; hat, and clothes, and bonnet brushes; hair, tooth, and nail brushes; shoe lifts; boot and button hooks; tongue scrapers; cap and wig blocks; wardrobe powder, for dry-cleaning silks; corn rubbers; toilet cushions; braid combs of various sizes; powder boxes and puffs; towel airers; toilet covers; work-boxes, and loaded pincushions; candlestick stands; bonnet boxes; sponge and sponge bags; flesh brushes; soaps of various kinds.

CHAPTER XIII.

INVALID FURNITURE.

1250. Invalids frequently require peculiar articles of furniture to afford them ease and relief. Without attempting to detail all the contrivances for this purpose, which must vary in some degree with the particular cases, we shall give examples of such articles as, being frequently demanded, are usually made and kept for sale.

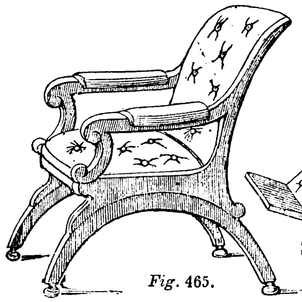


Fig. 465.

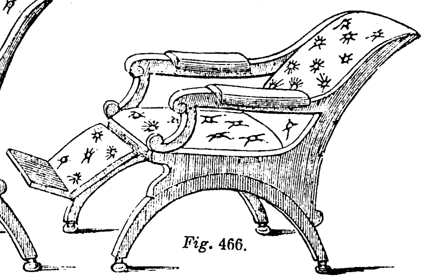


Fig. 466.

1251. *Reclining chairs* are found convenient not only for invalids, but for affording rest after fatigue, or for varying the position of the body on occasion. *Fig.* 465 represents one that, when upright, may be used as an ordinary chair; but by the back and seat sliding round on the circumference of the arched legs, the chair is brought into a position for reclining, as at *fig.* 466; and a rest for the legs and feet may be drawn out from beneath the seat. These chairs may be covered with Morocco leather, and stuffed. *Fig.* 467 is one where the back may be made to form any angle with the seat by a joint, and may be laid almost quite flat, the arms sliding in a groove in the frame of the seat.

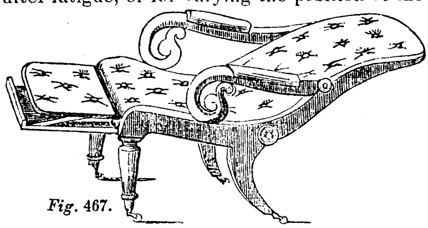


Fig. 467.

1252. *The Douro chair*, *fig.* 468, is said to have been invented by the Marquis of Douro as a camp chair. The back is made to slope in any degree required, merely by shifting the holes in the leather straps by which it is supported; and it thus becomes a very economical and comfortable easy or arm chair. To render it portable, the frame is made to fold up flat with the greatest facility, and the stuffed back and seat being laid upon it, the whole is strapped into a square package.

1253. *A rocking chair*, for exercise, is represented in *fig.* 469. It is made wholly of iron, with a stuffed covering, but not very heavy.

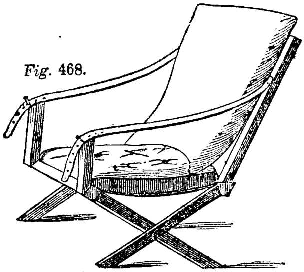


Fig. 468.

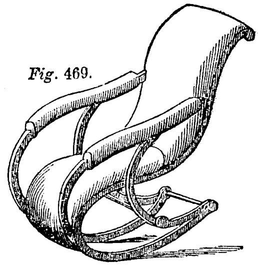


Fig. 469.

1254. *The Merlin chair*, *fig*. 470, is a very ingenious invention, by which an invalid may move himself to any part of the room, by turning the handles which move the wheels of the chair by means of pinions on axles: but it is to be observed that it requires some little practice to learn the manner of working this chair; on which account the construction, *fig*. 471, is preferable, in which the two large wheels of the chair are moved by the invalid laying hold of a smooth mahogany circular rim outside the wheels, and of a smaller diameter, and which is several inches distant from the wheels. There are handles at the back for an assistant, if necessary.

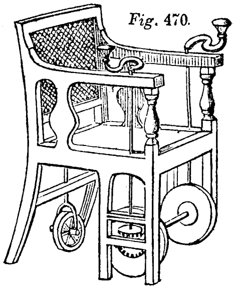


Fig. 470.

Fig. 472 is the *Bath rail chair*, for exercise out of doors, to be drawn by an assistant.

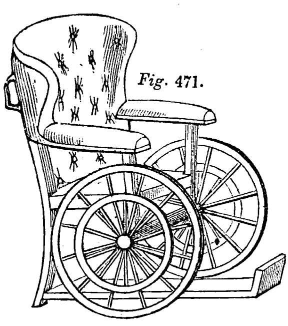


Fig. 471.

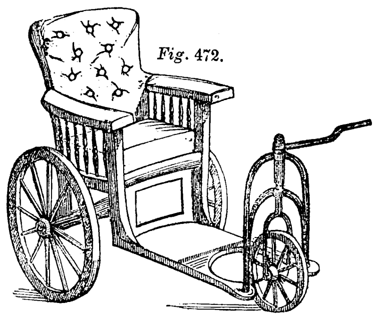


Fig. 472.

Fig. 473 is the *sofa britska carriage* for persons who have spinal complaints.

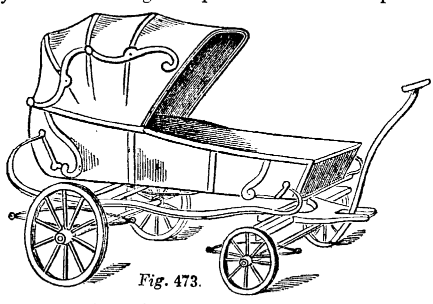


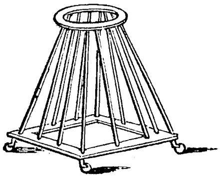
Fig. 473.

All these articles of invalid furniture are made by Mr. Griffin, of Leicester Square, London, who has paid particular attention to the subject.

1255. *Fig*. 474 is called a *walking-horse*, and is for assisting a person to stand and move about who is too weak to be able to stand without such assistance; the body of the person goes within the hoop at the top.

1256. *Leg rests* are used in cases of gout, or any complaint in the legs that requires them to be kept up in a certain position. *Fig*. 475 is the simplest, consisting merely of two pieces of board at right angles to each other, one of them being covered with some stuffing, or only baize. *Fig*. 476 is a more complete one, made of mahogany, well stuffed, and so as to be raised to any desired angle by a rack.

Fig. 474.



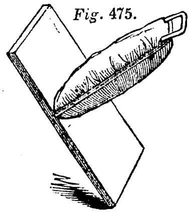


Fig. 475.

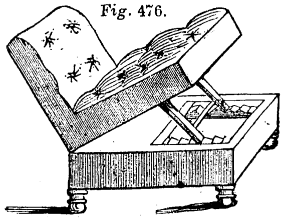


Fig. 476.

1257. *Bedsteads for the sick and wounded* are eminently useful in alleviating their sufferings, by affording them ease in changing their position, or removing the pressure upon a particular part of the body ; many contrivances have been made for this purpose, and employed in hospitals, as well as other places.

Fig. 477 is the simplest, consisting of an ordinary bedstead with a part of the sacking made to raise at the head, so as to support the back of the invalid : this may be elevated to any angle by two upright pieces with holes and pins through the bedframe.

Fig. 478 is called a *bed chair*, and is placed behind the back of invalids in bed, to en-

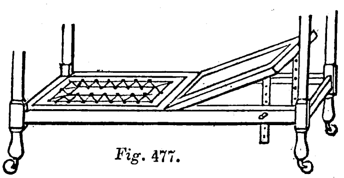


Fig. 477.

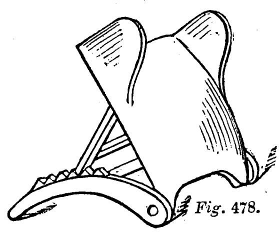


Fig. 478.

able them to sit up. It may be elevated to any required angle by means of a rack behind.

1258. *A bed table for invalids, fig.* 479, is made so that the foot of it can be put under the bed and the top project over. It may have a reading-desk or not, as required. The top is made to rise higher or be lowered, and is fixed at any height by means of a screw, as at *a*, or as at *b*, in which, by turning the handles, the table is raised or lowered. The foot should be made heavy by lead underneath, and the top should turn round upon the stem. It may be made of mahogany, or any other kind of wood, according to price, and the top may be made with various conveniences, as at *b*, with a board for draughts, or any other game, and a well below to keep cards, chess-men, &c.

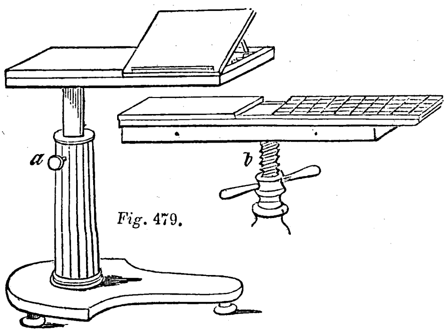


Fig. 479.

Fig. 480 is an *invalid couch*, contrived to raise the back to any angle, and to conform

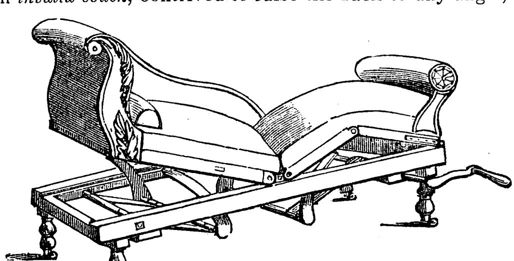


Fig. 480.

to the situation of the legs, by elevating part of the frame by means of a winch acting on levers by bands This is usually called a *fracture bed*, and is made by Mr. Chapman, of Denmark-street, Soho, London. It has been recommended by Sir Benjamin Brodie, and other eminent surgeons.

1259. *An elastic or swinging seat, couch, or bed,* for counteracting the uneasy motion of a ship or carriage, and thus preventing sickness, was invented by Mr. Pratt of Bond-street. To effect this, the frame of the seat or couch is suspended on juribals or joints, turning at right angles to each other; and an elasticity is produced both in the seat and cushion, and in the swinging frames, by the use of spiral metal springs, which, it appears, were first introduced by Mr. Merlin seventy years ago, but which had been neglected until lately.

1260. *A bedstead for invalids* was also invented by Mr. Cherry of Coventry. The sacking is attached to a cylinder on each side of the bed, and running lengthwise: these cylinders contain springs by which the sacking is kept always stretched when not in use; but when it receives the weight of the body, the springs give way a little, and the bedding sinks down several inches into a concave form, by which it encompasses the sides of the patient, and relieves the back from sustaining the whole weight. The patient may also, by the construction of the bed, be placed in any required position; and the bedstead may be converted into an easy chair.

1261. *The invention of cloth impenetrable to fluids* has given rise to invalid beds of an excellent kind. So long ago as 1819, Joseph Pierre Gros, member of the Medical Athenæum at Montpelier, published a thesis read to the Ecole de Médecine of Paris, in which he states that he had employed water for this purpose, which, he observes, possesses three important characters, viz., perfect softness, arising from the mobility of its particles, capacity for caloric, and the susceptibility of being contained in an envelope impenetrable by the excrementitious matters of the sick, and being inaccessible to contagious miasma. This thesis is preserved in the library of the Ecole de Médecine of Paris.

1262. *Dr. Arnott's hydrostatic bed* is particularly useful for invalids, and we cannot do better than give the description of it in his own words: "In many of the diseases which afflict humanity, more than half of the suffering and danger is not really a part of the disease, but the effect or consequence of the confinement to which the patient is subjected. Thus, a fracture of the bone of the arm is as serious an injury as one of the bones of the leg; but the former leaves the patient free to go about and amuse himself, or attend to business, as he wills, and to eat and drink as usual—in fact, hardly renders him an invalid; while the latter imprisons the patient closely upon his bed, and brings upon him, first, the irksomeness of the continued position, and then the pains of the unequal pressure borne by the parts on which the body rests. These, in many cases of confinement, disturb the sleep and the appetite, and excite fever, or such constitutional irritation as much retards the cure of the original disease. That complete inaction should prove hurtful to the animal system may by all be at once conceived. The operation of continued local pressure will be understood from the following statements: The health, and even life, of every part of the animal body depends on the sufficient circulation through it of fresh blood, driven in by the force of the heart. Now, when a man is sitting or lying, the parts of his flesh compressed by the weight of the body do not receive the blood so readily as at other times; and if, from any cause, the action of his heart has become weak, the interruption will both follow more quickly and be more complete. A peculiar uneasiness soon arises where the circulation is thus obstructed, impelling the person to change of position; and a healthy person changes this as regularly and with as little reflection as he winks to wipe and moisten his eyeballs. A person weakened by disease, however, while he generally feels the uneasiness sooner, as above explained, and therefore becomes what is called restless, makes the changes with much fatigue; and should the sensations after a time become indistinct, as in the delirium of fever, palsy, &c., or should the patient have become too weak to obey the sensation, the compressed parts are kept so long without their natural supply of blood that they lose their vitality, and become what are called sloughs, or mortified parts." Dr. Arnott then describes some cases of that kind, and continues: "Under these circumstances, the idea of the hydrostatic bed occurred to me. Even with the pressure of an air pillow, it was evident that persons in such a condition could not be saved unless they could be supported without sensible inequality of pressure. I then reflected that the support of water to a floating body is so uniformly diffused that every thousandth part of an inch of the inferior surface has, as it were, its own separate liquid pillow, and that no part bears the load of its neighbour; that a person resting in a bath is nearly thus supported; that a patient might be laid upon the surface of a bath over which a large sheet of the water-proof India-rubber cloth was previously thrown, the body being rendered sufficiently buoyant by a soft mattress placed beneath it. Thus the patient would repose on the face of the water, like a swan on its plumage, without sensible pressure anywhere, and almost as if the weight of the body was annihilated. The pressure of the atmosphere on our bodies is fifteen pounds per square inch of its surface, but, because *uniformly diffused*, is not felt. The pressure of a water-bath of depth to cover the body is less than half a pound per inch, and is similarly unperceived. A bed such as this was made. A trough of convenient length and breadth, and a foot deep, was lined with metal to make it water-tight; it was about half filled with water, and over it was thrown a sheet of the India rubber cloth, as large as would be a complete lining to it if empty. Of this sheet, the edges, touched with varnish to prevent the water creeping round by capillary attraction, were afterward secured in a water-tight manner all round to the upper border or top of the trough, shutting in the water as closely as if it had been in bottles; the only entrance left being through an opening at one corner, which could be perfectly closed. Upon this beautiful dry sheet a suitable mattress was laid, and constituted a bed ready to receive its pillow and bedclothes, and not distinguishable from a common bed but by its most surpassing softness or yielding. It may be here recalled to mind that the human body is nearly of the specific gravity of water, or of the weight of its bulk of water, and therefore, as is known to swimmers, is just suspended or upheld in water without exertion, when the swimmer rests tranquilly on his back with his face upward. He then displaces water equal to his own body in weight as well as in bulk, and is supported as the displaced water would have been. If his body be two and a half cubical feet in bulk (a common size), he will just displace two and a half cubical feet of water, equal in weight to his own body. If, however, instead of displacing the water with his mere body, he choose to have something round or under him which is bulky with little weight, as the mattress of the bed above described, when his weight has forced two cubical feet of that under the level of the water around, he will float with four fifths of his body above the level, and will sink much less into his floating mattress than a person sinks in an ordinary feather bed. It thus appears that, by choosing the thickness of the mattress, and, if unusual positions are required, by having different thicknesses in different parts, or by placing a bulk of folded blanket or of pillow over or under the mattress in certain situations, any desired position of the body may be easily obtained. If the water be about six inches deep, which, in general, will suffice, the person standing upon any part of the bed, or sitting with the knees raised, will cause the part of the mattress on which he rests gently to touch the bottom, because a narrow end of the body cannot displace water equal to the bulk of the whole; but then the person is standing or sitting upon a soft sofa, and in standing or sitting, he naturally prefers the fixed to the floating support: on lying down, however, he as completely floats as if the Atlantic were under him.

"This bed is warm, owing to water being nearly an absolute non-conductor of heat from above downward, and owing to its allowing no passage of cold air from below. From this last-mentioned fact, however, less of the perspiration, sensible and insensible, will be carried off by the air than in a common bed; and unless the patient can rise, or be lifted daily, to allow the bed to be aired like a common bed, there will be a necessity for using some such means as the following, to prevent the condensation of perspiration on the water-sheet below: An oiled silk laid over the mattress, or a blanket, to be occasionally changed, laid under it, or a set of flexible tubes of spiral wire laid under it, with their ends open to the atmosphere, to ensure a constant ventilation of the mattress; or, similarly placed, and producing the same effect, a layer of cork cut into square pieces, with spaces left between them as conduits of air. This bed is in itself as dry as a bed can be, for the India-rubber cloth (of which bottles can be made) is quite impermeable to water. Then some persons may prefer having a double sheet of it, to prevent the possibility of accident. Unlike any other bed that ever was contrived, it allows the patient, when capable of only feeble efforts, to change his position, almost like a person swimming, and so to take a degree of exercise affording the kind of relief which, in constrained positions, is obtained by occasionally stretching, or which an invalid seeks by driving out in a soft-springed carriage." Dr. Arnott then states that it has been introduced with success into several hospitals. He observes, "If used without the mattress, it becomes a warm or a cold bath, not allowing the body, however, to touch the water; and in India it might be made a cool bed, for persons sick or sound, during the heats which there prevent sleep and endanger health. Before reflection, a person might suppose a resemblance between it and an air bed or pillow, calling this a water bed or pillow; but the principles of the two are perfectly distinct or opposite. An air-pillow supports, by the *tension of the surface*, which encloses the air, and is therefore like a hammock or the tight sacking under the straw mattress of a common bed, and really is a hard pillow; but in the hydrostatic bed there is no tense surface, or wet at all: the patient is floating upon the water, on which a loose sheet is lying, merely to keep the mattress dry, and every point of his body is supported by the water immediately beneath it. To recall the difference here described, and which is of great importance, the bed is better described by the appellation of *hydrostatic bed* than of *water bed*.

The envelopes made at present to contain water for beds are liable to a defect, that the canvass, which is always in contact with the water, decays in a short time, generally in a year, and sometimes in six months, and the whole water-tight case then requiring to be renewed; this not only creates a considerable expense, but the renewal cannot be effected in every place. Some material of superior manufacture might, perhaps, obviate this difficulty.

1263. *Sedan chairs*, once so common, are now scarcely known, except as a conveyance for invalids. They were first introduced into England in the reign of James I., when they were used by the Duke of Buckingham, to the great indignation of the people. Towards the end of the reign of George III. the increase of carriages occasioned them to be gradually laid aside.

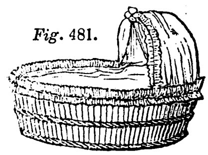
CHAPTER XIV.

FURNITURE OF THE NURSERY.

1264. The furniture of the nursery ought to be very simple, and should consist of no more things than are absolutely necessary. We refer the reader to Book XXII., "On the Nursery," and propose at present to describe such things as can be illustrated by figures.

1265. *The bassinet*, *fig*. 481, is usually the first thing the infant is put into. It is, in fact, a basket, with a hood which may fall backward if required. It has a hair mattress, stuffed very soft, and a small soft pillow; it is lined within, is very convenient for carrying about without wakening the child, and is much warmer than a large cradle or bed. It is generally made of wicker, about 2½ feet or 3 feet long, 18 inches wide, and fifteen deep, and is usually ornamented with muslin, ribands, &c.

Fig. 481.



1266. *Cradles* have been used from time immemorial, and the rocking has been thought necessary to cause children to sleep; but rocking and swinging are now generally condemned by medical men. Rocking is liked by nurses, who find it convenient in sending infants to sleep when they ought, perhaps, to be carrying them about in the open air, until at last, from habit, they will scarcely sleep without it. When children are in good health, they require no rocking; nevertheless, in certain cases, it appears to be useful in allaying irritation, particularly in a state of disease. They are usually made of basket-work, *fig*. 482, but also of other materials.

Fig.482.

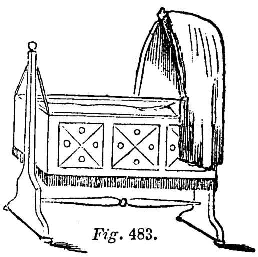


Fig. 483.

In the swinging cot, *fig*. 483, the motion is more gentle than in the cradle.

1267. *Cribs*, *fig*. 484, are more generally used at present. These are small bedsteads, supported on feet of such length that the height of the crib may be the same as that of the mother's bed, close to which it is placed in the night; one side is made to slide out in a groove in the uprights. The sides are frequently filled in with cane-work, or small balustrades; but care should be taken to have the cribs also lined inside, for it has sometimes happened that the child's fingers have been hurt by getting them in the openings. They are put on castors, and may be made to take to pieces, and put up very easily for travelling.

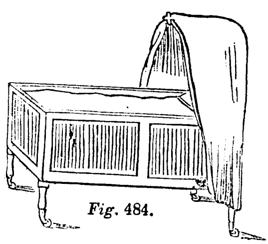


Fig. 484.

1268. *Children's chairs* are of various kinds, varying with their age. *Fig*. 485 is a little chair without legs, which some use to place very young children who cannot support themselves: it has a stuffed seat.

Fig. 486 is a child's chair, called a *Bergère*, used when they begin to sit at table. There is a bar across to prevent the child's falling, and this bar should have a fastening to prevent its getting out, which it is apt to do. The chair has also a foot-board, which may be placed at different heights, and is placed upon a square stand to raise it to the table. At other times the stand itself may form a table for the child to put its playthings on.

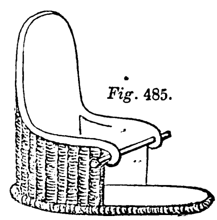
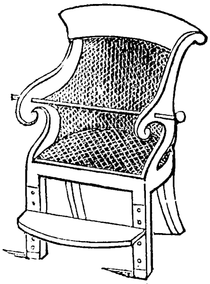


Fig. 485.

Fig. 487 is a similar chair of a different pattern, and high enough to do without a stand.

Fig. 488 is a chair called an *Astley Cooper's*, because recommended by him; the back is high, to afford a support for the child, and prevent it stooping when placed at table; but this form is not universally approved of, and is objected to by some medical men.

Fig. 486.



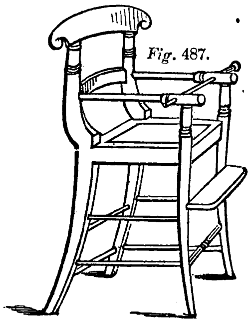


Fig. 487.

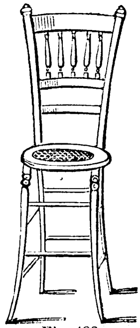


Fig. 488.

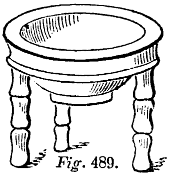


Fig. 489.

1269. *Child's bath.* This is a large earthen-ware basin fixed in a stand of wood, *fig.* 489.

1270. *Earthen-ware* vessels of various kinds are made on purpose for the nursery, and are kept at most of the respectable shops that sell earthen-ware. They are made plain, and of convenient forms.

Fig. 490.

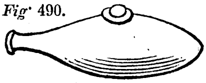


Fig. 490 is a sucking bottle, the use of which is well known.

1271. *The nursery lamp*, for keeping liquids warm in the night, or for warming anything in the day when there is no fire. *a b*, *fig.* 491, is a cylinder of tin, within which a lamp is placed upon a shelf that is moveable up and down by means of a slit in the tin cylinder, and a screw, *d*, that fixes it at any particular height from the vessel holding what is to be warmed and placed on the top. This vessel may be of tin, or earthenware, or porcelain, or it may be a small tea-kettle, all of which must fit exactly within the top. At *e f* there should be small apertures to let out the smoke and hot air, otherwise the lamp will not burn; and there must also be apertures below the lamp to supply air. If, instead of a tin cylinder, there is one of wire gauze, the lamp will also afford light, and yet be perfectly safe; and it may be then made use of, on occasion, as a housemaid's safety lamp. Should a stronger heat be wanted, without smoke, the chemical Argand lamp with a copper tube may be used, which, in a few minutes, would boil water enough for one person's breakfast. The handle is not represented in the woodcut.

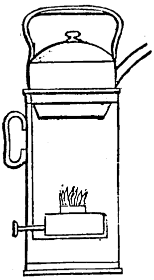


Fig. 491.

1272. *The nursery milk-warmer*, *fig.* 492, is a very useful apparatus, on the principle of the balneum mariæ, or water-bath. It consists of a small saucepan of tin to hold water, and another to fit within, but not to reach to the bottom of the external saucepan. This has a cover of the same material. This utensil effectually prevents the common accident of burning when anything is heated, because whatever is put into the inner vessel can be no hotter than boiling water, or 212°, a heat not sufficient to burn.

The inner vessel is sometimes made of white glazed earthenware.

Fig. 493 is more easily kept clean.

Fig. 494 is a section, by which the principle may be more easily seen; a small one may be used over the nursery lamp.

Fig. 492.

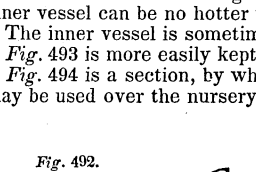


Fig. 493.

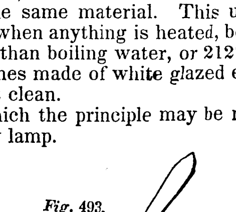
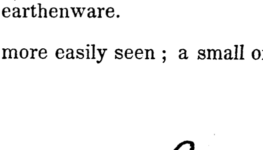


Fig. 494.



1273. *Wire guards for the fire* should never be omitted in a nursery.

1274. *Fly guard.* It has been lately discovered that a net placed across a window on the outside will effectually prevent the entrance of flies when the windows are open. The net may be stretched on a frame to be fixed within the reveals of the window. Whether from the fear of entangling their wings, in consequence of their experience, or for some other reason, they avoid trying to come through a net, even when the meshes are as wide as nearly an inch square, and the net made of black thread.

1275. *If balconies are used* before nursery windows, care should be taken that the bars are very close, as instances have been known of children getting their heads out between the iron bars, which were obliged to be cut through before they could be rescued from their dangerous situation.

1276. *A complete list of furniture* may be found convenient to refer to in arranging an establishment.

FURNITURE OF THE HALL AND STAIRCASE.

Door scrapers and brush.	Chairs.	Mats.
Cloak and hat stands.	Benches.	Letter box.
Cloak rails.	Floor cloth.	Lamps.
Umbrella drains.	Stair carpet and rods.	Stove.

FURNITURE OF THE PRINCIPAL APARTMENTS.

Window curtains.	Tapestry.	Music stool.
Window blinds.	Pictures and statues.	Canterburies
Carpets and druggets.	Vases and various ornaments.	Tea equipage.
Tables and stands.	Book cases.	Tea poise.
Sideboards and cellarets.	Book shelves.	Cheffoniers.
Moving sideboards.	Writing tables.	Fire-screens.
Rising tables.	Writing desks.	Folding screens.
Dumb waiters.	Secretaries.	Hand screens.
Sofas and couches.	Bureaus.	Hearth rugs.
Ottomans and divans	Cabinets.	Bells, ropes and pulls.
Chairs and seats.	Portfolio stand.	Table bells.
Stools.	Inkstands.	Lamps.
Mirrors.	Music stands.	Candlesticks.

FURNITURE OF BEDCHAMBERS AND DRESSING-ROOMS.

Beds and bedding.	Toilet tables and apparatus.	Cabinets.
Chairs and couches.	Dressing glasses.	Chests and coffers.
Carpets and hearth rugs.	Mouth glasses.	Bonnet boxes.
Matting.	Wardrobes.	Wash stands.
Bed steps.	Chests of drawers.	Chamber horses.
Window curtains.	Commodes.	Towel airers.
Blinds.	Hassocks.	Foot baths.
Baskets.	Night bolts.	Water cans.
Night convenience.	Boot hooks.	Baths.
Dressing cases.	Shoe lifts.	Clothes brushes.
Shaving pots.	Wax tapers and stands.	Alarm rattles.

FURNITURE OF THE NURSERY.

Bassinets and cradles.	Baths.	Pap boats.
Nursing and rocking chairs.	Shower baths.	Earthen-ware.
Astley Cooper and wicker do.	Nursery lamps.	Baby linen baskets.
Washing stands.	Sponges.	

CHAPTER XV.

EARTHEN-WARE, INCLUDING PORCELAIN.

SECT. I.—HISTORICAL REMARKS ON POTTERY.

1277. *The produce of the potter's art is the more interesting, as it is every day subject to our observation.* Not a day passes but we receive more or less pleasure from the neatness and beauty of those vessels from which we take our breakfast beverage, or our evening's refreshment. Vessels made of baked earth capable of holding liquids doubtless preceded those of metals; and the possession of the potter's art marks a certain advance in civilization, although we find that it existed among nations of the highest antiquity, when still in a very rude state. This invention was probably coeval with that of making bricks, which, we know, was practised at the building of the tower of Babel 2200 years before the commencement of the Christian æra. That pottery was carried to great perfection among the ancient nations, is shown by the exquisite remains discovered in Egypt, Greece, Italy, and other classic countries. Specimens of Mexican pottery exist which have a considerable resemblance to the Egyptian.

1278. *It is probable that the ancient Britons were acquainted with this art,* from the vases of earthen-ware which have been found in barrows in different parts of the kingdom.

Abundant remains of beautiful red pottery, made by the Romans, are found in the vicinity of Bath, and other parts of England where they had settlements, as at Burslem, in Staffordshire, where it appears, from fragments dug up, a Roman pottery existed; but it does not appear that the Greeks or Romans employed a vitreous glaze, though this is common in Egyptian antiquities, and had been long known to the Chinese. In later times, earthen-ware with a painted glaze was largely employed by the Arabians in decorating mosques and other buildings, as well as for domestic purposes, and the art of fabricating it passed from them into Spain in the ninth century.

1279. *A manufacture of beautiful compact stone-ware was established at Fayenza, in Italy,* from which the French term *faience* seems to have come. The body of this was a red or a white clay, and the glaze was opaque, being formed of the oxydes of lead and tin along with potash and sand. The Venetians, Genoese, and Florentines bestowed much pains upon this manufacture, and specimens of their early pottery are much prized by collectors: some of it is elegant in form, and admirably painted. It is said that Raphael in his youth, as well as other able artists, painted on earthen-ware, or at least gave designs for that purpose, and some is still distinguished by the name of *Raphael's china*, which sells for a very high price.

1280. *Bernhard de Pallissy*, a person of great ingenuity, about the middle of the sixteenth century, manufactured the first white *faience* at Saintes, in France, and not long afterward, the Dutch produced a similar article, of a substantial make, called, from the place where it was made, *Delft-ware*, but destitute of those graceful forms and paintings for which the ware of Fayenza was distinguished.

1281. *The Dutch probably derived their knowledge of this manufacture from the Venetians*, with whom they had extensive commercial dealings; but the blue colour which they employed in ornamenting it with Dutch subjects may have been imitated from the blue and white ware of Nankin, which they likewise imported. Delft-ware is a very coarse kind of pottery, and, from the coarseness of its texture, the potter was obliged to make it thick, clumsy, and heavy, in order to ensure its strength and durability. The glaze was made of common salt, sand ground fine, oxyde of lead, and oxyde of tin, the latter giving opacity to the glaze. It resisted the sudden application of heat, and was much employed, among other things, for tiles to line chimney fireplaces and stoves.

Before the manufacture of European porcelain, a great deal of the best earthen-ware used in this country was imported from Delft, or was made at Lambeth, where some Dutchmen had settled about two hundred years ago. But the use of Delft pottery was afterward superseded by the white stone-ware from Staffordshire, the latter being lighter and more durable. Delft-ware is now made only into tiles for lining dairies and baths, pomatum pots, a few jugs, and similar articles, and, instead of twenty manufactories of it, as formerly at Lambeth, it only partially employs one.

The vast improvement that has taken place of late in English pottery will be described under "English white stone-wares."

Sect. II.—Principles of Pottery.

1282. *Clay is the material which forms the basis of all kinds of pottery*, whether coarse or fine. Pottery may be divided into two principal kinds: *ordinary earthen-ware* of every kind, which is formed of clays that are infusible in a strong heat, and continue always opaque after having been fired in the furnace; and *porcelain*, which is composed of two sorts of earth, one infusible, and the other fusible, by which, when baked in the strong heat of a furnace, it becomes semi-vitrified and translucent.

1283. *Natural clays* are of various qualities; but those which are fit for the potter are rare. Clay consists of the earths alumina and silica mingled together.* Alumina readily unites with water, and forms with it a pulpy mass, which has a certain degree of tenacity and adhesiveness. Silica, on the contrary, when mixed with water, has no adhesive property. It is, therefore, the alumina in the natural clays that gives them the property of being plastic, or capable of being moulded into any form when in a moist state. Alumina is never found pure or separate in nature, although it can be procured by the chemist by detaching it from other substances; but this is not necessary for the purpose of the potter; the clay which he requires is a *natural* mixture of alumina and silica.

1284. *Clay, when made into a paste with water*, becomes harder by drying; but then it shrinks, and is apt to become full of cracks. The mixture of silica with the alumina corrects this fault, the silica having no tendency to crack. Clay, after having been properly worked up into various forms when in a moist state, and dried in the sun and air, so as to acquire a certain degree of hardness, may be softened again by being beat up with water, and thus brought back to its original state. But if such hardened clay be exposed to the heat of a strong fire, and baked or burned, as it is called, not only will its hardness be very much increased, but a great change will be found to have taken place in the nature of the substance, for it is no longer capable of being again reduced to a paste by water, and its fragments cannot be softened any more than those of stone.

1285. *These properties of clay were, no doubt, discovered by mankind in the earliest times.* We read in the Bible of bricks made in Egypt by mixing clay with straw. The latter substance was for the purpose of correcting the defect of clay alone in cracking by drying, for such bricks were merely dried and hardened by the heat of the sun; and we actually find such bricks at this day in Egypt, and also in the ruins of Babylon; but when vessels of clay are required to hold fluids, burning them in the fire is a necessary process.

1286. *For making pottery or earthen-ware*, the clay is beaten a good deal in water, by which the fine parts are suspended in the fluid, while the coarser sink to the bottom of

* We shall speak of silica as being simply an earth (the siliceous earth), which will be sufficient for a popular view of the subject; but this earth is now known to consist of the elementary principle silicon united to oxygen, and is sometimes termed by chemists silicic acid. The earth alumina consists likewise of the element aluminum united to oxygen.

the containing vessel. By pouring off almost instantly the water containing the finer particles, the coarse are left behind. If now this finer part of the clay be suffered to subside, and the water be poured off, a clay will be produced much finer than the first, and may be still farther depurated by passing through a fine sieve. This appears to have been the only process employed in making earthen-ware formerly. The best natural clays were sought for, and were purified in this manner. They were then moulded on the potter's wheel, and burned by a proper degree of heat.

1287. *Very good potter's clay, or a mixture of alumina and silica alone, is infusible in the heat of our furnaces*, and, as it becomes more and more hard by a greater degree of heat, by high and long-continued firing, to wares made of this material an extreme degree of hardness may be given, with the quality of being impenetrable to fluids. But such clays are extremely rare, and those which are employed for pottery are usually mixed naturally with a small quantity of lime, iron, and perhaps magnesia, and other substances. Much lime, and also oxyde of iron, in the clay causes it to fuse, and therefore prevents its being subjected to the same degree of heat as it otherwise might, and of receiving the same degree of hardness.

1288. *After the potter's clay has been well ground and kneaded, it is put upon the centre of the potter's wheel*, which is a circular board placed horizontally, and kept in constant rotatory motion; it is then, first by the workman's hand, and afterward by proper tools, formed into vessels of various shapes, which are dried, and, as soon as they can bear being removed, are baked in the potter's kiln or oven. After it is baked, it will still be more or less porous, and cannot yet be applied to the purpose of holding liquids. It is necessary, therefore, to cover it with some sort of glaze, which is usually of a vitreous kind.

SUBSECT. 1.—*Common Red Pottery and Stone-ware.*

1289. In every civilized country an earthen-ware is made of the finer varieties of the same clay of which bricks and tiles are made, but much better selected, and prepared in a clay mill; the red colour which it acquires on being burned, is owing to the oxyde of iron it contains.

1290. *Red pottery* includes the common red pans, pipkins, baking-dishes, and a variety of others in household economy. As this ware does not stand the heat of a fire, it cannot be used for many purposes of cookery, for which, in England, metal is almost universally employed. This coarse kind of pottery had been made in this country from time immemorial, being, in ancient times, chiefly manufactured at the place still called the Potteries, in Staffordshire, which is now celebrated for the variety of its earthen-ware of the best description. It is also manufactured in the vicinity of London, and in many other parts of the kingdom.

1291. *The materials of which the glaze is usually made* consist of litharge of lead or galena, which is a lead ore, ground up with clay. After the glaze is laid on, the vessels are again exposed to a high degree of heat, which causes the lead and the surface of the clay to vitrify, or run into glass. This thin coating of glass, being transparent, shows the red colour of the ware; if a black, opaque glaze be required, manganese is mixed with it.

1292. *There is a serious objection to this glaze made with so great a quantity of lead*, which is, that it is soluble in vinegar and the juice of most fruits, especially when hot, and also in boiling fat, which renders the use of vessels that are covered with it dangerous to health, if employed for holding food.

In some countries the use of such vessels in the process of boiling and stewing is forbidden by the laws, under severe penalties. In this country, those who understand this subject take care not to preserve pickles in earthen vessels glazed with mixtures containing much lead.

1293. *A great improvement was introduced at the Potteries in Staffordshire, in* 1690, by two brothers, named Ebers, from Nuremberg. They manufactured a new kind of fine earthen-ware of red clay, which they glazed without lead, and by the use of common salt alone. When the earthen-ware is in the kiln, salt is thrown in; and the fumes caused by this substance have the effect of producing a vitreous glaze on the surface of the ware. The mode in which this effect, so simple, is produced deserves explanation. The salt is thought to be decomposed by the heat into its constituents, muriatic acid and soda; the former flying off in dense white fumes, while the latter attaches itself to the sides of the ware, with the surface of which it forms a thin coating of actual glass (see "Glass making"); and this, being entirely impervious to liquids, answers the intended purpose. This glazing, besides, has the valuable property of being perfectly harmless. Notwithstanding the obvious advantages of this new glazing, however, in consequence of some jealousy among the neighbours, from the process being kept a secret, they obliged the strangers to leave the country; but not before the art had been learned by a workman of the name of Astbury, who had made himself acquainted with every part of the process, and who afterward practised it.

1294. *The common brown stone-ware* was probably the produce of the same period, having been made in various countries of Europe ever since the fifteenth century. The manufacture of it was brought to us from Holland by some potters who settled at Lambeth. It has the valuable property of bearing, without injury, the heat of the fire, which is not the case with the red ware ; and on this account it has long been employed in various countries for boiling liquids. Its power of resisting heat renders it useful even for chemical vessels ; and Macquer says, that with respect to infusibility, it has all the qualities of the finest old Japanese porcelain. Its body is exceedingly dense and compact ; and, when properly made and baked, it is sufficiently hard to strike fire with steel ; it is composed of pipe clay, mixed with fine sand, and sometimes broken stone-ware ground to powder, in order to diminish the contraction of the clay in the fire. In the finer jugs, some calcined flint is added. The vessels, after having been formed by the potter's wheel, are fired in a kiln, and glazed by salt in the manner above described.

1295. *At present, stone-ware is made into* water-pitchers, soda-water bottles, and pipkins intended to stand the fire ; also crucibles, retorts, and a variety of other chemical apparatus are made of a material nearly similar. The best kind is still made in the potteries at Lambeth, the proprietors of which procure some of their clay from Devonshire and Dorsetshire, and purchase flint ready ground from Staffordshire, where this material can be afforded at a cheaper rate than would attend its preparation near the metropolis. Jugs have often a light and a dark part in the glaze ; the light is from salt alone, the dark has a mixture of some other glaze. The proportions of the ingredients are kept secret by the manufacturers ; but the best materials are said to be a mixture of pounded Hessian crucibles and Stourbridge clay.

Metallic vessels are so generally used in England for boiling and stewing, that the want of an earthen-ware manufacture to answer this end is little felt ; but it would be desirable that a cheap article of this kind for culinary purposes should be got up, since earthen-ware is preferable to metal for stewing ; and on the Continent it is the general practice to stew in earthen-ware.

It is said that the *grey Dutch stone-ware* is superior to the English in strength, and particularly in bearing exposure to the fire. Some of the original Dutch stone-ware jugs, brought into England before they were made here, it is stated, may sometimes be met with in the eastern parts of London.

SUBSECT. 2.—*English White Stone-ware and Wedgwood's Wares.*

1296. *To Astbury, already mentioned, is ascribed* a great improvement in pottery, the introduction of flints, calcined and ground, as a material to be mixed with the clay, from which a much better white earthen-ware was made. It is said that accident led to this discovery. While travelling to London on horseback, in 1720, Astbury had occasion, at Dunstable, to seek a remedy for a disorder in his horse's eye ; when the ostler at the inn, burning a flint, reduced it by pounding to a fine white powder, which he blew into the diseased eye to effect a cure. The potter, observing the beautifully white colour of the flint after calcination, instantly conceived the use to which it might be applied in his art, by mixing it in his clay, and thus made the first white stone-ware.

1297. *The improvements we have mentioned paved the way for some of still greater importance by Mr. Josiah Wedgwood,* who was the younger son of a Staffordshire potter, and born in 1730. This extraordinary man, overcoming the difficulties of his early life, by indefatigable industry and perseverance, and applying himself to a great variety of improvements in pottery, not only succeeded in acquiring an ample fortune, but became even a considerable benefactor to his country, by carrying the art of pottery to a high degree of perfection, and creating a commerce which, to this day, proves a source of national wealth. But the merit of Wedgwood did not consist merely in having the sagacity to perceive that a profitable business could be formed by improvements in his art. His mind was of a higher class. Not only devoting himself to patient investigations, he gathered round him the talents of various countries, and by the liberality of his conduct towards the individuals whom he engaged, he encouraged them to give him the most effective assistance in prosecuting and completing those views which his genius imagined, but which he could never have accomplished alone. He engaged Mr. Chisholme, an able chemist, to apply himself solely to those pursuits and experiments which were necessary for the selection of the best materials, and for perfecting his various processes ; and he liberally provided for him when old age incapacitated him for farther exertions. Not satisfied with improving the materials of pottery, he was desirous of giving greater value to it, also, by improvements in form. Assisted by the classic taste of his partner, Mr. Bentley, the ablest modellers were brought from Italy and other countries, who were intimately acquainted with the works of the ancients, and he rewarded the services of these with liberal encouragement. The consequence of this was, that English pottery, hitherto unknown as a class, became celebrated and eagerly sought for throughout the civilized world. We cannot help repeating, that it was to the enlightened and liberal views of Wedgwood that his success was mainly owing ; nor should it be forgotten that the ample fortune he thus acquired was generously expended in promoting the spread of knowledge, in encouraging the efforts of genius in others, and in lessening, as far as lay in his power, the sufferings of his fellow-creatures. The disposition and manners of Wedgwood were no less estimable than the powers of his mind, so that he became the object of admiration and esteem for his moral as for his intellectual qualities. He died in the sixty-fifth year of his age.

The interest that must always be taken in the pottery produced by Wedgwood demands that we enumerate the various kinds. In 1763, Wedgwood manufactured a kind of ware for the table, of a cream colour, which came into universal use in this country, under the name of *queen's ware*, which was conferred upon it in consequence of the patronage of her majesty. The materials were the whitest clays from Devonshire and Dorsetshire, mixed with ground flints, and covered with a vitreous glaze. This ware, being executed with care and expedition, was sold at a cheap rate, and was superior to any that had hitherto appeared for ordinary purposes. By varying his experiments and the proportions of his materials, Mr. Wedgwood discovered the mode of manufacturing other species of earthen-ware, which were excellent and beautiful, and adapted to various purposes of use and ornament.

1298. *The ware known in general by the name of Wedgwood's* is a kind of semi-vitrified pottery, which is not susceptible of receiving a strong superficial glaze, but which can receive all kinds of colours by means of metallic oxydes and ochres. The pastes of which they are formed are extremely plastic, and may be worked and moulded with the greatest facility. The more delicate ornaments are cast in moulds and stuck on; they are applied with remarkable dexterity by women and children. It is of the following varieties:

A Bamboo or cane-coloured biscuit was one of Wedgwood's original wares, and was employed for many elegant articles for the table: it is extremely compact, and was not glazed. It is still in use, and is sometimes slightly glazed.

A white biscuit was also made, having the chief qualities of porcelain, but without its transparency.

An extremely hard porcelanous ware was likewise made and employed for chemical vessels, as evaporating basins, crucibles, mortars, tubes, and other apparatus: this, from its resisting the corrosion of the strongest acids, and not fusing with the strongest heats, has been an invaluable acquisition to the chemist. These are composed of six parts of potters' clay, three of granite, two of calcined flints, and one of Cornish or China clay.

Wedgwood's black Egyptian ware was for a long time very extensively used for the tea-table, owing, in a great measure, to the elegance of its forms and decorations, which rivalled in design the works of Greek and Roman artists. When this novel kind of ware was produced porcelain had not been made in England, all that was then used being foreign, which was for a time almost entirely superseded by the various beautiful wares of Wedgwood. Its black colour was given by manganese. Besides tea-pots, sugar-basins, and milk-pots, a variety of ornamental articles were made of it, such as inkstands, vases, lamps, &c., which were ornamented with elegant bas-reliefs, figure foliage, and other devices, which were sometimes in a dark red colour. This kind ware is still executed by several potters, but it is lamentable to perceive the falling in the taste of the forms and designs since the death of Wedgwood. It is owing to this, and the introduction of English porcelain and other wares, that the black Wedgwood articles have nearly gone out of use, being purchased now merely for their cheapness. Originally they were not glazed, by which the perfect effect of the beautiful ornaments was seen; but this had the inconvenience of being somewhat difficult to keep clean. At present it is generally covered with a slight glaze, which permits its being washed and kept clean with perfect facility, though the effect of the ornaments is much diminished. To produce the slight glaze given to it, technically termed *smearing*, the ware is not dipped into a liquid glaze, but placed in the seggar in the state of biscuit; and the insides of the seggars being coated with salt, or some volatile glaze, these are converted into vapour, which vitrifies the external part of the ware, and gives it the desired lustre.

Wedgwood made, likewise, what he called the *jasper-ware*, which had elegant bas-reliefs on a beautiful blue ground. The white vitrifying pastes used in the jasper-ware is composed of forty-seven parts of sulphate of baryta, twenty-six potters' clay, fifteen of calcined flints, fifteen of granite, six sulphate of lime, and ten sulphate of strontium: the baryta serves as a flux to the clays. The fine Wedgwood blue on this ware is produced by cobalt. The delicate white ornaments are cast in moulds and stuck on. From this jasper-ware, which found its way into every country in Europe, he derived great profit, until, by the infidelity of a servant, the secret was disclosed and sold, so that others executed the same art; and though by means of inferior artists, yet this interfered so much, that it prevented Wedgwood from keeping up the price and employing the same talent as before.

Excellent imitations of Etruscan and other antique vases were executed by Messrs. Wedgwood and Bentley. It does not appear that the Greeks or Romans were in possession of a complete vitrified glaze for their pottery; but the vessels mentioned as having been made in the island of Samos had a red covering that was probably imperfectly vitrified, as they were held in high estimation for cooking. Earthen jars for holding dry substances were not glazed, but were similar to those now brought from Spain and Portugal with grapes. When they were employed as amphoræ for holding wine, they were rubbed over with wax to stop their pores. The vases found in such numbers in Greece and Italy, and commonly called Etruscan, were in part coloured by a black covering that is carbonaceous and not vitreous, which wears off by use. The exact nature of this black varnish has never yet been determined with certainty; but the vases themselves are exquisitely beautiful in form, and ornamented with infinite taste.

Among the ornamental works executed by Wedgwood may be reckoned two imitations of cameos: one of a slave in chains, of which he distributed many hundreds, to induce the suppression of the slave-trade; and the other representing Hope, attended by Peace, Art, and Labour, made of clay from Australia, to show what is produced there. One of the most splendid works of this kind was an imitation of the celebrated Barbarini or Portland vase, which was discovered in the tomb of Alexander Severus, and which was purchased by the Duchess of Portland. This copy was modelled by Mr. Webber, and fifty vases were made, for which 50*l.* each were subscribed, a sum which did not nearly defray the expense.

Various imitations of antique cameos were executed in great abundance and variety, many of which were white, upon a deep blue ground; and others resembled agates, jasper, and other stones. The modelling of many of them do infinite credit to the artists who executed them; and it is highly to be regretted that no works of the same merit now come from our potteries. After Mr. Wedgwood's decease, his establishment in London was given up, and his stock was sold, part of which was purchased by Mr. Phillips, and a remnant is now to be seen in his warehouse in Oxford-street.

1299. *Of Wedgwood's manufacture, it was said by the celebrated Faujas Saint-Fond,* "Its excellent workmanship, its solidity, the advantage which it possesses of standing the action of the fire, its fine glaze impenetrable to acids, the beauty, convenience, and variety of its forms, and its moderate price have created a commerce so active and so universal, that in travelling from Paris to Petersburg, from Amsterdam to the farthest point of Sweden, and from Dunkirk to the southern extremity of France, one is served at every inn upon English stone-ware. The same fine article adorns the tables of Spain, Portugal, and Italy; it provides the cargoes of ships in the East Indies, the West Indies, and America."

1300. *The usual processes by which the various kinds of pottery called white stone-ware, or Staffordshire ware, are manufactured,* are the following: the body of the ware is formed of a fine pipe or potter's clay mixed with calcined flints, and sometimes a little porcelain clay. The clay consists of 76 parts of silica and 24 parts of alumina; it is very refractory in strong heats, and burns very white in the fire: properties which render it extremely valuable for pottery. The best clay is found in Dorsetshire; an inferior kind is procured in Devonshire. This clay is beat up with water, and then passed through fine sieves to separate all the coarse particles. The flints are burned in kilns, and while hot are quenched in cold water, by which they are cracked through and through in innumerable places; after this they are ground in mills to the consistence of cream. The porcelain clay consists of decomposed feldspar, and, being entirely procured in Cornwall, is called *Cornish clay.* The proportions of these materials are varied according to the particular kind of ware, or the skill and experience of the manufacturer, and each has generally some mode of his own, which he keeps secret. They are mixed by measure, and put into troughs to be reduced by evaporation to a proper consistence for moulding. When tempered in a pug mill, and brought into a plastic state, like a kind of dough, the clay is formed on the potter's wheel into plates, cups, saucers, basins, and all the various articles usually made. When these are half dried, they are finished by turning in a lathe. Handles, spouts, bas-reliefs, and such parts, are made separately in moulds, and stuck on while the clay is soft by dipping them in some of the liquid clay. Plates are made by a mould, into which is pressed clay rolled out, and are finished by turning the mould round. When the forms are complete, they are dried, and the whole is placed in large cases made of burned clay, called *saggars,* and burned in the kiln to the state called biscuit, which has no gloss, and resembles in colour an egg-shell: it has the property of strongly imbibing moisture. The burning in kilns demands a great deal of fuel, and the abundance of this in Staffordshire is the chief reason why the potteries are established there; but another is the facility of transporting the materials and manufactures by canals. A great deal of care is necessary in piling up the biscuit previous to burning; and the management of the fire is of great consequence. The baking usually lasts from forty to forty-two hours, and the ware is suffered to cool very slowly. The ware is now to be coloured or painted. Some of this is performed by hand with hair pencils; but the principal part of the ornament is often produced by the following process: the pattern is engraved on a copper plate, and an impression is taken on thin unsized paper made on purpose, and previously immersed in strong soap water; this is applied in its moist state to the surface of the biscuit, which is of a very absorbent or adhesive quality; the paper is then rubbed or pressed down by means of a roll of flannel. Afterward the ware is dipped in water, and the paper is easily removed, leaving the impressions upon the surface; and after this the piece is dipped into a caustic alkaline lye, to saponify the oil before the glaze is applied.

The pigment with which the lines of the engraved copper-plate are filled up depends upon the colour intended. The colour that has been most generally used is a pale blue, like that of the Chinese porcelain, which has a remarkable elegance and softness: this colour is a compound of arseniate of cobalt, ground up in boiled linseed oil, and mixed with a proper flux. It is made darker or lighter, according to the quantity of cobalt used. In some cases, where the engraved pattern is smaller than the surface to be covered, a very ingenious mode is employed. The impressions are taken upon an elastic substance, a composition of glue and treacle, or upon India rubber, which, being stretched to the due size, are applied to the biscuit.

When the pieces thus painted have stood long enough to dry, they are placed in a gentle heat in an oven, in order, by dissipating the oil that was used with the colour, to prepare the ware for receiving the glaze. This is transparent, as otherwise the distinctness of the pattern would be impaired.

The substances employed for the glaze are ground to impalpable powders, in water, to the consistence of cream, and the biscuit-ware, now coloured, is dipped into this, called *slip*, and enough adheres to form a vitrified covering, when the ware is again put into an oven called the *gloss oven*, which finishes the baking.

1301. *A variety of glazes are employed by* different manufacturers; a good glaze or enamel is essential to the beauty of earthen-ware and porcelain: it should experience the same degree of expansion and contraction, in consequence of the change of temperature, as the biscuit which it covers, otherwise it will crack in all directions, which happens to imperfect glazes, or to earthen-ware where the body and glaze are not suitable to each other.

Silica alone cannot be fused in the most powerful furnace, and therefore cannot be employed for a glaze; but when an alkali or lime is added to it, it is vitrifiable by a very strong heat. This mixture is the glaze used in true porcelain; but the ordinary earthen-ware cannot bear the heat that would be necessary for it, and therefore one more fusible must be resorted to. Silica, combined with oxyde of lead, is easily converted into a glass fit for glazing earthen-ware, and this, being convenient for the potter, has been generally used. But this glaze we have already stated to be objectionable, since, when the quantity of lead is considerable, there is great danger of its being dissolved by substances used as food, and the deleterious effects of lead are well known. The application of such glazes has likewise injurious effects upon the health of the workmen, who are frequently seized with paralysis.

The best glazing for common earthen-ware vessels that are to be used in preserving and preparing food is undoubtedly that which has been described as produced by salt, though this glazing has not a high lustre; but it is very hard and durable, never cracks, is insoluble in all kinds of acids, and is not, in the smallest degree, unwholesome. It has long been a desideratum to discover some glaze which has all the advantages of that where lead is employed, without its poisonous qualities; and other glazes have been invented, but they are not yet employed universally in our pottery.

The glaze for common cream-coloured, or queen's ware, is composed of 53 parts white-lead, 36 of ground flints, 16 feldspar, and 4 of flint glass. Some use white-lead, ground flints, and common salt. The quantity of lead employed here is considered too small to be injurious to health, particularly as it is so locked up in the glaze; but some manufacturers employ a glaze that has no lead, as white glass and soda. Mr. Rose, in Coalport, Shropshire, makes his glaze of 27 parts feldspar, 18 of borax, 4 of Lynn sand, 3 of nitre, 3 of soda, and 3 of Cornish China clay.

Before the invention of this method of applying designs to earthen-ware, table services of English pottery were composed of plain queen's ware, sometimes with a coloured edge, and occasionally with a painted border, done by hand, and which was executed in a slovenly manner. But the mode of transferring prints to earthen-ware gives such a facility in decorating it that it has completely changed the aspect of our pottery, and contributed greatly to extend our trade in earthen-ware over the continent of Europe.

1302. *The blue printed ware of England cannot yet be manufactured in France*, according to the report of M. Brongniart, director of the porcelain manufacture at Sèvres. It appears that the extent of our potteries in Staffordshire, and the abundance of fuel, enables us to prepare the calcined flints at a cheaper rate than the French can; consequently, they employ chiefly pipe-clay, which, alone, is a very inferior material; and the English artisans have more dexterity, from their vast practice. The French, indeed, admit that our ware of this kind is unrivalled for strength, lightness, and elegance, the delicate blue printing equalling the colouring of the Chinese; and this the French fail in attempting.

Subsect. 3.—*Some other Kinds of Earthen-ware made in England.*

1303. *The wares called lustres* have a metallic appearance, and would be highly prized if they were not so cheap and common. There are gold and copper lustres; also platina lustres of two kinds, one which imitates polished steel, and another that approaches to the colour of silver. The latter are made by dissolving the platina in aqua regia, and mixing this solution with balsam of sulphur; this compound is diluted with turpentine and laid on the ware, which is then placed in an oven, where the metals are revived in their metallic state, and they are then covered with a glaze, which effectually protects them. An iron lustre is also sometimes made, but it is inferior to the platina. An aventurine glaze may be given by grinding some silver leaf with the above glaze.

1304. *A kind of pale red or flesh-coloured earthen-ware,* not glazed, is made at Lambeth from clay found at Maidstone, and is much used for ornamental vases, stoves, and ornamented chimney-pots, &c.

1305. *Lately a manufactory of terra cotta* of flower-vases, garden pots, &c., of a superior kind has been established at Lowestoffe, in Leicestershire, from clay found on the estate of Sir Frederic Fowke. Some of these are made of classical shapes; others are of English design. They are not affected by frost or rain, and are certainly a great improvement on the common forms of garden pots; they are employed in ornamenting balconies, conservatories, &c. The clay bakes to an agreeable red, and some of the articles are embossed; others are painted or coloured in imitation of the Etruscan. Specimens of this manufacture are to be seen in the Pantheon Bazar, London.

1306. *Rockingham ware* is a coarse strong ware, lately introduced, capable of standing the fire, and resisting changes of temperature. It is covered with a dark brown glaze, and is employed for tea-pots, and various vessels liable to be exposed to heat and cold. It is manufactured at Rotherham, in Yorkshire, and derives its name from the Marquis of Rockingham.

1307. *Tobacco-pipes of the common white kind* are made of best potter's clay, such as that found in Dorsetshire, hence called pipe-clay, which burns perfectly white. After the clay has been formed into a ductile paste, it is rolled out into portions the length of a pipe, and perforated with a brass wire rubbed over with oil. The heads are made in a mould, and fixed on to the tube. The pipes are then dried, and are piled in furnaces built for the purpose, where they are baked. The Dutch pipes are glazed with a varnish made of soap, white wax, and gum arabic, which is rubbed on with a cloth. These pipes, as is well known, are capable of sustaining a red heat without injury. Some tobacco-pipes are made of red clay, and others of meerschaum, which are imported.

1308. *The produce of the English potteries* have found their way into every part of the civilized world; and it is a remarkable fact, that they have even penetrated into countries to which our most enterprising travellers have scarcely had access. Captain Clapperton, in the account of his journey into the interior of Africa, states that, when on a visit to the court of Sultan Bello, " provisions were regularly sent me from the sultan's table on pewter dishes with the London stamp; and I even had a piece of meat served up on a white wash-hand basin of English manufacture."

It is estimated that the value of the various sorts of earthen-ware produced at the potteries may amount to about £1,500,000 a year, and that the earthen-ware made at Worcester, Derby, and other parts of the country, may amount to £750,000 more, making the whole of the manufacture £2,250,000 or £2,350,000 a year. The consumption of gold for gilding, &c., at the potteries is about £650 a week, and of coal about 800 tons per week.

Sect. III.—Porcelain.

Subsect. 1.—*Historical Remarks*

1309. *Porcelain is the most perfect production of the potter's art, and had its origin* among that extraordinary people the Chinese, who were in possession of the art of fabricating this beautiful ware before the Christian era; and a coarser kind of it was made also by the Egyptians. Vessels of porcelain occasionally found their way into ancient Rome in the first century, probably from China or Japan, a certain quantity of trade having been carried on then, as now, between nations very distant from each other by means of caravans. It appears that the Portuguese, in trading with China, were the first to bring porcelain into Europe in considerable quantities; and they gave to it its present name, it is said, from the resemblance of its glaze to the natural polish of a shell called by them *porcella.* The Chinese name is *tse-ki.*

1310. *Dr. Anderson, in his History of Commerce, says that the first porcelain brought to London was in a Portuguese ship taken as a prize in* 1593. Its beauty soon caused it to be in great request among the great and wealthy; and the emulation of European artists to imitate it was soon excited. Of the various attempts made in different parts of Europe, the most successful was at Dresden; afterward, some Jesuit missionaries, who were permitted to penetrate into the interior of China, learned something of the manufacture there. They contrived to procure specimens of the materials, and transmitted them to Europe, with some account of the processes employed. These materials were analyzed by Reaumur and other chemists, and it was soon discovered that the same substances existed in France, and in many other parts of Europe. In consequence of this, several European sovereigns, anxious to possess manufactories of so beautiful a ware, formed establishments for that purpose. That of Dresden was the first to make porcelain like the Chinese, and it has ever since been famous for the beauty of its productions. A magnificent establishment was likewise formed at Sèvres by the French government, and others in Vienna, Berlin, Bohemia, and several even of the smaller states in Germany.

Subsect. 2.—*Distinctions of Porcelain, and Manufacture of English China.*

1311. *Two materials are necessary to form the true porcelain of the Chinese:* one is named by them *Kaolin*, and is our porcelain or China clay, which results from the decomposition of feldspar; the other is called *Petunze*, and consists of fresh or undecomposed feldspar ground very fine. Feldspar in the latter state contains some potash, and is a substance fusible in a considerable heat; but when the feldspar has lost this ingredient in consequence of being decomposed by the weather, it falls into an earthy powder, constituting the kaolin, and is then extremely refractory, not fusing in our powerful furnaces. By the union of two substances, one very infusible, the other fusible to a certain degree, the body of the porcelain-ware is made: if the kaolin alone was used, the ware would have no transparency. The Chinese, likewise, occasionally employ another material instead of the kaolin, which they call *hoaché*, and which answers to our soapstone, or perhaps agalmatolite. These materials being prepared with the greatest care, are formed into paste with water, moulded on the wheel, or cast in moulds, and the vessels so formed are exposed to a strong heat in a kiln, which produces the semi-vitrified appearance which real porcelain always has.

1312. *One of the chief properties of true porcelain* is the great difficulty with which it is melted, being quite infusible in our ordinary furnaces; on which account, it is frequently employed in chemical experiments, to contain substances that are to be exposed to a degree of heat sufficient to fuse all metallic vessels except those of platina. Other properties are, whiteness and semi-transparency, owing to the commencement only of vitrification in the process of baking; and this latter quality is very often considered, though incorrectly, as the distinguishing character of this ware, vulgarly termed *china*. But it is possible to obtain the whiteness and transparency of true porcelain in fabrics of the potter, without its infusibility and hardness; for if a species of pottery that is very fusible be exposed to a heat just sufficient to bring it to the commencement of vitrification, and then the fire be withdrawn, the transparency and appearance of porcelain will be produced; but such ware will vitrify by a degree of heat only a little higher than that by which it was made; yet articles manufactured in this manner are often called porcelain or china, and sold as such.

1313. *From this account, there are two kinds of ware which receive the name of porcelain*, and yet are essentially different; a circumstance that gives rise to very erroneous ideas on the subject.

1314. *The genuine or true porcelain*, like the Chinese, is called by the Continental potters the *hard porcelain;* and is, as we have stated above, made entirely of kaolin or China clay, and petunze or undecomposed feldspar ground to a fine powder; and the glaze of this is likewise feldspar alone, vitrified in the kiln.

1315. *The false porcelain*, called the *soft or tender porcelain*, is made of a vitrifiable frit, composed of various ingredients, such as fine pipe clay, calcined flints, bone ashes, with, perhaps, some China clay, and barilla, alum, &c., according to the particular practice and experience of the manufacturer. The glaze of this latter kind is merely a kind of glass prepared on purpose, and made of siliceous sand, or flints, alkali, and oxyde of lead; and is much softer and more easily scratched than the glaze of the true porcelain composed of vitrified feldspar. This soft porcelain, likewise, is not only fusible in a heat not very considerable, and therefore incapable of being applied to the same uses as genuine porcelain, but it cannot resist the rapid changes of temperature like true porcelain, soon becoming covered with cracks even by the heat of boiling water; it is generally more transparent than true porcelain, and, having some advantages in the processes of painting, is made so gay in its decorations that it easily imposes upon the inexperienced eye. It is this soft kind of porcelain that is mostly made in the English potteries, where it appears that comparatively very little true porcelain is manufactured. It was also the soft porcelain that was made in the manufactories established, many years ago, at Bow and at Chelsea, where a great deal was formerly produced in imitation of the Dresden china. At that time the true materials for porcelain, the China clay, which was employed in the Continental potteries, was not known to exist in England.

1316. *The first true porcelain made in this country* was by Mr. Cookworthy, who, in 1768, discovered that Cornwall contained the earths necessary for that purpose; but although he had a patent for the exclusive right of using them, and succeeded tolerably well in the quality of his ware, which was confined to an imitation of the Chinese, the demand was not equal to the expense; owing, in a great measure, to the circumstance of Mr. Wedgwood having excited so much interest by the invention of several new kinds of pottery, foreign porcelain, or its imitations, became less an object of desire.

1317. *Of late years, however, by the employment of the only true materials*, together with great improvement in the painting, English porcelain has been made occasionally that scarcely yields to that of any other country. It is important to observe that there is a considerable difference in the quality of what is manufactured, owing to the various ingredients used. In the best English porcelain, the China clay from Cornwall is employed; and also the soap rock from the Lizard, together with petunze, or ground compact feldspar; but in several manufactories they content themselves with mixing with this a considerable proportion of pipe clay, calcined flints, and bone ashes, with, perhaps, a little alkali, to assist the commencement of fusion, and give the semi-transparency. As each manufacturer keeps secret the nature and proportions of the materials he employs, each person having some particular composition which he considers superior to every other, it is not easy to speak decidedly with respect to the complete practice in our potteries. The manufacturers of porcelain in France are less reserved; and we have published descriptions of their processes. Generally five tenths of the whole mass consists of kaolin, which they procure from Limoges. Some employ also a certain proportion of sulphate of baryta, and other substances. Private manufacturers of porcelain in Paris, of which there are many, avoid the trouble of preparing the materials by purchasing them in a state of readiness from establishments at Limoges, where the porcelain earth is found; and the price of the prepared material costs, in Paris, only three sous per pound, which gives them a great advantage over our potters.

1318. *The leading principles observed in the usual processes for making porcelain* in this country do not differ essentially from what we have already described when treating of the Staffordshire ware. The materials are very finely ground, mixed separately with water, to the consistence of cream, and then joined in the proper proportion. This is exposed to heat and evaporation, and made into a paste that is, when properly tempered, formed into circular vessels on the wheel, technically called "throwing;" and the facility with which the potter, by means of his wheel, forms the plastic clay into vessels of various shapes, by using merely his hands, excites the admiration of visiters. A great deal of care is bestowed upon the finishing the raw porcelain in the lathe after coming from the wheel, and likewise in putting on handles, spouts, and raised ornaments. The pieces are then carefully dried, and are now ready for the firing. For this they are placed in deep boxes, made of baked fire clay, called seggars, which admit the heat of the furnace, but protect the ware against any accidents. The process of baking generally lasts about from forty-eight to fifty hours, and great attention is paid to the degree of heat by placing in the kiln trial-pieces made of clay. These are taken out from time to time, to ascertain whether the ware is baked enough. The porcelain is now white, and in the state of *biscuit*, which is very like white sugar. In many cases the process stops here; and in this way are made those exquisitely delicate pieces of fruit, flowers, and other ornamental works of white biscuit for which the Derby works are so famous. All the soft porcelain, as well as common earthen-ware, is so porous in this state as to be permeable to water, and, consequently, a vitreous glaze is necessary to fill up the pores when vessels are made. The glazes for soft porcelain are, as we have stated, mixtures of some earthy substance, such as flint or clay, or both combined, together with some vitriable metallic oxyde, in order to give the necessary fusibility. The oxyde of lead is generally employed for this purpose, with some addition of oxyde of tin or arsenic, to produce a certain degree of opacity. In the best hard porcelain, such as that of China, Dresden, or Sèvres, the glaze does not contain lead or any metallic oxyde, but consists of undecomposed feldspar alone, ground to a fine powder, which is fusible in an intense heat, from the potash which it contains naturally. Pure undecomposed feldspar fit for the glaze of porcelain is rare in England, though abundant in some parts of the world. As it is the potash which is supposed to communicate to feldspar its fusible property, it might be thought that this alkali added to any earth, as calcined flint or pipe clay, would produce a perfectly good glaze; but, although these materials will form a glaze that is sometimes employed, yet such glazes crack all over, particularly when hot water is applied. The oxyde of lead forms a glaze that is not liable to this objection, but it is to another, that of making a glaze so soft as to be easily detached. The porcelain, after having been dipped in the material for glazing, is now subjected to a second firing, being placed, as before, in seggars; and the heat employed is that which is just sufficient to melt the glaze and cause it to vitrify. It is then ready for the painting and gilding. The different colours are produced by metallic oxydes, which are bodies that in general are capable of assuming a vitreous form with various degrees of facility; but they require to be accompanied by a certain vehicle, called a *flux*, which has the effect of rendering the whole more fusible than the first, or proper glazing, already described. This flux varies according to circumstances, but oxyde of lead, borax, ground glass, and nitre are substances employed. The colours are mixed up with oil of lavender in laying them on. The manner of painting the best porcelain with a variety of colours is much the same as painting in enamel; and frequently the work is highly finished like miniatures. When the painting is finished, the oil evaporates, and leaves the colours dry and ready to be burned in by a third firing in the enamel kiln, which fixes and brings out the colour by the fusion of the vitreous colouring matter. Very great skill is required where many colours are employed; but in ordinary china the colours on one piece are but few. It frequently happens that a piece of porcelain has to go into the enamel kiln four or five times when a great variety of colours are contained in the painting.

1319. *Of late the use of this porcelain has been much extended,* and a great variety of articles are made of it, as fancy baskets, door handles, finger plates, candlesticks, ink and taper stands, &c.

1320. *Gilding on porcelain or glass is performed* by applying the gold in a metallic state, either as leaf gold, or in the state of a powder. It is made to adhere to the surface of the ware, either by exposing it to such a degree of heat as to cause an incipient fusion of the glaze on which it is laid, or by mixing with the gold some substance as a flux, the melting of which occasions its adherence. The powder of gold is sometimes made mechanically by grinding gold leaf with honey, which is afterward washed away; or it may be made by precipitating gold from its solution in aqua regia. This powder is then diluted with gum-water, either with or without a fluxing material, and the ware is exposed to the necessary heat in the oven. After the gold has been *burned in,* it is burnished with agates, an operation which is usually, in manufactories, performed by female hands. There is a great difference in the gilding of porcelain: some of the cheap kind sold is gilt in a very imperfect manner, by putting on the gold with japanners' gold size, and exposing it to heat; but this kind of gilding soon comes off by washing in hot water, whereas what is properly burned in never wears off.

1321. *Painting on porcelain is known as an occupation for ladies* who draw or paint on paper; and proprietors of potteries are accustomed to supply vases and other ornamental objects, in the state of biscuit, to such as wish to exercise their taste and ingenuity in embellishing them by painting and gilding. The pieces being then returned to the manufacturer, the glaze is applied, the baking is finished in the glass oven, and the gilding is burnished.

SUBSECT. 3.—*Porcelain of various Countries.*

322. *The chief excellence of Chinese porcelain* is the perfection of the ware itself, and its great infusibility and lightness. With respect to the painting, though the colours are often bright, yet the drawing is generally very rude. Among this extraordinary people the arts of design appear scarcely to have advanced far beyond their infant state; and it is remarkable that, with so much practice, the knowledge of drawing seems to have remained nearly stationary for ages. It is said that the Chinese themselves consider that the porcelain-ware made by their ancestors was superior in quality to any more recently manufactured, although this is doubted by some. For many ages they used only white porcelain, and the white colour was extremely brilliant. A very rich and deep blue was the first colour they employed, which, some say, was made from *lapis lazuli;* others think it was from cobalt. The fine blue porcelain-ware of China is highly valued by the curious; but now, it is said, they prepare this colour from English smalt, though inferior. There are also many other colours made from iron and copper. Black porcelain, ornamented with gold, known under the name of *uniam,* is much esteemed in the East. The principal porcelain manufactures are carried on at *King-te-ching,* in the province of Kiang-si, where they have been established for ages. It is said that there are 500 factories, employing a million of hands; these are walled round, and no strangers can have access to the works, so that, in fact, little is known respecting the details of their processes. It is stated that they keep their clay for a number of years before it is used, and that they will lay up a stock of it early in life for the use of their sons. Very large vases and other pieces of great magnitude are made by them; but the emperor monopolizes the finest specimens; and the best kinds, even in that country, are scarce, and fetch high prices. Porcelain is also made at Nankin, and a few other places in China, but it is thought to be inferior to that of King-te-ching. The Chinese evidently excel in the use of the potter's wheel, as may be seen by the extreme thinness of some of their cups and saucers; and the principle of the division of labour is by them carried to such an extent that a great many persons are employed on one tea-cup, each workman performing one operation, in which, by constant repetition, he becomes extremely expert. It appears that the processes of the Chinese differ in several respects from ours.

Their material is so infusible that they can apply a glaze which requires a much higher degree of heat to vitrify than any of our European porcelains, and which is much harder and less liable to crack. In our modern porcelain, in general, the body of the ware being more fusible than the Chinese, we cannot easily apply a sufficient degree of heat to fuse a glaze except it contain some lead or alkali, because the heat required would melt the body of the ware. But we have stated that the use of lead is prejudicial to health, and the employment of alkali causes the glaze to come into innumerable cracks. Hence, not only our porcelain itself, but likewise the glaze, are usually inferior to the best Chinese. It is said, also, that their ware is merely dried in the air before glazing, as their composition so effectually resists water that it can be immersed in an aqueous glaze, without being first made into biscuit, and, consequently, they are enabled to burn their porcelain by a single firing The glaze of Chinese porcelain is so hard that it cannot be operated upon by any of our common instruments, whereas our glazes become scratched and defaced by ordinary wear.

1323. *Mr. Nicholson mentions a very simple method of ascertaining when the glaze of china is too soft.* This consists in dropping a small quantity of strong ink upon it, drying it before the fire, and then washing. If the glaze be too soft, an indelible brown stain will remain upon it. It has been remarked that the heat of the Chinese furnaces must be tremendous, far exceeding what we employ for the same purpose. Parke states that the calcined bones lately introduced as a material into some English porcelain acts much to the injury of the ware, which is thus very apt to crack with hot water.

It must be admitted, however, that, although difficult as it may be for the manufacturers of porcelain of this country to come up to Chinese porcelain in some qualities, yet we excel it far in the paintings with which it is ornamented; and we have stated the comparative merits of both, not with a view to undervalue our own produce, but, by placing the subject in the just point of view, to stimulate our native talent.

1324. *There are a great many varieties of Chinese porcelain*, and the passion for collecting these, and all kinds of articles from China and Japan, is not so prevalent as formerly, when the contents of a china closet were the subject of such amusement and admiration; but it is not altogether obsolete; and though it has been much ridiculed for the dragons, nodding mandarins, vases, fans, and tea-pots brought together, yet the collecting fine specimens of beautiful or ancient porcelain is by no means an absurd or inelegant amusement. The history of domestic customs is extremely interesting, and is illustrated by such specimens of art. It is, however, essential that very great care should be taken in distinguishing what is really ancient from modern imitations; for it is well known that when this kind of collecting was the rage, vast numbers of articles were made here, and on the Continent, to imitate Chinese; and these are frequently sold as such in the present day. Those who are good judges of real china-ware will detect the counterfeit chiefly by the style of painting, that of China and Japan being quite peculiar, both in the drawing and colouring.

1325. *The Dresden porcelain manufactory* was established at Miessen, near Dresden, by Augustus, elector of Saxony, in the early part of the seventeenth century. It was the first to succeed in making porcelain of a compactness and infusibility equal, according to Macquer, to the best of the Chinese. It has produced, besides the usual tea equipages, an immense number of figures of all kinds modelled in white biscuit, as well as glazed porcelain; and it was the source from which multitudes of chimney and other ornaments were for a long time supplied, which were less excellent for their design than for the perfection of the material and the brilliancy of the painting and gilding. The royal collection of porcelain at Dresden is thus described by a late tourist: "We have just returned from an interesting exhibition — the collection of porcelain in the Japanese palace. There are eight rooms full of china, of every age and from every country, chronologically arranged, from the first bowl of rough unglazed porcelain that ever was made by the alchemist Botiger, who discovered the manufacture, and who died in 1719, down, through various gradations of excellence, to the splendid vase fresh from the fabric of Meissen. There are specimens of Sèvres porcelain, a present from Napoleon, and some genuine Wedgwoods from England, besides a few articles of the curious serpent and green porcelain, the art of making which is unknown in Europe, and which is very rare even in China. They show you a set of china in exchange for which August der Stark gave Frederic I. of Prussia a fully equipped regiment of cavalry! But the most beautiful thing by far in the collection is a piece representing the crucifixion. It is of white porcelain, very large, and cost $20,000, about £3000. The figures in this, their expression and grouping, are exquisite."

1326. *The Berlin manufactory of porcelain* was founded by Frederic the Great, who, when he conquered Saxony, carried away several of the best workmen from Dresden. Five hundred workmen are generally employed there, but, though the true materials are brought from Saxony, the Prussian porcelain has not equalled that of Dresden.

1327. *The most magnificent and perfect manufactory of porcelain in Europe is undoubtedly that at Sèvres*, eight miles from Paris, carried on at the expense of the French government. Here, under the direction of M. Brongniart, the celebrated chemist and mineralogist, not only every possible attention has been, for many years, paid to the selection of the best materials, and to all the various processes, but likewise good artists of all kinds are employed in painting the decorations with great taste. Every description of porcelain has been produced at Sèvres in the greatest perfection, and most magnificent specimens of large vases and other objects are prepared, chiefly as presents to various potentates. The private manufactories of porcelain in France have benefited greatly by this munificence of the government, and, as no secrecy is observed, improvements find their way over the kingdom. To these causes must be attributed much of the superiority and cheapness of French porcelain. In Paris there are several manufactories of porcelain; one exists at Chantilly, and another at Passy, which supply our shops with vast quantities of their produce, notwithstanding the heavy duty of 30 per cent.

At Vienna there is a royal porcelain manufacture in high esteem, and some of the smaller states of Germany can boast of similar establishments.

1328. *What has been called Reaumur's porcelain* consists merely of glass vessels which have been heated to a red heat in sand, and then allowed to cool very slowly, when it is found that the glassy structure is destroyed, and the vessels are converted into a white opaque substance resembling stone-ware or porcelain. These vessels are then much more difficult to melt than glass, and have the advantage of resisting changes of temperature to a considerable degree. It does not appear, however, that they have been brought into use, or that there is any manufacture of them. They are, of course, not porcelain.

Principal porcelain manufactories in England. At Derby and in Colebrook such establishments have long existed. Subsequently, Worcester has become celebrated for its porcelain, and the superior kinds of earthen-ware, where, at Chamberlain's royal porcelain works, the painting and gilding have been carried to a considerable degree of perfection. Yorkshire has also a china work at Swinton near Rotherham, and another exists at Rockingham, where some articles have been made of great beauty. It is difficult to pronounce upon the comparative merits of these, as the porcelain of each manufactory excels in some particular quality. One had been carried on formerly for some years at Nungarrow, in Wales, where the wares produced are considered to have been superior to any that have been manufactured in this kingdom, but the public patronage was not sufficient, and it was discontinued. The amateurs and collectors of porcelain now give greater prices for Nungarrow porcelain than when the manufactory existed. *Iron stone china* is a new variety of ware, which has some valuable properties: it is extremely strong, and resembles the older and coarser porcelains of China. Its composition is said to be 60 parts granite, 40 China clay, 2 flint glass; glaze, 30 parts granite, 15 flints, 6 red-lead, and 5 soda.

1329. *The present fashion in porcelain appears to be* to revive that style which, though prevalent about a century ago, became almost obsolete, yielding to a purer taste derived from the study of Grecian art. The Dresden porcelain was more remarkable for the excellence of the material, and the mechanical skill displayed in the modelling a variety of forms of difficult execution, and likewise for the colouring and gilding, than for the good taste displayed, in general, in the choice of subjects and the forms produced. Although occasionally there was considerable skill exhibited in them as works of art, and figures and flowers of various classes were executed in porcelain with a delicacy of finish truly admirable, and such as had never before been even attempted in such materials, yet the taste degenerated too often into the puerile, and the public appears to have been tired and satiated at length with shepherds and shepherdesses leading young lambs, and the innumerable conceits and grotesque absurdities executed for the mantelpiece, and which are yet treasured up in old china shops. Not confined within the limited range of subject and form in the imitation of the antique style of pottery, everything was attempted in porcelain that the modeller could execute. The brilliancy of the colours and the gilding employed in its decoration often drew the attention from the bad taste displayed in the subjects, and gaudiness and ostentatious finery took place of the modest but exquisite elegance of ancient art. This, in fact, corresponded with the general style of the period when these works were executed. The improvement of taste, by the study of antique remains, at length drove these from the field, and consigned them to the collector's closet. The revival of these species of porcelain in its original freshness, but without its worst peculiarities, appears at present to have fascinated the public, and has given the semblance of novelty to a style which is far from being new, and is producing a change which it is difficult or impossible to speculate upon. One circumstance may be regretted, that the fine things executed under Wedgwood are disappearing fast, without the substitution of what can bear a comparison with them; and what is now executing instead, not demanding those accomplished artists which he had the liberality and the spirit to patronise, the art of pottery cannot be expected to rise, at least in point of design. But it must be admitted, nevertheless, that nothing can exceed the richness of the painting and gilding on modern services of plates, dishes, and other vessels for the table. To be comprehended, they must be seen in their numerous repositories and show-rooms in the shops of the metropolis, to which we must refer the reader, who will be gratified by an examination of the numerous articles of this kind, both English and foreign. To treat of them in detail would far exceed the limits of our present work.

SUBSECT. 4.—*Purchasing and mending China.*

1330. In purchasing china, it is well to deal with shops that are supplied from known and respectable sources, for a great deal of badly manufactured goods, such as we have described, is sold in this kingdom at low prices, frequently hawked about by pedlers, in which the glaze is so slight as to crack after being cleaned a few times in hot water.

1331. *When holes are required to be drilled in china or earthen-ware*, for the purpose of riveting it when broken, the usual method is to use a drill made of a splinter of diamond set into a handle, and this is an effectual mode; but as a diamond may not always be at hand for this purpose, it is useful to know that holes may be worked in these materials without it. Procure a three-cornered file, and harden it completely by making the end red hot, and plunging it into cold water; then grind the point quite sharp on a grindstone, and afterward on an oilstone. Then, with the point of this tool, pick repeatedly on the spot to be bored, taking care not to use too much violence lest the object should break. In a short time, or in a few minutes, by a continuance of the operation, a small conical piece will be forced out not bigger than a pin's head, and the hole may afterward be widened by introducing the point and working the file around.

1332. *The best cement for broken china or glass is that sold under the name of the Diamond cement*, which is colourless, and resists moisture. This is made by soaking isinglass in water till it is soft, and then dissolving it in proof spirit. Add to this a little gum ammoniac, or galbanum and mastic, both dissolved in as little alcohol as possible. When the cement is to be used, it must be gently liquified by placing the vial containing it in boiling water. The vial must be well closed by a good cork, not by a glass stopper, as this may become fixed. It is applied to the broken edges with a camel's-hair pencil.

1333. *When the objects are not to be exposed to moisture*, white of an egg alone, or mixed with finely sifted quicklime, will answer pretty well. Shell-lac, dissolved in spirits of wine, is better.

1334. *A very strong cement for earthen-ware* is made by boiling slices of skimmed milk cheese with water into a paste, and then grinding it with quicklime in a marble mortar, or on a slab with a mallet.

CHAPTER XVI.

ON GLASS.

SECT. I.—HISTORY OF GLASS-MAKING.

1335. This substance has now become so familiar to every one in civilized society, that many are not aware that its general use is comparatively modern. To form a just estimate of its importance, we have only to carry our ideas back to those times when it was unknown, or consider what would be our condition if deprived of this valuable material. Although the invention of glass dates from a remote period, it is scarcely above a century or two that its use has become general in the windows of domestic edifices; and to this day a great part of the world has not yet learned to employ it for this purpose. It is curious and interesting to reflect how much pleasure and convenience have been added to our habitations by the introduction of glass windows. The compactness of this admirable substance renders it efficacious in excluding the fiercest shower or keenest wind, while its transparency allows the rays of light to pass through without obstruction. By these means, therefore, the house is rendered not only warm, but light and agreeable, and the sight may, at the same time, be gratified with the beauties of a fine country or a delicious garden, and all that passes without may be distinctly seen from the interior of the building.

1336. *The discovery of glass* is involved in the same obscurity as many other inventions important to mankind. Accident probably first produced it, and the vitrification of various substances by a high degree of heat being observed by some reflecting person, would naturally give rise to experiments that might ultimately lead to some process for obtaining it at pleasure. Numberless instances must have occurred of the occasional fusion of earthy substances by means of intense heat, as in the making of pottery and bricks, and masses of coarse glass are often found in places where great fires have been. We are, indeed, informed by Pliny that, according to tradition, glass was discovered in the following manner: a merchant ship, laden with fossil alkali, being driven upon the coast of Phœnicia, the sailors, in cooking some provisions on the shore, had made use of pieces of the alkali to support their kettle, in consequence of which a vitrification of the sand took place, the alkali acting as a flux, and that this gave the first hint for the manufacture of this material. Whether this was the actual manner in which the discovery was made or not, nothing is more probable than the story, and we find that the earliest accounts attribute the manufacture of glass to the inhabitants of Tyre and Sidon; but the first that was made was no doubt extremely imperfect, and destitute of that beautiful and complete transparency which distinguishes it at present.

1337. *Glass-making appears to have been known in Egypt at least before the year* 1800 *before our era.* Judging from ancient Egyptian paintings at Beni Hassan, which appear to indicate the process, an ancient glass bead bearing the name of one of the Egyptian Pharaohs, who lived at the period alluded to, leaves no doubt as to its early use in the valley of the Nile. The Egyptians were not only acquainted with glass, but knew how to stain it of various colours; for many articles of coloured glass, made with extraordinary skill, are discovered among the antiquities of that country.

1338. *But the art of depriving glass entirely of colour, and rendering it as transparent as crystal,* were subsequent improvements. It appears that a very extraordinary value was put upon some vessels of transparent glass which the Emperor Adrian received at Alexandria; and from some small panes of glass, thick and not very transparent, which have been found in the windows of antique baths in Pompeii, it appears that these were not unknown to the Romans latterly; among them, however, this employment of glass never became general. When windows in private dwellings were required, various contrivances were resorted to, as lattices, parchment, and transparent membranes, or linen stretched across frames, and even thin plates of semi-transparent stones, as mica, selenite, or alabaster. In warm climates the necessity for excluding the air and cold by these means was not so obvious as in colder countries; and, for common houses, glass is at this day very little used in many parts of Spain, Portugal, and the East. Although the employment of glass, for admitting light into private houses, appears to have been but little practised among the ancients, yet drinking vessels and bottles of glass were latterly sufficiently common among the wealthier classes, this circumstance being mentioned by Horace, Pliny, and other classic authors, and numerous specimens of these have been found in the ruins of Pompeii. Glass was introduced into India by the Europeans; and it is said that the Chinese to this day are only able to make glass vessels out of broken glass made in Europe.

1339. *The Venetians were the first Europeans who excelled in the manufacture of glass;* and panes for windows used to be imported into Britain for churches in the fourth and fifth centuries; but their employment appears to have been at that time limited to ecclesiastical buildings, and the comfort of glazed windows in domestic edifices was little known, even down to a very late period. In the year 1567, the glass casements of Alnwick Castle were only put in when the lordly proprietor visited the place, and were taken out and put aside for safety when he was absent, which may give us an idea of their rarity at that period. It is supposed that glass windows were first introduced into gentlemen's houses about the reign of Henry VIII., and that they were not used in farm-houses prior to James I. In Scotland, so late as 1661, the windows of ordinary houses were not glazed, and only the king's palaces could boast of this advantage. Previous to the use of glass in England, windows were filled with wicker-work, or with lattices of oak laths placed checker-wise. In some cases the rich used casements filled with panes of horn.

SECT. II.—COMPOSITION OF GLASS.

1340. Notwithstanding the extraordinary beauty and singular properties of glass, it is made from materials which are very abundant and easily procured. Glass of some kind may be made by exposing a mixture of various earthy and saline materials to a high degree of heat, by which they are fused or vitrified.

1341. *But for that kind of glass so valuable in domestic economy, two substances are essential, namely, siliceous earth in a state of considerable purity, and an alkali.* Siliceous earth, in its various states of quartz, sand, flint, &c., is infusible by itself in the most powerful furnace; but when mixed with a certain quantity of any alkali the mass fuses very readily, and glass is the result. Nothing, therefore, is easier than to make mere glass; but the transparency and perfection of this substance depend upon a proper selection and management of the materials: without this, the glass will turn out to be almost opaque, and very imperfect. Both soda and potash are employed as the alkalies: they are used in the state of carbonates, and the carbonic acid flies off during the process, leaving the alkali by itself to combine with the silica.

For the very best glass pure alkali is necessary; but for the inferior sorts the coarser kinds of alkali, as barilla, kelp, or wood ashes, are made use of. Lime, an alkaline earth, is also used occasionally as a flux. In almost all the materials commonly employed there are more or less of impurities which would injure the glass; besides, therefore, the silica and alkali, certain additions to these ingredients are made in the best kinds, in order to destroy the colour and opacity that would otherwise result, or to give the glass particular properties. Nitre and oxyde of manganese are added, to get rid of colouring matters; hence the latter has been called glass-makers' soap; but if too much manganese is used, the glass will have a purple tinge: a small quantity of arsenic is used for the same purpose. The latter is not free from danger to health if the glass should contain so much alkali that any part of it is soluble in acids. The oxydes of lead, chiefly litharge and red-lead, are found to be of singular use in the manufacture of the finer kinds of glass, rendering it more dense, though softer and easier to cut. The French use more lead in their glass than is the practice in this country; on this account their glass, though more brilliant, is softer. In glass, but particularly in flint glass, more alkali is used than is necessary to flux the sand; and when the whole is in fusion, the fire is continued so as to volatilize the superabundant quantity. But if too large an excess of alkali be left in the glass, it will attract water from the atmosphere, and be partly dissolved; and to this cause may be attributed the decay of some old glass. Indeed, a certain proportion of alkali fused with the silica will make a glass that will even completely dissolve in water.

Sect. III.—Process of glass-blowing.

1342 *The general process employed in the manufacture of glass is the following:* premising that all those who have never yet witnessed it should take the first opportunity of visiting a glasshouse, since no verbal description alone can convey a perfect idea of the extraordinary, and apparently almost magical, dexterity by which all the various articles of glass in daily use are made. Glasshouses are commonly large, conical buildings, from 60 to 100 feet high, and from 50 to 80 feet in diameter, having the furnace in the centre.

1343. *When the materials are properly prepared by a process called fritting*, which is a commencement of vitrification, they are thrown into a large kind of crucibles or pots, which have been previously brought to a white heat in the furnace in which the fusion is made. Great care is bestowed in the fabrication of these crucibles or glass pots, as they must resist the most intense heat without melting or cracking. They should consist of five parts of the best Stourbridge fire clay, and one part of old broken crucibles ground to powder, and a red clay. Great nicety is required in kneading and mixing these together, for the breaking of a pot would be a serious accident. They are about forty inches deep and wide, and from two to four inches in thickness. In about thirty or forty hours the materials melt, and gradually a white porous scum rises to the surface, called *glass gall:* this consists of salts and various impurities in the glass, which is not perfect until the whole of this is removed: it is purchased and used by the refiners as a powerful flux. To ascertain the purity of the glass a little is taken out from time to time. A very intense heat is necessary, because the alkali will not combine with the silica until the carbonic acid and water are completely driven off, and it retains the last portion of these with remarkable obstinacy: when that is effected the combination and fusion take place. The fuel employed in this country is coal: in France they use wood. In the glasshouses the workmen are employed day and night, because it is necessary that the work should go on without intermission till all the melted glass in the furnace is exhausted.

1344. *Every object of glass, plate glass excepted, is formed from a hollow globe that has been produced by blowing.* The principal implement used by the glass-blower is an iron tube about five feet long. This he dips into the pot with melted glass, which has been suffered to cool till it has acquired the proper consistence, as at first it is too fluid, and a proper quantity of material is taken out adhering to it. The workman now applies his mouth to the tube, and blows strongly through it, causing the glass to be distended by degrees into a hollow globe. By alternately heating this again at the mouth of the furnace, blowing it larger, and occasionally rolling it upon a flat table, and fashioning and cutting it with various tools, the plastic substance is at last skilfully made into all the various articles in use. As soon as the various pieces are finished, they are put into the *annealing furnace*, where they are heated to a particular temperature, and then suffered to cool very gradually.

1345. *Glass, brittle as it is, would be much more so were it not annealed;* the annealing consists in again heating the various articles of glass and letting them cool very slowly, and when this operation is imperfectly performed, it is more brittle than ordinary; window glass in that state cuts badly with the diamond, and often flies in a direction different from that which was intended.

Sect. IV.—Properties of glass.

1346. *Glass, when well made*, is perfectly transparent and colourless. It is very brittle when cold, but, by the application of a high degree of heat, it becomes so flexible and tenacious as to be readily fashioned into any form that fancy may dictate, or may be made so fluid as to be pressed into moulds. Its ductility is so great, when soft, that it can be drawn out or spun into elastic threads of extreme fineness, and these retain their elasticity for any length of time. Glass is absolutely impermeable to air and water, even under any degree of pressure; and we mention this fact the more particularly, because many persons suppose that some fluids can pass through glass under certain circumstances; but this is an error. What has led to this erroneous idea has probably been observing that drops of liquid sometimes appear upon the outsides of vessels, and the supposition that they must have passed through the glass; but in such cases these drops are generally precipitations of water from the atmosphere upon the cold glass in the manner of dew, or some of the liquid having got through the cork.

Another valuable property of good glass is, that it cannot be corroded by any liquid except one, the fluoric acid: hence vessels formed of it are capable of containing all kinds of fluids, even acids, without any injury, which is not the case with metal and other substances; and its transparency enables us to judge of the state of the fluid within. As it is not acted upon by any ordinary liquids, it imparts no taste of any kind to what is kept in it; and, from its smooth, unalterable surface, it is easily cleaned, and its transparency enables us to see whether the vessels are perfectly so. No other substance has these valuable properties, from which, however, it must be admitted that its great brittleness is a considerable drawback. It may be observed that glass, when well made, although so easily broken by mechanical violence, is absolutely unchangeable by decomposition in the greatest length of time. It is therefore now used for enclosed medals and other objects that are placed in the foundations of buildings, for the information of remote posterity. Many attempts have been made to destroy the brittleness of glass, and to render it malleable, but without the least success. Glass, though brittle, is considerably hard, but not so much so but that it can be ground by other substances harder than itself, as sand, emery, &c., and it is polished by using finer and finer powders. This property renders it capable of admitting of much ornamental work, by cutting in vessels of various kinds, which very much increases its beauty; and it may thus also be formed into lenses for spectacles, telescopes, and microscopes, instruments which have enlarged the bounds of human knowledge to a most extraordinary degree.

1347. *Glass is one of the most elastic bodies in nature.* This elasticity may be well seen in a bunch of spun glass used as ornament; and, on account of its great elasticity, it has been even employed as a watch-spring. This elasticity may also be perceived in the well-known musical glasses, which consist of goblets filled partly with water; when the wetted finger is drawn over the edges of these glasses a musical note is produced, and the vibrations of the glass may be distinctly seen by means of the water.

1348. *Silica and alkali are not the only substances from which glass may be made.* Borax has long been known to be the most powerful flux for silica, and its high price in this country is the only objection to its general use; but a certain quantity of it is always employed in the finer kinds of plate glass, and those other kinds of the manufacture that are required to be absolutely free from specks and bubbles. Glass made with it flows remarkably thin, and fit to be cast into a mould. In consequence of various experiments made lately to improve the glass for optical instruments, boracic acid has been substituted for alkali, and glass has been made of that and silica, which is more free from imperfections than flint glass. The composition of some made by Mr. Faraday is, boracic acid, 24; silica, 16; protoxyde of lead, 112.

SECT. V.—VARIOUS KINDS OF GLASS IN COMMON USE.

1349. There are several different kinds of glass in common use, manufactured for various purposes. 1. *Flint glass*; 2. Window glass; 3. Plate glass; 4. Bottle or common green glass. We shall consider each of them separately.

1350. *Flint glass* derives its name from having been made originally from flints calcined and ground, and then fused with alkali. Flint, it must be observed, consists wholly of siliceous earth. But it is now found that fine white sand, which consists of small grains of quartz, also siliceous, answers the purpose better, and the flints are laid aside, although the name is retained. The very white sand found at Alum Bay, in the Isle of Wight, and at Lynn, in Norfolk, are made use of instead. Flint glass is the most beautiful kind, and is that which is always used where cutting is required. It is distinguished from the other kinds of glass by having in it a certain proportion of oxyde of lead, to which it owes some of its most valuable properties, particularly its greater density, by which it refracts the light more strongly, and, consequently, exhibits more beautifully the blue, red, and yellow rays in cut ornaments. It is softer than other glass, which renders it easier to cut and to polish.

1351. *Every manufacturer has some particular ideas respecting what he thinks the best proportion for his materials*; but the usual mixture for flint glass is, fine white sand, 120 parts; well purified pearlash, 40; litharge, or red-lead, 35 parts; nitre, and a small quantity of the black oxyde of manganese, 13. Some flint glass analyzed by Mr. Faraday gave, in 100 parts, silica, 51·93; oxyde of lead, 33·38; potash, 13·77, with minute portions of other substances.

1352. Great care is taken to select the sand for the purpose. It is then well washed and calcined, and mixed with very good alkali. The process of blowing and fashioning the various articles is such as we have already noticed in a general manner. If it be required to give an article some form not attainable by the ordinary methods, a mould is provided, into which the glass is placed when blown, and where it receives an impression with as much facility as wax.

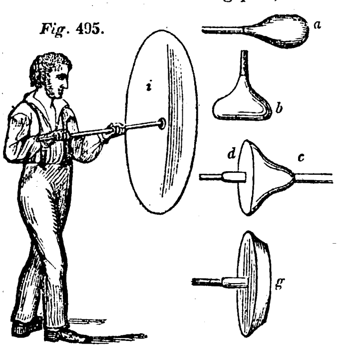
1353. Of flint glass are made all our decanters, goblets, and the usual drinking-glasses; in short, all the glass brought to table. This is the only glass employed for optical purposes, for making glasses for telescopes, spectacles, and other instruments;

consequently, great endeavours have been made to improve its quality. Of this glass, also, are made thermometer and other tubes used by the chemist, which are sometimes extremely fusible, so as to be easily bent, by means of heat, into any form, and to be worked by the blowpipe into various ornaments.

1354. *Window glass* differs from flint glass in containing no metallic oxyde except a little manganese to destroy the green colour derived from combustible matter or iron in the materials. It is harder than flint glass, and would not be so easily formed into various shapes. There are two kinds of window glass in common use, of which the best is termed *crown* glass; the inferior sort is called *broad* glass. These differ in their composition and mode of manufacture. The composition of crown glass some years ago was, fine Lynn sand, 6 bushels; kelp, 12 bushels. In the excellent crown glass formerly made at Radcliffe Highway, London, Spanish barilla was used as the alkali instead of kelp; but soda is now generally employed in the manufactories.

1355. *To make crown glass*, the materials are first subjected to an operation called *fritting*. For this purpose, they are thoroughly mixed and calcined for about two hours in a degree of heat not equal to that of complete fusion, but sufficient to render them pasty, and they are well stirred for three hours more, that they may be thoroughly incorporated. This occasions the dissipation of what volatile and gaseous matters there may happen to be present. When in this pasty state, the mass is of a grayish-white colour; and while soft it is cut into brick-shaped pieces, which, after cooling, are piled up for use. By long keeping, an efflorescence of soda appears on the surface, and the glass-makers consider it as improved by lying by some time. These pieces of frit are put into the melting pots, old glass being piled up with them, and the heat of the furnace is increased so as to bring the whole into fusion. The glass-blower now dips his iron tube into the melting pot; and having gathered as much glass round the end of his iron tube as is sufficient to form a table of glass, he blows it into a ball in the usual way, and works this into the form of a pear, *a*, *fig.* 495. Having done so, he next, by pressing its end against a flat surface, gives it the form *b*, which is called *bottoming*. He now heats it again at the mouth of the furnace hole, and, by whirling it round, brings it to the shape *c*, the bottom being more extended than it was. Another workman now takes out some melted glass, *d*, upon the end of another smaller rod, and attaches it, while hot and soft, to the middle of the flat bottom thus produced. The first workman next touches his glass at the spot where it is attached to his blowing-rod, *c*, with a cold iron which has been dipped in water, which causes the glass to crack at that place, and then the rod is easily detached from the glass, which has now an opening where the fracture took place. Taking now hold of the smaller rod, *d*, the glass-blower presents the glass with the small hole at *c* to the heat of the furnace, and keeps whirling it round more and more rapidly. This causes the diameter of the bottom to increase by the centrifugal force, as well as the opening which has been made; and when the whole has assumed the form at *g*, the glass flies open in a surprising manner with some noise, called *flashing*, and presents the appearance of a simple disk, *i*. This last part of the process strikes the stranger with astonishment, and he is ready to expect the whole to fly into pieces. However, by turning more slowly in the air, the glass cools gradually in the form of a disk, or circular flat table, until it is solid. The place in the centre of the circle where the rod is attached is the knot often seen in glass panes called a *bull's eye*. The glass is now sent to the annealing furnace, where it is annealed with great care, lest it should warp. From these disks, called *tables*, the ordinary panes of crown glass are cut by a diamond; and it is obvious that the larger the disk the larger pieces they will afford. Notwithstanding the care employed in this process, all the tables of glass are not of the same quality, and some will be flatter and freer from blemishes than others, and will therefore enable the glass-cutter to cut larger panes of good glass out of them, on which account crown glass is sorted into firsts, seconds, and thirds, which vary in the price according to the quality. This kind of glass is peculiar to England.

Fig. 495.



1356. *Broad or spread glass* is an inferior window glass, called also green window glass, and is made from somewhat less pure materials: fine sand, 5 bushels; kelp, 11 bushels; slacked lime, 5 bushels. But the inferiority of these alkalies does not prevent them from dissolving the silica into a good glass, though less beautiful than the last kind. The carbonaceous matter, which would injure its colour, is chiefly burned out, and separated in the first process, called *fritting*, after which the materials are thrown into the melting pots. This glass, when of the commonest sort, has always more or less of a greenish tint from the iron which exists naturally in the ingredients, and it is liable to be altered by long exposure to the weather, particularly in places where noxious effluvia occur, such as sulphuretted hydrogen. This may be frequently perceived in old cottages, and other buildings where it has been used. At present this kind is little employed, the price being nearly the same as inferior crown, which is much preferable to it. It is, however, found particularly useful to glass stainers. The manner of making it is different from that of crown glass. The glass-blower having formed a hollow sphere by blowing, stops up the end of his tube through which he blew, and holds the hollow globe at the mouth of the furnace, when the air within the glass, expanding by the heat, bursts it in a rent, which is completed by shears. The glass is then flattened upon a table, and detached from the tube. The flattening cannot be performed very perfectly, which is the cause of many defects in the tables, which have usually a wrinkled surface.

1357. *Plate glass* is made in two modes. One kind is made by blowing; the other is by casting, or causing the glass to flow on a smooth table in the same manner as sheet lead. The materials for this kind of glass are very well selected, consisting of fine white sand, soda, and lime, the latter substance having, likewise, the quality of a flux. Soda is preferred to potash, because it makes the glass flow thinner. Parkes recommends the following proportions: Lynn, or Alum Bay sand, 720 parts; alkaline salt, containing 10 per cent. of soda, 450; quicklime, 80; nitre, 25; broken pieces of plate glass, 425.

1358. *Plate glass made by blowing* is sometimes called *British sheet glass.* A globe is first formed, as in the ordinary processes; then this is, by rolling on a table and farther heating and blowing, converted into a cylinder, which is at length cut open by a pair of shears and laid out flat. The great weight of the glass prevents these from being made of a large size. Plates that are blown cannot be properly made above forty-five, or, at most, fifty inches in length, and with a proportionate breadth; if made larger, they are two thin, and are, besides, liable to warp, which injures their value for mirrors, as they distort the objects viewed in them.

1359. *Mirrors of glass* were first manufactured by the Venetians, who long kept the art a secret. These glasses were blown, and they supplied all Europe, but by this process perfect glasses could not be produced more than fifty inches long.

1360. *The best plate glass* is made by casting. The art of casting glass was invented in France by Thevart, in 1688, and the manufactory established at St. Gobin still exists. A sufficient quantity for the plate required is melted in a vessel called a curvette; and a very solid table is provided, sometimes of iron, to cast the fluid glass upon. The curvette is brought by means of a crane to the table, which is surrounded by a low ledge, and the glass, after being poured out upon it, is smoothed and made of equal thickness while hot, by a hot roller that passes across from one ledge to another. The plate, when cool, is annealed, and squared by cutting with a diamond. The surface is then ground quite flat by flint powder and emery, and polished by crocus martis, well washed. There is great difficulty in procuring large plates quite free from flaws, and when any are perceived after the plate is cast, it is diminished by taking off a part, and this, perhaps, may do for a smaller mirror; but several castings may be required before they can procure one of the full size required.

At present the principal manufactory of plate glass in this country is at Ravenhead, near Prescot, in Lancashire. The company to which this belongs is incorporated by charter, and mirrors are made equal to any in the world. Their office is in Albion-street, Blackfriars Bridge, London. The following table exhibits the sizes and prices of plate glass made by them:

Dimensions.	Surface in square Inches.	Price. £ s. d.	Dimensions.	Surface in square Inches.	Price. £ s. d.
60 inches by 30 inches	1·800	10 10 1	100 inches by 60 inches	6·000	63 15 1
60 —— 40 ——	2·400	16 3 5	100 —— 70 ——	7·000	80 8 2
60 —— 50 ——	3·000	22 10 5	100 —— 80 ——	8·000	98 4 10
70 —— 50 ——	3·500	28 7 8	132 —— 84 ——	11·088	200 8 0
80 —— 50 ——	4·000	34 14 10	160 —— 80 ——	12·800	246 15 4
100 —— 50 ——	5·000	48 9 8			

From this table it will be seen that the price is not simply by the superficial foot or inch, as in many other materials, but that it increases by the square inch according to the size of the plate.

It has been observed that some plate glass acquires a purple tinge by exposure to the sun's rays, and that this takes place so rapidly as to be distinctly seen at the end of one or two years in plates that were colourless when new. We may point out as a proof of the great increase of wealth and luxury, the use of plate glass, not only in mirrors, but likewise in windows of houses of the higher class, and even in those of shops, which it is not uncommon to see in London, consisting only of two or three panes of plate glass, and sometimes a single pane of great size.

1361. *German plate* was a large variety of well-made glass formerly imported, chiefly for the purpose of covering drawings and prints; but England is now independent of any foreign manufacture of glass. The German plate was made by blowing, as above described.

1362. *Common bottle glass* is of a dark or dirty green colour, and forms the largest quantity of glass made in Britain. Its composition varies in different parts of the kingdom, being made of coarse sand, lime, and clay, with any alkaline refuse that can be procured, such as soap-makers' waste ashes. Large quantities of this, as well as the other kinds of glass, are made at Newcastle on account of the cheapness of coal, of which only the small refuse, called slack, is used, being found sufficient, and which there costs little more than the carriage. Lime and sea-sand are the materials usually employed for this glass at Newcastle, the mass being frequently wetted with salt water, the soda of which is useful in assisting the fusion. Bottle glass is a hard, well-vitrified glass, and will resist the corrosion of acid liquors better than flint glass, and is not so easily softened by heat, having no lead in its composition. The green colour is owing to iron, which is naturally mixed with the materials. In some countries it is made by fusing basalt. On account of the coarseness of the materials of which bottle glass is made, there is frequently much carbonaceous matter, and this, during the fusion, is burned and converted into carbonic acid gas, which gets enveloped in the pasty soft glass, occasioning bubbles and blisters, which frequently injure and disfigure it. It is necessary, therefore, to keep up the heat after the materials are melted until the carbon is consumed. Government will not allow the makers of this species of glass to use any but the common sand, lest the glass should be too good, and the revenue be defrauded by its being applied to purposes for which the best glass is generally used, and which pays a higher duty. Of this glass are made bottles, garden bell glasses, large chemical retorts, carboys, &c. Thin glass is less liable to break than thick by sudden changes of temperature, and the common green glass than the white; hence the flasks of green glass in which olive oil is brought, generally called *Florence* flasks, are made very thin, and are particularly useful for boiling liquids where glass is required.

1363. *The most usual defect of window glass* is the waviness arising from an imperfect mixture of the materials, as also the striæ or threads, knots, and bubbles, which disturb the rays of light in passing through, and produce confused and indistinct vision. It is from the surface of polished plate glass being rendered absolutely flat, that objects are seen through it without any of that distortion which always takes place, more or less, in common glass. These defects are so difficult to avoid entirely, that it has not been possible hitherto to obtain a single pot of glass absolutely free from them; although this is a desideratum in those glasses which are ground into lenses for telescopes. Since the entire absence of colour is one of the qualities of perfect glass, any kind of tinge is an imperfection. Glass has sometimes a violet hue from too much manganese, or it is green from iron; and an over proportion of lime is apt to communicate to it a smoky tint. These colours cannot always be discovered, except by looking at the edge of the glass. When window glass is much warped, there is not only the inconvenience of the objects which are seen through it being distorted, but it frequently happens that it is difficult to secure it properly in the sashes without using small tacks for the purpose; and if the glazier is negligent, the wet gets in.

Previous to taking off a considerable part of the duty on glass lately, a large quantity of the smaller glass articles was made in an illicit manner, and these were generally of bad quality, and imperfectly annealed: it went under the title of "Jews' glass." But it is said that less of this is made at present, the price of good glass being considerably reduced.

Sect. VI.—Cutting and Grinding Glass.

1364. *The art of cutting glass is much more modern* than that of painting and staining it. At present the richness and brilliancy of our vessels of glass, which contribute so much to the ornament of our tables and saloons, are owing, in a great degree, to the elaborate and elegant manner in which they are cut. The cutting is effected by wheels driven by considerable power, the glass being held to the wheels. The first cutting is with wheels of stone, then with iron wheels covered with sharp sand or emery; it is then polished in the same manner by putty, or oxyde of tin. To prevent too much heat being excited by the friction, a small stream of water is kept constantly running on the glass. In large manufactories the wheels are urged by a steam-engine.

1365. *Glass may be ground* by hand on any coarse-grained sandstone, or with sand, or with emery and water.

1366. *Panes or flat pieces of glass may be divided*, when a glazier's diamond is not at hand, by making a notch with a file and carrying a piece of hot charcoal in the line in which it is wished the fracture should proceed. The charcoal must be kept alive with the breath. A red-hot iron will also do.

1367. *The art of casting in glass has lately arrived at such perfection* that many articles, such as small plates, salt-cellars, &c., now almost rival, at first sight, those that are cut; and glass casting has one advantage over glass cutting, that certain ornaments can be cast that could not be cut with the wheel; but no casting has yet quite equalled the sharpness and beauty of cut glass, and, indeed, cannot bear close comparison with it.

Sect. VII.—Coloured Glass and Enamel.

1368. *Coloured glass is perhaps nearly as ancient as the material itself.* Egyptian mummies are found decorated with coloured glass beads, which must be 3000 years old. Several examples of coloured glass have been found among the ruins of antique buildings, which prove the skill of the ancients in this art. The oldest specimens of coloured glass in churches resemble a kind of mosaic, and were composed of panes of glass that had been coloured throughout in making, joined together by lead.

1369. *But the modern method of painting on glass*, or, as it is called, *staining glass*, consists in the application of colours to the surface of uncoloured glass, and then exposing them to heat in a furnace, by which the colours strike into the glass and are permanently fixed. The colours are the same as those used for enamel, and are united with some substances which serve as flux. Only three colours, orange, red, and yellow, can be floated on as stains; all the others are hatched on by the strokes of a brush. Oil of spike is generally used to work with the colours.

So far from the art of painting of glass being lost, as some have stated, it is now practised in greater perfection than ever, with the exception of a fine scarlet seen in old churches, which, it is said, cannot now be produced of equal richness. Pictures in stained glass are executed with a vigorous and natural effect of light and shadow entirely unknown to our ancestors. Lately a great deal of coloured glass of the richest hues, in a great variety of utensils for the table and the boudoir, has appeared in the London shops. These are chiefly of Bohemian manufacture, although we are beginning to imitate them. Some of these vessels are of elegant forms, and often gilt with delicate ornaments. In some of them, coloured glass ornaments are laid on vessels of colourless glass.

1370. *Opaline glass* is of a semi-transparent opaline hue, used for various ornamental articles, chiefly for the boudoir. The effect is produced by adding to the best glass a small quantity of oxyde of tin, or, what is better, phosphate of lime, or well-burned bone ash.

1371. *Glass ornaments of two colours* are now made in the following manner: Sufficient glass of one colour is collected on the working-table for blowing, and is then dipped into a pot of another coloured glass. This mass is then blown and moulded into a vessel of the required shape, and the exterior coating being cut away in parts by the glass-cutter, the inner glass is exposed to view. In this, therefore, the projecting parts will be of one colour, and the cut parts of another, the effect of which is often extremely elegant.

1372. *An ornamental glass, resembling medallions, crests, or other ornaments let into transparent glass*, is made thus: The ornament to be let in is moulded in a peculiar kind of clay, and is introduced by the glass-maker into the glass while soft, having then the appearance of unburnished silver. Glass door-handles, decanters, girandoles, and other articles made of flint glass, are thus ornamented with arms, crests, medallions, &c.

1373. *Enamel is a glass rendered opaque by having an admixture of oxydes of metals with a flux.* For the white enamel of the dial plates of clocks and watches oxydes of tin and lead are employed; and coloured enamels are used for making a number of ornamental articles.

In painting in enamel, the colours are formed of this basis and mixtures of the oxydes of various metals, as iron, copper, manganese, &c. When these are finely levigated and laid upon an enamel ground, heat is applied sufficient to flux them, and thus they sink into the ground, and become permanently fixed. This kind of painting is highly esteemed on account of its perfect durability. The art of enamelling is of great antiquity, and probably coeval with that of making glass. That it was practised by the Egyptians is evident from specimens found with their mummies. From them it passed to the Greeks and Romans, the latter of whom introduced it into this country. Various Roman, British, and Saxon enamelled trinkets have been found in England; and a gold cup, ornamented with enamel, given by King John to the corporation of Lynn in Norfolk, is still preserved. Enamelling is generally done upon grounds of metal, which must be so difficult of fusion as to resist the heat necessary to melt the enamel: gold is best, but copper is most usually employed.

The imitative enamel used for the dials of Dutch clocks is a kind of japan painting, and is not formed of glass.

Sect. VIII.—Glass Beads.

1374. *The manufacture of glass beads is simple.* A short, thick rod of coloured glass, with a hole made through it: this is drawn out in a heated state by two men running in opposite directions, and by this very long tubes are procured of the size of the beads required. These rods are chipped into short pieces of the length of the bead. The perforations in the pieces are then filled with sand and ashes by shaking them up with them in a bowl with a little water. This is done to prevent the bore from filling up when they are subjected to heat to cause such a degree of fusion as to take off the angles and cause the beads to acquire a globular form. They are afterward washed to separate the ashes, and are then strung by children. The largest manufactory in the world for beads is at a place called Murano, very near to Venice. Immense quantities of these, of above sixty different kinds, are exported.

For *imitation pearls*, see "Jewelry."

Sect. IX.—Duty on glass.

1375. The manufacture of glass is subjected to the excise; but lately the duty on flint glass has been reduced from sixpence to twopence per pound.

1376. *Some enthusiastic persons have imagined that we might easily procure glass in any quantity*, since it may be formed of the sand of the seashore and the ashes of burned seaweeds. But an acquaintance with the real processes of a manufacture will tend to correct these speculations. It is not every kind of sand that will do for making good transparent glass. It must be purely siliceous, and sand sufficiently so is very rare, and, of course, forms a valuable property to the owner of the land where it is procured. The glass-maker must, therefore, pay a considerable price for this material and its carriage; or should he use inferior sand, the correcting of the effects of the impurities, which give a bad colour to his glass, will be still more expensive. Flints will do, but they are not to be procured but in certain parts of the country, and they must be calcined and ground. The siliceous materials fit for a glass only half transparent, and of a dark green colour, are indeed extremely cheap, consisting of impure sand, or even basalt. Our native alkali used for glass is chiefly procured from kelp or from sea-salt, but requires considerable labour to produce. The vegetable alkali is imported, and though the woods of America and Norway are boundless, yet the glass-maker must pay a high price for his pearlash.

The ashes which we could make from common weeds, though useful in washing, would go a very little way in the manufacture of glass. The heat required for glass-making is intense; but to produce this, very large and strong furnaces are required to be built in an expensive manner, at a cost of several thousand pounds; added to which, workmen are necessary who have acquired great skill by long practice, and to whom high wages must be given. Capital also must be found, and talents to conduct a manufacture successfully. When all these circumstances are taken into the account, and none can be omitted in fair reasoning, it is easy to perceive that there are various natural limits to the cheapness of glass; and that although, by the improvements in manufactures, reduction of duties, and other causes, it is not difficult to contemplate the possibility of this very valuable material becoming still more abundant, and applicable to more purposes than it is yet applied to, yet an accurate knowledge of the general facts in its manufacture will correct extravagant expectations. Semi-transparent glass, which would admit a certain quantity of light, without allowing objects to be seen through it, might be made at a greatly cheaper rate; but, from what we have stated, it is obvious that making glass transparent and clear must always be an expensive process.

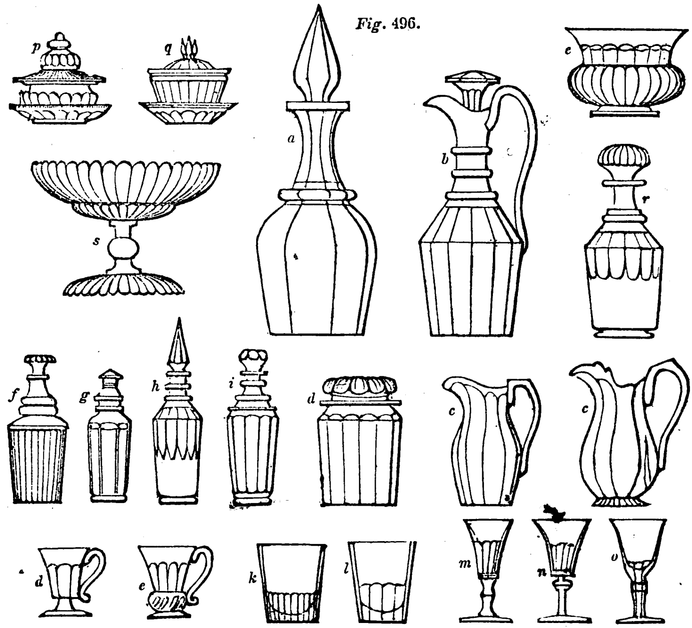
Sect. X.—Glass mirrors.

1377. *The silvering of glass for mirrors* is covering the back of the glass with a composition or amalgam of tin and quicksilver. There is only one position in which transparent glass, not silvered, even when ground perfectly flat and polished, reflects the rays of light so as to become a mirror; but the silvering causes it to reflect the light in all positions. The manner of applying the amalgam is peculiar. The tin is reduced by hammering into leaves as thin as paper; but, as any joinings in these leaves would produce unpleasant lines upon the mirrors, it is necessary to have a single leaf of tin as large as the mirror to be silvered. The leaf is then laid on a very smooth stone table covered with paper, and surrounded by a border of wood; mercury is then poured over it to the thickness of a line, and spread even with a roll made of cloth. The glass, properly ground and polished, is now to be slid in horizontally over the mercury, by one side of the wooden border being removed, but so carefully that it shall not touch the tin, and prevent any bubbles of air getting between. Care must be taken, likewise, that the glass should push before it any oxyde of tin or dust that may be on the surface; for, if this should adhere to the glass, it would form a blemish in the silvering that could not be remedied. When the plate of glass is completely over the amalgam, it is allowed to sink upon it by its weight, and the mercury that is thus forced out flows into a channel in the wooden border. The glass, being now covered with flannel, is loaded with weights placed all over the surface, and is at the same time tilted a very little to permit the quicksilver to drain off. After it has remained in this situation for a day, it is gently raised and cautiously removed, to be set up in a wooden frame for the soft, pasty amalgam to harden. It is some considerable time before this has acquired its utmost degree of firmness; and globules of fluid mercury have been seen to drip from new mirrors even after they have been set up in a room; small portions of the amalgam are, at the same time, apt to be detached by any sudden concussion or jarring: defects which cannot be mended by any patching without leaving lines of junction visible. Glass mirrors have been made by the British Plate Company as large as 160 inches by 80 inches; value, £246.

Sect. XI.—Glass used as table furniture.

1378. The use of glass in furniture is too well known to require much illustration. We shall confine ourselves, therefore, to an enumeration of the various articles in common use. Mirrors have been already mentioned for chandeliers and other holders for lights in Section on Lamps. Glass for the table consists of decanters for the usual wines, *a*, *fig.* 496; ditto, for claret, *b*; liquor bottles, *r*; water jugs, *c*, *c*; pickle glasses, *d*; finger cups, *e*; custard cups, *d*, *e*; cruet glasses, *f*, *g*, *h*, *i*; tumblers, *k*, *l*; wine-glasses of various kinds, *m*, *n*, *o*, including those of green glass; butter basins, *p*, *q*; *s*, salad basins, &c.

Fig. 496.



CHAPTER XVII.

ON PLATE.

Sect. I.—General remarks.

1379. There are very few domestic establishments in which the expense of plate does not form a considerable portion of that of the furniture; and much judgment is required in selecting it. Plate includes all those articles which are made of the precious metals; table services of all kinds, spoons, forks, desert knives, ladles, fish slices, candlesticks, snuffer-stands, bread-baskets, waiters, &c. Our object will be to convey a just idea of the relative value and qualities of articles of this kind executed in various materials, by treating, in a general way, of their manufacture.

In the highest classes of society whole services of gold and silver are used; and in almost all families there are certain articles of table furniture made of these metals; but the arts of gilding and plating are now executed in such perfection, that much ex pense is saved by resorting to substitutes with little loss of appearance. We shall first treat slightly of the business of the goldsmith.

Sect. II.—Goldsmith.

1380. *The Goldsmith* is the artist who makes vessels, utensils, and ornaments in gold and silver; for he at present sometimes includes the silversmith. In London he employs several persons under him for the various articles of his trade; the jeweller, the silver turner, the gilder, the burnisher, the chaser, the refiner, and goldbeater, are all employed by him. Formerly, before glass was so abundant and so beautiful, drinking vessels, made of the precious metals, were much more in request among opulent persons than at present; and there was a prevailing taste for massive silver tankards and cups, which extended even to the taverns to such a degree, that, in 1696, the use of silver plate (spoons excepted) was prohibited in those places. During the middle ages the goldsmiths were persons of great importance; they were the only bankers of the time, and it was through their agency that sovereigns and their opulent subjects transacted pecuniary business with one another. Many of them excelled greatly in the fine arts; of whom the celebrated Tuscan, Benvenuto Cellini, was a remarkable example. It is difficult to conceive the vast amount of the precious metals laid up in churches during this period, in the form of statues, sacred vessels, and votive gifts.

1381. *Articles made of gold are ornamented in two ways:* either by designs cut into the work, and called *engraving;* or by making the ornaments rise above the surface *in relief.*

1382. *Engraving on gold* was practised at a very early period, particularly in Italy; and it is a remarkable fact that it was this kind of engraving that gave rise to the art of producing prints by engraving on copper; but it was long before it occurred to any one, that by filling the lines so engraved with a thick ink, and pressing them upon paper, an impression or print could be produced; and it was accident alone that gave rise to this valuable discovery.

1383. *When ornaments were to be in relief,* they were at first cast in moulds; and we find the terms molten and beaten gold used by writers of antiquity, denoting that the processes of casting and hammering were employed in working this metal.

Articles are very rarely, however, now cast in solid gold, owing to the great shrinking that takes place on the cooling of the metal in the mould, in consequence of which it is difficult to obtain that sharpness of impression that is desirable; as well as the great expense of the metal. The most usual method is to roll out the gold into thin plates, and to strike up the figures in relief from behind. This process is termed *chasing* or *embossing,* and is a very ingenious part of the goldsmith's art; to which those of former times were much indebted for the perfection of their works. The vessels upon which it was employed were of extraordinary value; and, when these were executed in the first style of art, excited universal admiration. Fine examples of these may be seen in the superb table services of the British sovereign, and in those of the various princes of Europe, as well as in many private hands, especially in the plate repositories of goldsmiths.

1384. *To perform the embossing,* the body of the design is bulged out from the inside by the application of a hammer; the vessel is then filled up with a composition of pitch and ashes, and rested upon a sand bag. The parts to be sunk, in order to produce the detail of the design, are struck by a hammer and little steel punches; and if any parts are required to be raised, they are struck up from the inside. By this simple mechanism, the various parts of figures, foliage, landscape, &c., are represented with the greatest exactness. It is said, however, that this art has declined, or, at least, that few can be met with at present in this country who excel in it.

1385. *Gold is so soft a metal, that it is scarcely ever used in its purest state,* from its liability to wear; it is therefore hardened a little by an alloy with other metals. But this alloy would be carried to excess, were every one permitted to add as much as he pleased, and it would then be very difficult to determine the actual value of what was called gold; the quantity of alloy is therefore restricted by law.

1386. *Goldsmiths usually indicate the purity of gold in the following manner:* They suppose each article divided into twenty-four parts, which they call *carats;* and if it is pure gold, they say it is gold of twenty-four carats; but if there is any alloy, then this is deducted from the whole. Thus, if one twenty-fourth of alloy is added to twenty-three parts of gold, they call the mixture gold of twenty-three carats; if this mixture contain four parts inferior metal, it will be gold of twenty carats; if it contain six, it is of eighteen carats fine.

1387. *Plate is not legally sold as gold or silver, except it be of standard purity;* and to ascertain this, it is examined by the assay master of the Goldsmiths' Company, whose business it is to test all works in the precious metals, that the public may not be defrauded. If they are found to be sufficiently pure, they are stamped with the proper mark. The purity of gold may be tried by chemical analysis, but a shorter method is resorted to for the purpose. It is sometimes determined by the touch-stone, which is a black flinty slate. This is founded upon the fact, that a mark made upon this stone, by rubbing a metal upon it, has a colour peculiar to that metal; and the colour of the mark made by pure gold is different from that made by any of its alloys. Pieces of pure gold are kept, called touch needles; and others are likewise kept made of alloys in various proportions, and, by comparing the colour of the marks made by them and by those of any article to be examined, its degree of purity is determined.

1388. *In purchasing gold articles of any kind, therefore, it is necessary to see that they bear the stamp of the Goldsmiths' Company.* With respect to many ornaments made and sold by jewellers without the proper stamp, and called *gold*, they contain only a portion of that precious metal, having as much alloy as jewellers can possibly add without losing the appearance of gold; and *jewellers' gold*, as this is called, looks very well when new, but frequently soon tarnishes, which real gold never does. The colour of pure gold is given to this alloy by a certain process, called by the jewellers *colouring*, by which, after the articles are manufactured, the base metals are destroyed at the surface by an acid, and the gold alone is visible: when this superficial gold wears off, as it will in a little time, the articles now tarnished may undergo the process of colouring a second time, by which the gold colour is restored; and even a third time, if the thickness of the article permits the action of the acid by which the restoration is effected, which is not always the case with ornaments such as chains, ear-rings, &c. Dr. Macculloch states that the process of re-colouring may be effected by any person without going to the goldsmith; the method is, boiling the article in a solution of pure ammonia instead of the acid the jewellers use. It is to be observed, that such articles as are made only of jewellers' gold, and not stamped by the assay master, not being of standard purity, are, of course, always of inferior value to those of the mint standard, or that of gold coin, which has only an alloy of two parts in twenty-four, whereas jewellers' gold has an alloy of from that to six parts in twenty-four.

1389. *The gilding of metals* is effected in various ways. Iron is gilded by polishing its surface, and then heating it till it has acquired a blue colour. When this is done, leaf gold is applied, slightly burnished down, and exposed to a gentle fire, after which it is burnished again. Copper or brass may be gilded in the same manner. Gilding metals by amalgamation is effected by forming the gold into a paste, or amalgam, with mercury, and is chiefly employed for gilding silver, copper, or brass. The metal being well cleaned, is dipped into the amalgam, or spread over with it, when a quantity will adhere to the surface. The metal is then exposed to the heat of a furnace, which volatilizes the mercury, leaving the gold adhering; this is afterward burnished. In this way buttons and similar articles are gilded.

Ornamental figures may also be delineated in gold, upon steel, by a very ingenious process, by means of ether. Gold is dissolved in nitro-muriatic acid, and a quantity of ether is added, and the mixture shaken. The ether will then take the gold from the acid, and an ethereal solution of gold will be produced, which is separated, and applied to the surface of the steel by a camel's hair pencil; the ether will evaporate, leaving the gold on the surface of the steel. The metal is then heated, and the gold burnished. In this way sword blades are ornamented. Instead of ether the essential oils may be used.

1390. *Making gilded trinkets is now brought to such perfection*, particularly at Birmingham, that the use of real gold is very much diminished. The most elegant patterns are struck in thin copper, sometimes in London, and sent to Birmingham to be gilded, whence they return, so as not to be distinguishable, in a general way, while new, from gold, and, with care, they will last a considerable time; but, when the gilding does wear off, the colour cannot be restored as in jewellers' gold; they must be re-gilded, which is seldom or never worth the while.

1391. *Lately a new process has been discovered, by which gilding may be performed by means of electricity* with the greatest facility, and by which the workmen will be freed from the unhealthiness attending the process of amalgamation.

Electro-gilding and plating is one of the most interesting discoveries of the present time. When a current of electricity is made to pass through a solution of a metallic salt, the salt is decomposed, the metal passing to the negative, and the acid or solvent to the positive pole of the galvanic battery. By means of this principle, it is found possible to coat a metal with another by plunging it into a solution of the latter, and employing a galvanic apparatus. Thus copper, iron, and several other metals, can be coated with zinc, and likewise with silver and gold, and that in the most perfect manner. The advantages of electro-gilding and plating are so considerable, that they bid fair to supersede every method hitherto employed, and may be seen by a visit to the depôt of Messrs. Elkington and Barratt, in Regent-street, London.

1392. *Gold wire* is, in fact, a silver wire gilded. It is made as follows: A small, cylindrical rod of silver is gilded, and afterward formed into wire by being drawn successively through a great number of holes in a steel plate, each smaller than the other, until it becomes no thicker than a hair. This furnishes a remarkable proof of the ductility of gold; for, although the wire is drawn out to an amazing degree of fineness, yet it keeps firmly together, and the whole of the silver remains perfectly covered. When it is required to be spun into cloth, stuffs, laces, &c., this wire is flatted by steel rollers. Six feet of the finest gilded wire weighs only one grain; and the gold is not quite $\frac{1}{57}$ of the whole. A single grain of gold is thus extended to 345 feet.

1393. *Gold thread* is this flattened gilded wire wrapped or laid over a thread of yellow silk, the circumvolutions of the wire just touching each other so as to cover the silk completely. Some make a flattened wire, gilded on one side only, for this purpose. A gilded copper wire is also made for this use. The Chinese, instead of flattened wire, use slips of gilded paper, which they interweave in their stuffs, and twist upon silk threads.

Sect. III.—SILVERSMITH.

1394. *The beauty of silver occasions it to be much employed in furniture*, and the same observations which were made with respect to the manufacture of gold apply also to works in this metal. Articles which experience much wear are sometimes, and often most economically, purchased of solid silver.

1395. *An important branch of the business of the general silversmith* is the making of silver ladles, spoons, forks, sugar nippers, &c., which forms an independent branch of trade. These articles are mostly manufactured in London by manual labour; and, as the intrinsic value of the material constitutes a very large portion of the price, they could not be sold at the usual rate of the metal, but in consequence of the skill acquired by men exclusively devoting themselves to this particular branch. In the wholesale price of gold and silver plate, the workmen's wages and the manufacturer's profits are combined in a single item, always entered as "fashion;" for instance, a dozen of silver teaspoons, intended to sell for £3, would be invoiced thus—silver £2 6*s*. 6*d*., duty 1*s*. 6*d*., fashion 12*s*. Of course, while the value of the material and duty are, in all cases, according to the weight of the article and the current price of silver, the sum charged as fashion will vary exceedingly, according to the quantity and quality of the workmanship. Articles of genuine silver are always stamped as such; but persons are frequently deceived by seeing a stamp on them, somewhat similar, though not identical with the true one.

1396. *The following is a list of the usual articles in silver* required to furnish the table:

Dishes and covers.	Fish slice.	Cheese scoops.	Cream ewers.
Table knives and forks.	Trays and waiters.	Knife rests.	Sugar tongs.
Dessert knives and forks.	Bread baskets.	Nut crackers.	Teaspoons.
Table spoons.	Cake baskets.	Grape scissors.	Toast racks.
Dessert spoons.	Decanter stands.	Tea urns.	Butter coolers.
Gravy spoons.	Decanter labels.	Coffee urns.	Snuffer trays.
Soup ladles.	Liquor and bottle stands.	Tea pots.	Snuffers.
Sauce ladles.	Cruet frames.	Coffee filterers.	Candlesticks.
Salt spoons with gilt bowls.	Asparagus tongs.	Sugar basins.	

Fig. 497 is an example of a silver waiter in the present usual style of chasing; half the pattern only is shown. *Fig*. 498 is a richly-chased silver cake basket.

Fig. 497.

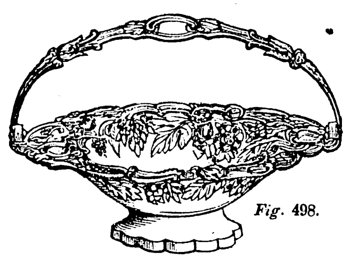


Fig. 498.

Fig. 499 is a silver egg-frame. *Figs*. 500, 501 are silver cruet frames; the first richly chased, the other plainer.

Fig. 499.

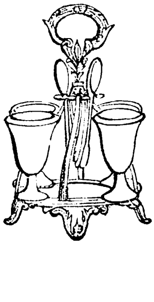


Fig. 500.

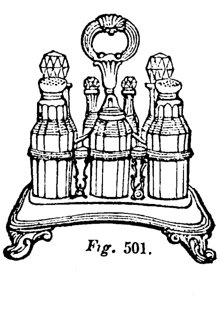


Fig. 501.

Figs. 502, 503 are silver candlesticks in the present usual style.

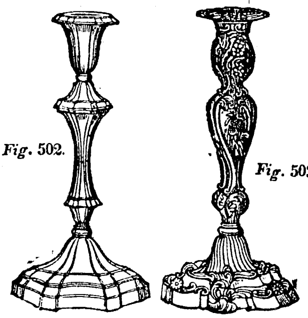


Fig. 502. *Fig*. 503.

1397. *Fig*. 504 is a tea service richly chased, in what is styled by the silversmiths *king's pattern.*

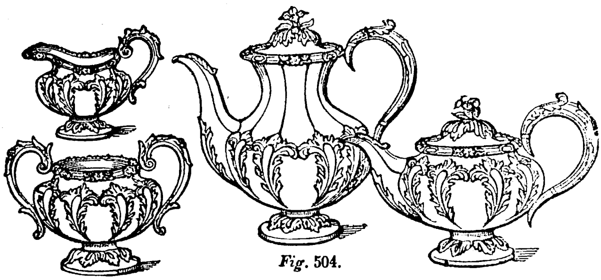


Fig. 504.

1398. *Fig*. 505 are silver dishes and covers.

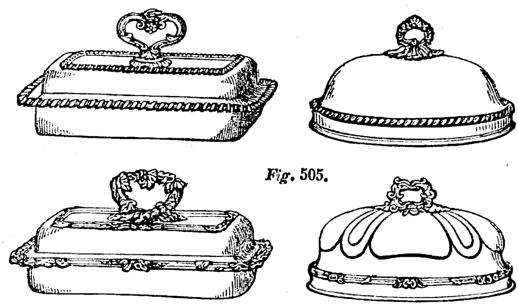


Fig. 505.

1399. *Fig*. 506 *are varieties of silver spoons*, named by the silversmiths, *a*, the *fiddle pattern*; *b, threaded pattern*; *c, threaded shell pattern*; *d, king's pattern.*

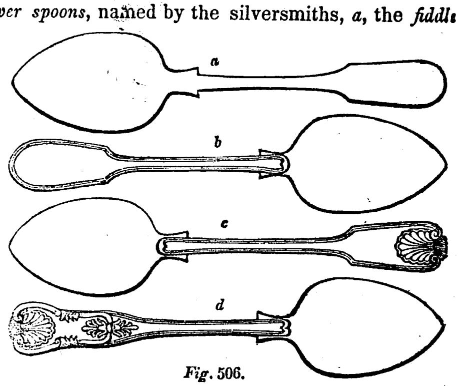


Fig. 506.

1400. *The great price of silver has given rise to the art of plating*, or covering other metals with a thin coating of it.

1401. *French plating* was the first method that was employed, and consisted in burnishing down upon the heated surface of copper or brass articles, after they were finished, successive layers of leaf silver, which thus adhered firmly to the metal beneath, and was polished by the action of the burnisher; but this process was tedious, and it possessed little permanence, from the thinness of the leaves; nor could the joinings of these be always perfectly concealed.

1402. *A much superior kind of plating* is now employed in England, and was the invention of a manufacturer at Sheffield, where, and at Birmingham, it is practised to a great extent.

By this mode an ingot is formed of an alloy of copper and brass with a thick plate of silver attached to it, and this ingot is rolled out by a flatting mill to any thinness required, the silver continuing to cover every part of the surface of the extended sheet. Great care is of course taken that no imperfections in the silvering should happen, as these could not easily be remedied. Heat being employed in the process, the two surfaces of the silver and copper are intimately united by fusion, although the temperature has not been sufficient to melt the ingot; for it is known to chemists that an alloy of two metals will melt sooner than either of the metals singly; soldering has therefore been unnecessary. These plated sheets, being now prepared, are cut and hammered into all the forms required, and are stamped, by dies and punches, into a variety of raised ornaments, which are connected together by solder so as to produce the various articles to be made. To strengthen the hollow parts out of sight, they are filled up with solder, so as to give the whole the appearance and strength of solid metal. One of the most usual articles of plated furniture consists of candlesticks; and as the business was, first, to imitate the forms of those which were executed in silver, they were made, at first, with much raised work that had many points and projections. A favourite fashion in these was one of the orders of architecture; but the capitals and square pedestals of this, with the various mouldings, were ill suited for plated metal, as the silver soon wore off the prominent parts, and then they had the shabbiest appearance possible. This occasioned the manufacturers to change the designs; the stems were made plainer, and the bases round or oval, with other improvements more suited to the nature of the material. Still, plated metal did not gain much respect in the world of luxury and fashion till the discovery of making *silver edges*, or of executing in solid silver those parts which projected most, and were most liable to wear; an improvement which added extremely to the durability of the imitation. These parts are made of silver rolled out extremely thin, and stamped; and after the inner sides have the hollows filled with solder, are then bent, and attached to the parts required. It is, indeed, surprising how long plated articles, defended with silver on the more exposed parts, will last when carefully used. *Figs.* 507, 508, 509 are examples of the usual style of plated candlesticks.

Fig. 507.

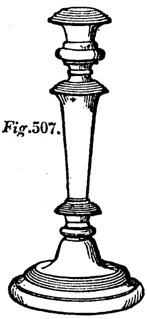


Fig. 508.

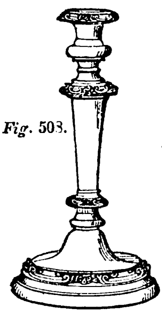
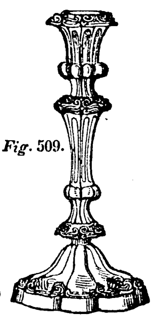


Fig. 509.



1403. *When plated goods come out of the hands of the workman,* the metal, though clean, is of a dull white colour, possessing no polish whatever. The last operation is the *burnishing*, which is generally performed by women. The burnishing tools are of agate, or similar hard stones, with smaller ones of hardened steel. Should any accident occur to lay bare the copper in any particular spot, or should the working up by the hammer of any latent blister in the metal produce a similar deformity, the workman has a remedy in the French plating. Having scraped or scoured the place quite clean, and perhaps matted or roughed it a little with a tool, he places upon it a piece of silver reduced to the thinness of foil, and well cleaned: holding the article over a charcoal fire, and directing the heat to the part to be mended, he suffers it to become just red hot, upon which he instantly applies a burnisher to the patch and rubs it for a few minutes, when it will be found to adhere so completely that no subsequent operation of hammering or otherwise will remove it. It is to the burnishing of plate that it is indebted for that rich, lustrous appearance so peculiar to the precious metals. In some silver articles there are parts represented in *matted* or dead work of a fine white ground, and producing a pleasing effect when contrasted with the burnished portions. This effect of matting is produced by covering the subject with a coat of pulverized charcoal and saltpetre, and often heating it until red hot over a charcoal fire, quenching it in a pickle of sal enixon. In some of the very rich and massy pieces of plate, the figures, instead of being stamped and embossed in sheet metal, are cast from designs modelled expressly by celebrated artists in wax, and copied in plaster of Paris. The London gold and silver-smiths sometimes employ first-rate talent in this way.

1404. *When plated goods are to be engraved,* it is evident that, as the depth of the engraved lines would cut through the plaiting and expose the copper, it is necessary to let in a thin plate of silver at the part where the engraving is required; but this is done so ingeniously that the joining is not seen.

1405. *From this description of plated articles* may be perceived the great necessity there 's for avoiding any circumstances in cleaning them that should scratch or rub off the silvering, which is extremely thin, not equal to the finest graved line.

1406. *It is much to be regretted that silver, which is susceptible of so fine a polish, and of which the lustre and the colour are so beautiful, is so liable to tarnish,* an effect which happens to solid silver and silver plate equally. This change is occasioned by the sulphur of the sulphuretted hydrogen gas, a small quantity of which is always present, more or less, in the atmosphere. This sulphur combines with an extremely thin coating of the external part of the silver, thus forming sulphuret of silver, a substance which is of a blackish brown hue. The tarnish can only be removed by taking off the whole of the sulphuret so formed, and therefore a considerable portion of the actual silver of the plated articles is destroyed in removing the tarnish. It is important to understand that the tarnish is not something added to the metal, leaving it as before, but the metal itself changed. The thinnest coating of any substance which may be easily removed, as gum arabic or isinglass, will prevent the tarnishing, by keeping off the air from the surface; and this may furnish a hint for preserving silver in its original brightness when it is necessary to put it away for any length of time.

1407. *While on the subject of plate,* it is necessary again to advert to what has been noticed in the Section of "Materials of Furniture," under the name of *German silver* and *British plate,* respecting which the most extraordinary degree of puffing and quackery is at present practised, and which it is essential that we should guard our readers against. We mentioned that the composition of these alloys is zinc, copper, and tin, and in one called *nickel silver,* it is said there is a little nickel, but no silver. The manufacturers have the assurance to assert that these alloys are quite equal to silver itself; but the fact is, that in their best state they are only equal to badly-cleaned or somewhat tarnished silver, and never equal the beauty of that metal, nor of any metal properly plated with silver. It is true that, being solid, or the same throughout, they do not show any other metal on the edges in wear, as in the case of copper plated with silver, and in some cases, where they are kept well cleaned, they have their use, as far as relates to economy. With respect to their being absolutely free from all deleterious ingredients, we believe this statement to be incorrect, and that the hardest and best of them will be found, on analysis, to contain copper, although the quantity may be too small to cause any alarm as to its use.

1408. *Electro-plating,* the new process of silver-plating by means of the galvanic battery, we mentioned under "Gilding," and it is applied with peculiar success to covering articles with silver, so as to equal the best of the other methods of plating in appearance at least, and at less expense. This method has, likewise, this advantage, that old plated articles, which have been worn so that the copper is exposed, and which could not be replated by any former process, can by this be restored to their first appearance. This may be easily understood by considering the process of Sheffield plating, which is such that the ornaments are forced up after the plating is completed, and therefore fresh silver cannot be applied to them; but in the electro process, the whole, ornaments and all, being merely plunged into the metallic solution, the most complicated enrichments are as easily covered with silver as the plainest work. In electro-plating, new articles, instead of copper as a ground to plate upon, a white, silvery-looking alloy is employed, of the kind called nickel silver, or albata, which, from its white colour, does not appear so much when the edges are worn as copper. The advantages of this mode of plating are so great that it will, in all probability, effect a complete revolution in the art.

1409. *The slight silvering given to certain articles,* as the faces of clocks and barometers, buttons, and similar things, is effected by dissolving silver in some acid, and occasioning a precipitation of it upon the surface of the metal, which is almost always copper or brass. But though some of these modes of silvering look well when burnished, they soon wear, from the thinness of the coating of silver. The silvered faces of clocks will not bear cleaning, and therefore they are varnished. A slight mode of silvering, sufficient for some purposes, as the engraved breast-plates for coffins, is produced in the following manner: two parts of silver powder precipitated from a nitric solution of common salt, one part of alum, and two parts of cream of tartar. These ingredients are made into a sort of paste with water. After cleaning the copper thoroughly, this paste is rubbed upon it by means of the finger covered with soft leather or fine muslin. When the piece is sufficiently whitened, it may be polished by the application of a buff powdered with calcined hartshorn or a little Spanish white.

1410. *The prodigious increase of the quantity of plate manufactured in England* is a striking proof of the progress of luxury. In 1828 (according to a statement made by Mr. Huskinson in the House of Commons) the essay duty on plate amounted to £105,000 for 17,790 lbs. of gold and 1,186,973 lbs. of silver manufactured into plate in one year. This is four times the amount of the precious metals manufactured in France, and is reckoned even equal to one third of all that is manufactured in Europe.

[The manufacture of silver plate in every variety of pattern and finish is conducted in the United States on an extensive scale, which is annually increasing. To such perfection has this art been cultivated in America, that very little silver plate is now imported, and of late the patterns of table articles introduced by silversmiths in this country have been imitated and adopted in London, as superior in taste and elegance to those of British manufacture.

The style for silver cups, dishes, and other fashionable articles for table use, which is usually known as the *square* pattern, and by which they are made to assume hexagonal and octagonal forms, &c., was first introduced at the extensive manufactory of Gale, Wood, & Hughes, of New-York, who are among the largest houses in the trade in this country, and who are favourably known in Europe. This American pattern, a decided improvement upon all the old English styles, is now found to grace the tables of the nobility, and even royalty itself, in the mother-country.

Silver spoons, which are found in almost every family in America, constitute an article of very extensive manufacture, and some fourteen years since, Mr. Gale, of the firm just named, invented and patented an improvement in their manufacture, by which they can be afforded at a much lower price than formerly, which has resulted in bringing silver spoons into almost universal use. His patent is now expired, and the improvement is in general use both in Europe and America.

The absence of any general law for assaying the precious metals in this country is felt and deplored both by the respectable venders and the purchasers of plate. The stamps usually found upon articles of silver or gold are nothing more than the initials of the manufacturer, and upon his integrity alone can reliance be placed as to the purity of the metal, there being no assay duty, nor sworn assayer to prevent frauds. Nor do the stamps upon silver plate give any indication of their relative purity, all the degrees of alloyed metal being stamped alike. So also with articles manufactured of gold; though these are often marked twenty-two carats fine, yet, when subjected to the touch-stone, or exposed to analysis, great frauds are often detected, and for which there is no legal remedy. The only safety for the purchaser in silver or gold plate is by selecting a manufacturer whose reputation affords a guarantee against wilful deception.

Whether the policy of imposing no restriction upon debasing the precious metals in the manufacture and sale of silver and gold plate is wiser than the strict inquiry and rigid examination by assayers, as in the countries of the Old World, it is perhaps not easy to decide. The absence of legally appointed assayers may be compensated in part, by both the vender and purchaser agreeing to subject the articles to the examination of some skilful artificer worthy of confidence; and hence there are found in most of the American cities gentlemen who devote themselves to the private business of assaying, whose certificate and stamp are sought by those who are particular as to the purity of their plate.

The amount of plate manufactured in this country for home consumption and exportation is very large, but there being no assay duty, it is impracticable to ascertain its extent with any degree of accuracy. Hence no comparison can be instituted with the amount manufactured in other countries.

Silver plating is not practised in America to any great extent, for the market is well supplied with silver plated ware from the manufactories of Birmingham and Sheffield, which are sold here cheaper than they could be made. The new arts of electro-plating and gilding have been introduced, but are not likely to come into general use.]

CHAPTER XVIII.

ON CUTLERY.

UNDER the head of cutlery are comprised all cutting instruments of iron or steel, as knives and forks, scissors, razors, &c.

SECT. I.—KNIVES AND FORKS, WITH VARIOUS CUTTING INSTRUMENTS.

1411. So familiar are we at present with the use of knives, forks, and other implements for cutting up and assisting us to eat our food, that many persons have little idea how modern are these inventions; and it is curious to contemplate what must have been the condition of society before they were in common use. The history of knives and forks alone would furnish matter for an interesting essay; we can only touch upon a few points that may tend to fix in the mind the relative importance of this portion of domestic furniture. If we look to those insulated tribes, now few in number, that have not yet acquired the use of metals, we perceive that their knives are formed of sharp splinters of certain stones, and of shells. Selected splinters of flint, and particularly of obsidian, have sharp edges; and, when fixed in handles, make cutting instruments much better than might be supposed by those who have not seen them; they are, however, very far inferior to those of iron in point of strength and durability, being extremely brittle, and incapable of being sharpened—for it is only the natural thin edges of the splinter that will serve to cut. These were the sole cutting instruments in possession of the inhabitants of the numerous islands in the Pacific Ocean previously to their discovery; and from the remains of spear heads, called *Celts*, made of flint, dug up in Britain, the aborigines, whoever they were, had not, in all probability, the use of iron.

1412. *Iron, although the best material fitted for the purpose of making edge tools, and now the cheapest and most abundant of the metals, was not the first employed.* It is never found in the earth in its metallic state, like some other metals, as gold, silver, and copper, and the art of extracting it from its ores is one that supposes a considerable advance in civilization. Copper, hardened by tin, and various other kinds of brass and bronze, appear to have been the materials of which all the warlike weapons and instruments for domestic purposes among the most ancient Greeks were formed. In the description of the Trojan war by Homer, no mention is made of iron or steel; but the swords, javelins, and armour were of brass; and it has hence been doubted whether iron was known in Greece at that period. We find, however, that the Romans were, from the first, not only possessed of iron, but that they at an early time made knives of that metal for carving their meat, and among them the office of domestic carver existed in great families as in later times.

1413. *Among modern nations, England seems to have been* pre-eminent in the manufacture of knives, and though previously to the reign of Elizabeth many were imported, yet then London was the place where the best cutlery was made, although some other towns, as Sheffield, Woodstock, and Salisbury, were its rivals. The most ancient kind of knives were of the sort called *case knives*, having the blade stuck in the handle like desk penknives, and which require to be kept in a sheath. Coarse knives of this kind, termed *whittles*, were manufactured at Sheffield in 1575, and were sold at the low price of one penny; and at this time and earlier, that town was celebrated for its cutlery. At what date the simple and effective contrivance was invented by which knives are made to shut, as clasp knives and common penknives, does not appear; but they are mentioned, in 1650, as having handles of iron covered with horn, tortoise-shell, &c.

1414. *Forks are a much later invention than knives.* According to Professor Beckman, they were probably first used by the Italians about the end of the fifteenth century. They were unknown to the ancients, none being met with among the furniture of Herculaneum and Pompeii; and the Chinese, to this day, use two small sticks, something like a cedar pencil, called *chop sticks*, for picking up the morsels of meat from the plate. Before the use of forks in Europe the fingers were often made to perform the service now rendered by them so much more readily, as well as decorously. The use of forks was, at first, considered by many an unnecessary luxury, and as such they were forbidden in certain convents. At first they had only two prongs of iron, but now have frequently three, and in a certain kind derived from the French, called *spoon forks*, they have four or five prongs, and these are always of silver. The first necessity for the use of a fork would probably be felt by the carver, and the oldest carving fork known, belonging to Henry IV. of France, is still preserved in the castle of Pau. It is of steel, has two prongs, and is of length and strength sufficient to secure a baron of beef.

1415. *The earliest distinct mention of the established use of forks* occurs in a curious passage of Coryates' "Crudities," a singular book of travels published in 1611. The author says, "Here I will mention a thing that might have been spoken of before in the discourse of the first Italian towns; I observed a custom in all these Italian cities and towns through which I passed that is not used in any other country that I saw in my travels, neither do I think that any other nation of Christendom doth use it, but only Italy. The Italians, and also most strangers that are cormorant in Italy, do always, at their meals, use a little fork when they cut their meat. For while with their knife, which they hold with one hand, they cut the meat out of the dish, they fasten their forks, which they hold in the other hand, upon the same dish; so that whosoever he be that, sitting in the company of any others at meals, should unadvisedly touch the dish of meat with his fingers, from which all the table do cut, he will give occasion of offence unto the company, inasmuch as that for his error he shall be at least browbeaten, if not reprehended in words. This form of feeding, I understand, is generally used in places of Italy, their forkes being, for the most part, made of iron or steel, and some of silver, but those are only used by gentlemen. The reason of this their curiosity is, because the Italian cannot by any means endure to have his dish touched with fingers, seeing all men's fingers are not alike clean. Hereupon I myself thought good to imitate the Italian fashion by the forked cutting of meat; not only while I was in Italy, but also in Germany, and oftentimes in England since I came home; being once quipped for the frequent using of my forke by a certain learned gentleman, a familiar friend of mine, one Mr. Laurence Whitaker, who in his merry humour doubted not to call me at table *furcifer*, only for using a forke at feeding, but for no other cause." It would seem, from the foregoing passage, that for each guest to put his fingers into the dish was no "curiosity" in England 250 years ago, any more than it is at present in Turkey and all parts of the East. We read still in the accounts by travellers of Arabian manners, of the host expressing his attention to his guests by helping them with his fingers to choice morsels of meat, even from his own plate.

1416. *The most ordinary and cheapest table knives* are made of common steel; *but the best table knives* are made of *shear steel;* and the words "shear steel" are generally stamped upon the blades. The tang, or part that goes into the handle, is made of iron welded to the steel blade, which, when finished by the smith, is heated red-hot, and plunged into cold water to harden it. It is afterward tempered down to a blue colour, and is then ready for the grinder.

1417. *Forks are generally a distinct branch of manufacture.* The prongs are first formed by a stamp that cuts them out, and they are afterward filed up, and then hardened and tempered. The forks are purchased from the fork-makers by the manufacturers of table knives, who put them into handles.

1418. *Handles of knives and forks* are made of wood, ivory, box, horn, silver plate, silver, &c. *Stags' horn* makes very durable handles, the surface of the horn being left in its natural state; these are often used for large carving knives. Handles made of the *horn of the ox* are generally dyed black, and ornamented with a great variety of patterns, by means of pressing them between two dies after having been softened with hot water. They are liable to injury from being dipped in hot water, as the grain rises, and completely spoils their beauty. *Bone handles* are made of the shank bone of the ox, and the thickness of the solid part of the bone is never sufficient to make the handles equally thick with those of ivory. Some of the bones are very dense and hard, but they do not keep their colour like ivory. To correct this defect, they are sometimes dyed green. The best handles of knives for common use are made of *ivory;* and the beauty, durability, and comparative cheapness of the material may well recommend it to those respectable tables where silver is not always used. *Handles of wood* are now very little used.

1419. *Handles of table knives are made in two ways,* either by drilling a hole in the handle, and cementing into it the tang of the knife, or by making the handle in two parts, each of which is laid on the sides of the tang, in that case made flat, the whole being riveted together to form the handle; this is called *scale tang.* In the first mode the tang is simply cemented in with melted resin mixed with fine ashes, as in the case of the best ivory handles, where there is no appearance of pins or rivets; or a stronger method is to drill a hole quite through the handles, and to run the tang through and rivet it on the opposite end; this is called *thorough tang,* and is the best for use, as the blade then rarely separates from the handle. There is an improvement made lately called *balance knives;* in those the haft is perforated considerably deeper than is required for the reception of the tang of the blade, and a piece of lead is inserted in the bottom of the hole, the blade having, at the same time, a projecting shoulder near the handle. By this contrivance the knife, when laid upon the table, rests upon the handle and shoulder, the blade never touching the cloth, as in common knives.

1420. *To guard the hand against any accidental slip of the knife in carving,* modern carving forks have a very useful addition, which consists of a small spur working upon a spring in the swell of the shank, and capable of being thrown up at a right angle with the instrument, so as to catch the knife should it slip.

1421. *The blades of fruit knives,* instead of being made of silver, are often of steel plated with silver; and these, of course, are much cheaper. In plating these the steel knives are first scoured bright and dipped into melted tin, being, in fact, tinned. Silver foil is folded round it and rubbed down close, and made to adhere by passing a soldering iron over it; after this the whole is exposed to heat over a clear fire to flux the tin. Lastly, the surface is cleaned and polished. Electro-plating will probably be applied to this.

1422. *Forks are now, at the best tables, generally of silver,* except when they are plated on steel, which latter is far preferable in appearance to the British plate or German silver, but does not wear so well.

1423. *Knives and forks are frequently too much worn in the cleaning by the common method.* A lathe and wheel, charged with knife-cleaning composition, would insure a saving of time in the proportion of five-sixths; that is, an hour's work might with this machine be done in ten minutes, and, if care be used, with less wear.

1424. *Knife sharpeners.*—Every person accustomed to carving must have felt, upon occasion, the great inconvenience of a blunt knife, and the advantage of one that has a good edge. The common steel used by the butchers is well known; but it is an inelegant instrument to be seen at table, and requires great dexterity to use it effectually. Several attempts have been made to invent a method of sharpening a knife expeditiously, and without producing any annoyance.

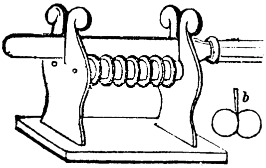


Fig. 510.

1425. *Felton's patent sharpener* consists of two steel cylinders, placed parallel to each other, and revolving upon their axis. Each cylinder has projecting rings of hard steel, the edges of which are grooved finely. The edges of the rings in the opposite cylinders overlap each other a little, as at *b, fig.* 510, by the rings of one cylinder falling between those of the other. If the edge of a knife be drawn from hilt to point between the cylinders at their junction, a good edge will be given to it by the action of the sharp grooves on the rings, which act like a file.

1426. *Westby's knife sharpener* differs from the last in consisting of two sets of straight bars opening to an angle, and having the insides grooved like a file: the knife to be sharpened is drawn between them, like the last.

1427. *Scissors.*—The beauty and elegance of polished steel is displayed to great advantage in the manufacture of the finer kinds of scissors. These are made of the best cast steel, and are very highly polished. Frequently they are curiously and beautifully ornamented by blueing and gilding with studs of gold, &c. Often the handles are of mother-of-pearl. The shanks of scissors are frequently ornamented with rich open work, or embossed figures, elegantly executed. Some of the filigree shank scissors at present in fashion are wrought with great labour and ingenuity, often occupying an industrious workman two or three weeks upon a single pair in boring and filing out the design.

The blades are made separately, without any regard to their being in pairs; they are afterward filed and paired. Very large scissors have their blades only of steel. Of late vast numbers of scissors of low prices have been made of cast iron instead of cast steel; and many of them do sufficiently well for common purposes, but are not to be depended upon either in their material or workmanship.

1428. *Shears* differ from scissors in being made of one piece of metal only, the two blades being connected together by a strong spring bent like a bow, whereas scissors consist of two pieces of metal moving upon a pin as a centre. The spring of shears causes them to open, and the force of the operator is only employed in shutting them to cut. They are used in various operations, such as clipping the fleece from the bodies of living sheep. We shall say nothing of such shears as are used for dividing sheets and bars of metal, some of which will cut through a piece of iron half an inch thick.

1429. *Penknives.*—A good penknife is an article of such indispensable necessity with almost every individual in civilized society, that it is no wonder uncommon pains have been taken for the attainment of perfection in its manufacture. They are made nearly in the same way as table knives, but should be of the best cast steel. Some are let into hafts for desk knives; others are made to shut, as clasp knives; and one, two, three, or more blades are included under the same handle, even to the knife with a hundred blades, which is a mere curiosity. Besides the goodness of the blade, something depends upon the form and size of the handle; if this be too large, the knife will be clumsy and unmanageable; while, on the other hand, if it be too small, the user will want that proper command of the blade which is essential in the dexterous and successful cutting of a quill. In general, a handle rather fuller in the hand than those of most of the fancy knives will be found preferable for use. If the blade be too broad, it will not effect that graceful curve required in the pen; and it appears to be a good way to make the under side of the blade next the pen a little curved or rounded, that it may turn easily. In the handles of penknives still more scope is afforded for the exercise of ingenuity than in those of table knives; stags' horn, black horn, mottled or white horn, tortoise-shell, mother-of-pearl, are the most frequent substances employed, and endless are the forms and modes of decoration, suited to all wants and all prices.

1430. *The best cutlery is manufactured in London,* chiefly by surgical instrument makers. They employ superior workmen, and reject, during any part of the process of the manufacture, such articles as, from slight flaws, cracks, or even any inferior quality in the steel, may be objectionable. Greater attention is likewise paid to the quality of the steel, and to the accuracy of hardening and tempering it. Although very many excellent articles of this kind come from manufactories in the country, what is town-made is most to be depended upon.

SECT. II.—OBSERVATIONS ON SHARPENING CUTTING INSTRUMENTS IN GENERAL.

1431. After the blades of cutting instruments have been formed, an edge must be given to them; and the same process must be performed, should that edge have been entirely destroyed by use or accident. The first operation is grinding by means of grindstones, coarser or finer, adapted to the nature of the various articles to be ground. Grindstones are made of a grit sandstone, and the best come from Newcastle, and from Bilston, in Staffordshire. The edge given by the grindstone is exceedingly rough; and although it may serve for many coarse purposes, it is too uneven for the nice cutting tools, and therefore a smoother edge must be obtained by a finer grindstone, and then by setting on a *hone.* Hones are of different kinds, for grinding down quickly, or for giving a very fine edge. Of the former is the Turkey stone, which comes from Smyrna, much used in sharpening carpenter's tools; as also the Ayr stone, and a few others, found in N. Wales and Devonshire. The best hone we have for giving a fine edge to razors and similar instruments is the *German hone,* a cream-coloured stone that comes from the slate mountains near Ratisbon, in Germany, and is sent all over Europe. Oil is generally used in setting, but those who dislike the dirt of this may use soap and water with the hone, which answers nearly as well as oil, and is more cleanly. A certain dexterity is essential in attempting to give an edge on the hone, which it would be vain to describe in words; and we would therefore recommend any one wishing to acquire the power of setting their own razors or other tools, to see the process performed by one who has skill.

SECT. III.—REMARKS ON POLISHING METALS.

1431.* *The following remarks upon the polishing of metals* are given, not so much from their connexion with the cutler's business as for their application to various cases in domestic economy. The polishing of metals differs according to the kind of metal and the kind of manufacture; nevertheless, there are some general principles to be attended to as being common to all, of which it may be useful to have a clear idea. All polishing is begun, in the first instance, by rubbing down the surface by some hard substance that will produce a number of scratches in all directions, the level of which is nearly the same, and which will obliterate the marks of the file, scraper, or turning tool that has been first employed. For this purpose coarse emery is used, or pumice and water, or sand and water, applied upon a piece of soft wood, or of felt, skin, or some similar material. When these first coarse marks have been thus removed, they next proceed to remove the marks left by the pumice-stone by finely powdered pumice-stone ground up with olive oil, or by finer emery and oil. In some cases, certain polishing stones are employed, as a kind of hard slate, used with water. To proceed with the polishing, still finer powders are used, as Tripoli and rotten-stone, which is still finer, and is found only in Derbyshire. Putty of tin and crocus martis are also used for high degrees of polish. But the fact is, in respect to polishing, that the whole process consists merely in removing coarse scratches by substituting those which are finer and finer, until they are no longer visible to the naked eye; and even long after that, if the surface be examined by a microscope, it will be seen that what appeared without any scratches is covered all over with an infinity of them, but so minute that they require a high magnifier to be discovered. The operator, therefore, who understands this principle, will know how to vary his polishing substances according to the nature of the article he wishes to polish. It is quite evident that his polishing material must be able to scratch, in a coarser or finer manner, the substance he is desirous of polishing, for wearing down is only effected by producing minute cuttings or scratches. It is evident, also, that great care must be taken to have the last polishing material uniformly fine, for a single grain or two of any coarse substance mixed with it will produce some visible scratches instead of a perfectly polished surface.

See remarks on polishing materials in Sect. XVII., Book V.; the coarsest being emery, sand, glass-paper; the next in degree, brickdust, washed emery, Tripoli; and the finest, rotten-stone, whiting, or chalk, putty of tin, and black-lead. Oil is generally used in giving the highest degree of polish, and the greatest care is necessary to prevent any of the coarser particles getting mixed with the finishing powders.

BOOK VI.

ON THE ESTABLISHMENT OF HOUSEHOLD SERVANTS, AND THEIR DUTIES.

CHAPTER I.

CONDITION OF DOMESTIC SERVANTS, AND THE OBLIGATION OF THEIR SERVICE; THEIR QUALITIES, ETC., CONSIDERED.

SECT. I.—CONDITION OF DOMESTIC SERVANTS.

1432. *Domestic servants are a class in society* no less essential to its welfare and convenience than the equivalent in subsistence and money which, for service done, that class receives, is essential to the well-being of each individual belonging to it.

1433. In no era of time, nor in any state of social life, has man been able to dispense with the aid of his fellow-creatures without losing ground in his progress towards civilization. Mutual assistance, co-operation among men, is the impetus to social improvement, the promoter of social convenience. So great has the necessity for it ever been, that, in countries and in periods in which this could not be the effect of mutual compact, the stronger members of communities imposed it by force on the weaker; and hence the origin and wrongs of slavery.

1434. Very different from slavery is the condition of domestic servants at the present time in most parts of the civilized world. It is respectable and creditable. It has its rights, its privileges, which give it a character of independence, notwithstanding the term "service" attached to it. Public laws protect this class of the British community from injury and oppression, and the prevalent domestic regulations and habits all tend to secure to it every requisite comfort, and, even more, much enjoyment. Independence, like happiness, is always comparative. There is no class of society but has its power "to will and to do" restricted variously and in different degrees. Each class and each individual composing it is under subordination of some kind or other; and each acquiesces in its necessity, on perceiving it to be based on principles of general utility and security. When subordination is so based, society must be both generally and individually benefited. Without it, what would be the state either of public or private life? The struggles and contentions of ungoverned passions, the clashings of different interests, the wilfulness of the powerful, would assail and overcome all the quiet and peaceful influences of domestic life, and be in perpetual opposition to the order and justice by which society is held together.

1435. Hardships and the loss of independence can scarcely be considered as characterizing, in this country at least, the state of domestic service. If deficient in personal freedom, it is exempt from great anxieties and responsibilities; and in admitting of change from one service to another, it fetters no individual to the permanent endurance of trials peculiar to any one situation. It compels no one to an undue devotion of his strength, nor to engage in any excess of duty beyond that which, on entering a service, he voluntarily, and for a stated compensation, engages to perform. It does, indeed, require from him a diligent and a faithful attention to the duties which he has undertaken; a strict regard to personal decorum, and to the moral obligations of temperance and honesty. Trials of patience and temper he may experience; but not in a greater degree, probably, than his superiors may have, in their sphere, to encounter.

1436. *The principal of a family* has a right to prescribe certain regulations by which his servants are to govern themselves. There can be in different families no complete uniformity in these domestic regulations, while there is neither uniformity nor equality in the circumstances and characters of those who form social communities: in every household some variations of habit and custom must be expected; and servants, entering new situations, will be disappointed if they expect to meet in each a counterpart of those which they had left. They must conform to each variety, or submit to the penalty of frequent dismissal. There can be no proper notion of domestic subordination when a servant permits himself to reproach his employer, and, which is not unfrequently the case, with some such expression as this: "I have never been used to that," or, "that work did not belong to me in my last place." Neither has he any right to object should his master prescribe the mode in which he is to perform his business; and he is especially blameable if, at the same time, he impertinently retorts, "I know my business, and am not come here to learn."

1437. In describing the course of domestic business, the object herein is not to mark the limits of each servant's province, as if he was not subject, in the main, to the wishes of his master, or to the convenience of the family whom he serves; but governed, as it were, by prescriptive regulations, to which, as a code of domestic laws, he may appeal for his justification when inclined to disobey orders given him. On the contrary, the intention of this work is, after setting forth the condition and usual treatment of servants, to present a manual of domestic knowledge and of household practice, to which inexperienced housekeepers and servants may alike refer, when seeking to know the details in each branch of household duty, and the mode in which, in all general cases, household work is distributed throughout the establishment.

1438. The suggestions and details thus brought together may be respectively useful to master and servant, without affording pretext to either for the omission of any part of their mutual obligations, or for any breach in their mutual compact.

SECT. II.—QUALITIES OF SERVANTS.

1439. *In servants, generally*, we look for the essential qualities of *integrity, sobriety, cleanliness*, and *general propriety in manner and dress*, together with the knowledge of the duties in their respective departments of household business which, on being hired, they professed; whence, besides these indispensable qualities and powers, some few members of large establishments should, in order to be competent and effective, have other distinctive marks of fitness for the office filled.

1440. *A house steward*, for instance, the chief member of the establishment, holds the most responsible of the household offices. Of him, as the representative of a higher domestic authority, we would remark that he should, in some measure, manifest qualities similar to those possessed by him whom he represents. Any one having authority over others should have *self-command*, to enable him to meet, without forgetting himself, provocations from the unruly or insolent subordinate members of the establishment. He should possess *firmness* in enforcing all reasonable performance of duty: he should have *integrity* beyond the powers of any one to induce him to connive in deviations from duty or honesty: with these qualities, he should demean himself in such a manner that none in the subordinate departments of the house should be on such familiar grounds with him as to diminish his authority or influence over them.

A butler is sometimes similarly situated with the house steward, and is hence called upon to exercise similar qualities with those above mentioned.

1441. *The housekeeper*, whose place in the female part of an establishment is similar to that of the house steward among the men servants, should possess the observation and vigilance of an active mistress of a family. Her eye should never be withdrawn from the circle of her duties; in that she should be ever ready to act with the decision, keenness, and interest of a principal, maintaining over the subordinate actors in it a strict but not severe superintendence. Those whom she has to direct, and to keep to a regular discharge of duty, are like children, requiring a firm mind to govern them, a quick apprehension of their dispositions, so as to apply to each an appropriate stimulus to good conduct; and a kind disposition, to afford them comfort and consolation when ill or in sorrow. To sum up the characteristics of a good housekeeper, she should display a propriety of manner which impertinence would not dare to attack, and an integrity of conduct which malignity could not impeach.

1442. *To the lady's maid and valet*, both standing on similar grounds, prudence of speech should belong. It would secure them the confidence of their employers, and save them from the inconvenience and trouble in which indiscreet tattling would involve them. Being more immediately about the person of those whom they serve than others of the establishment, they have opportunities of hearing opinions of persons and circumstances, hastily and unguardedly expressed, which, if repeated, might be mischievous, especially if told inaccurately, or with exaggerations. In these two members of the establishment, it is also apparent that uniform neatness and cleanliness of person, with order in their habits, and the power of controlling their tempers, are requisite qualities.

1443. *Of the head nurse*, the qualifications which appear to be requisite or desirable are so numerous as scarcely to be found united in one individual. Fitness for the important office of nurse must be found in an union of qualities and powers, both natural and acquired.

1444. *In person* a nurse should have no striking peculiarity or deformity. No habitual tricks with the features, such as squinting or grimaces; no defect in the articulation, such as lisping and stammering; no singularity or vulgarity in the tone or accent; for such peculiarities always bring into exercise the imitative propensities of childhood. *In stature* the middle size is, for a nurse, preferable to either extreme of tall or short; the one often causing deficiency in activity, the other in muscular power. *The constitution* of a nurse maid should be sound. Tendencies to humours of any kind, to consumption, to rheumatism, or even being liable to frequent headaches, would detract from the personal fitness of an individual for the duties of the nursery. *In age* the nurse should be neither very old, nor very young; were she old, she might possibly be very deficient in activity and temper; were she too young, she might want consideration and judgment. *In disposition* she should be cheerful, even to liveliness, yet, withal, gentle. Boisterous gayety in the nurse would be almost as injurious to her infant charges as a temper of irritability and violence. In the situation and duties of a nurse there is much to try the temper; and it is not reasonable to expect that it should be always unruffled; still, no one is fit for the charge of children who cannot control in herself any violent expression of irritation.

1445. *In personal habits* the nurse should be scrupulously correct. Cleanliness and neatness are not to be dispensed with in the individual who is to lay the foundation of good habits in the objects of her superintendence. Deficiency in such habits can, in her, only arise from indolence; and if this defect be inculcated in childhood, by the force of her example, it may, being the parent of so many other vices, blight the promise given in the first years of life of the exercise of future mental vigour.

1446. But, after all, no personal nor acquired qualification in the nurse can be put in competition with the all-important requisite of vigorous, effective, and virtuous principles. Neither deformity in person nor singularity of speech or deportment can inflict, on an infant generation, an injury equal to that which a vicious influence in the nursery can effect. The arts of deception and craft manifested there have often sapped the ingenuousness of the most guileless nature that childhood had ever evinced. Such evil once effected, and thus early in life, all hope of honour and integrity being manifested in manhood must be abandoned.

1447. A head nurse, besides being herself scrupulously upright in conduct, should be acutely alive to all habitual deviations from rectitude in the conduct of those employed as her nursery assistants. Should their faults, after a fair trial on her part, prove incorrigible, she should not from false feeling screen them from detection, but, rather, should openly and decidedly make them known to those authorized to dismiss them. Their occasional omissions of duty, together with many of the inadvertent errors of youth, may, and ought to be treated leniently, if not entirely overlooked; but any systematic deception, habitual indolence, and violence of temper, any one of which defects would render their example dangerous in the nursery, it is her decided and peremptory duty to expose. If her employers retain them after knowing their defects, her responsibility as regards them ceases, but as long as she conceals their misdemeanors, she makes herself answerable for the consequences. Let her keep always in mind, that although the conduct of a junior servant may not be as well regulated as that of one who has passed through the discipline of years, yet that it is part of her duty to see that no one over whom she has authority neglects to perform her share of work with neatness, cleanliness, activity, and good humour, nor sets any evil example before those whose infant propensities would render ready imitators. A nurse who acts thus would be entitled to no common share of respect and gratitude from her employers.

1448. *Foot boy.*—Of all the subordinate members of an establishment, such as foot boy, scullion, &c., the good qualities to be sought for in them are of an invariable nature. No one would, knowingly, engage in their service those whose characters could not stand a strict investigation as to honesty, sobriety, cleanliness, activity, and civility. Possessing these qualities, the duties of these inferior members of establishments are so much under the superintendence of those above them among the household that they are on the footing of learners rather than of able assistants in domestic business. Their fitness for the departments they fill must be sought for more in the qualities of which they give indications, and in their promise to improve, than in their efficiency as servants.

Sect. III.—Corrupt practices of servants.

1449. *Corrupt practices of servants*, which are not unfrequent, must here be noticed as warnings to their employers; in whom such practices are discovered there can be no confidence, for they betray the want of some of those requisite qualities above enumerated. The consequences of such low-minded trickery of which we are about to speak recoil upon servants generally; the good suffer with the bad.

In a household, every instance of pilfering and trickery accumulates odium on the whole class, and makes it individually watched and suspected. The prevailing bad opinion of servants inflicts, too, an injury on the employer and the employed; a suspicious temper being as unfavourable to the character of the one as to live suspected is to that of the other. Yet that there is sufficient ground for suspicion must be allowed. It is every day acknowledged that one of the main anxieties of housekeeping is the apprehension of the dishonesty of those who are under our roof and receiving bread from our hands; it is this insecurity which often destroys repose, and undermines a generous and confiding temper. Were the depredations of a description to be easily detected, the annoyance would be of less moment; but they are usually so systematically small as to defy the strictest scrutiny to discover, and yet so uniformly carried on as to be in the end incalculably great.

1450. *Of these practices, that of connivance* with the servants of the tradespeople employed by a family is one necessary to be known, as the remedy is evident, provided the practice be confined to the servants, and not to the tradesmen themselves. It is that of entering into the books more goods and articles of food than are brought into the house, the amount of which is divided between the cooks and the agents employed by the tradespeople to convey their commodities from their shops to their customers. So prevalent has this malpractice been as to give origin to slang epithets; for instance, the loaves added to the amount of those actually taken into a house are called *dead men's loaves.*

1451. It must, however, be remembered, that if the payment of the baker's bill be not settled between these dishonest parties, they can derive no advantage from the fraud, and will therefore have no inducement to practice it, unless the baker himself also connives.

1452. Against cooks, charges have been often substantiated of other ways of disposing of the provisions of families which they serve. It is indisputable that a traffic is carried on by many cooks with their own needy connexions; and from the discoveries which have been frequently made has arisen the rule of exclusion from every house of the friends and relatives of servants in the metropolis: an indispensable restriction, unless the friends are almost as well known to the family as the servants themselves. In all great towns petty depredators have so many means of evading discovery as to render them the more dangerous.

1453. *In paying bills*, dishonest servants find another means of emolument to themselves at their employers' cost; and in which the tradespeople certainly do connive, probably for the object of keeping in favour with those who, if so disposed, might injure them with their customers. It is no uncommon practice for a cook, on entering a new service, to make terms for herself with the tradespeople of the family, and if they prove unbendingly honest, she has no resource but to decry their goods, and thus lessening their estimation with their customers, induce them to deal elsewhere, and perhaps with persons of her own stamp. One of her claims is to the odd pence and halfpence of each small bill, and to the discount upon large accounts. *Christmas-boxes* are also generally demanded by servants from tradespeople. All these sources of secret gain must, it is apparent, spring primarily from the principals of families, and not from the tradespeople who, in affixing a price to their commodities, must take into account all these drawbacks upon them, or their business could not prosper. These facts do not rest on doubtful authority, but are indisputable, and illustrate the importance and economy of the habit of each principal settling his own bills, and allowing his domestics to have as little concern with his tradespeople as possible.

1454. *The honour which servants* pretend to preserve among themselves, and which prevents them from exposing the frauds and misconduct going on among them, is only another name for deception and dishonesty. An honest-minded servant ought to distinguish between the pettiness of tattling and the duty he owes to his employer and himself; and it should always be impressed on his mind that to see dishonest practices and not to disclose them to the injured party, is to participate in them. He becomes an accomplice, if he knows of frauds and is silent.

Sect. IV.—Household regulations.

1455. *In the following details* will be found the regulations, now generally, though variously modified, by which the treatment of domestic servants is governed:

Subsect. 1.—*Food of Domestic Servants.*

1456. *The food of domestic servants* is uniformly at the cost of the principals of families, though, in different spheres and houses, there are different modes of settling this part of domestic management.

1457. *One, and the most general plan*, is to have meals prepared for the household distinct from those of the family, at stated and early hours, and consisting chiefly of plain substantial fare, with specific allowances of beer and ale.

1458. *In this country*, but only in families of the first rank and greatest affluence, there are two distinct tables allowed in the establishment; one in the steward's room, for the chief members of the establishment; the other in the servants' hall, for the rest of the domestics.

1459. *The steward's table* has been of late years less frequent than formerly in the houses of the great. During the long war of the last century, provisions became so immoderately high, and every luxury so heavily taxed, as to induce, in most houses where large establishments were indispensable, great retrenchment in whatever way it could be effected; and the first step taken by many of the gentry was the abolition of the steward's table, only one general table in the servants' hall being thenceforward allowed to the establishment.

1460. Where the steward's table is yet extant in the houses of the nobility, the housekeeper and house-steward preside at it, and none of the domestics but lady's maids, valets, butlers, and head gardeners, are admitted to it.

1461. In the housekeeper's room, the same party take their breakfast, tea, and supper, at the last of which the head nurse has a place, when she can leave the nursery without neglecting her charges.

1462. *The meals* in the servants' hall are usually announced to the members of the establishment by the ringing of a great bell. It is rung at 8 o'clock in the morning for breakfast, at half past 12 or 1 o'clock for dinner, and at 8 again for supper. In large establishments, where many are to be served, an hour's time is allowed for dinner. In establishments of smaller number, half an hour is allowed for dinner, and half an hour also for tea and supper.

1463. *Breakfast and supper* for men servants consist generally of bread and cheese, occasionally of meat, together with a pint of beer to each. Generally speaking, *meat* is allowed to establishments only once a day.

1464. The consumption of food sufficient for each domestic has been calculated to be at the following rates: *Allowance of bread* for men servants, two quartern loaves each, or 8 lbs. per week; for women servants, one quartern, or 4 lbs. each per week. *Allowance of butcher's meat*, half a pound per head for each day's dinner for females; three quarters of a pound for men. *Allowance of cheese*, one quarter of a pound per week for each individual. *Allowance of butter*, if fresh, half a pound per week for each servant, or if salt butter be used, three quarters of a pound. *Allowance of tea*, half a pound *per month* for each servant. *Allowance of sugar*, half a pound per week. *Allowance of beer*, for the men, a pint at each meal; for the women servants, half a pint at each meal.

1465. *Board wages* are, in some houses, given to servants instead of food. Some regard this mode as economical, and as diminishing the trouble of housekeeping. But others consider it as a mode full of temptation to petty thieving in servants scarcely to be resisted, and hence its evils are greater than its advantages.

1466. For servants left in houses when families are absent from home, board wages form both a proper and convenient mode of fulfilling the master's obligation to provide food for them.

Board wages for men vary, according to the circumstances of the family paying them, from twelve to fourteen shillings per week; for *women*, from eight shillings to twelve per week. Servants living on board wages usually club together, and appoint the cook of the family to be their caterer; or, in some cases, the cook contracts with the rest to provide them at so much per head their dinners and suppers. *A third arrangement* is sometimes adopted. Food generally is provided for the establishment, but money is allowed each servant to provide for himself beer, sugar, and tea. *For beer* the allowance in money is two shillings per week for each man servant, and one shilling per week for each female servant. *For tea and sugar*, some families allow one pound per annum to each servant, others two pounds. *Of these modes, the principals of families* adopt that which to each family respectively appears to be most convenient or economical. *Servants* have no choice in the matter, farther than that of declining to serve in families where arrangements of this nature appear to them objectionable, or not conducted in a manner likely to promote their daily comfort.

1467. *The meals of servants* in small families, and of limited means, generally take place immediately after, and upon the remains of, the family meals. In such cases the hours of the family are early and regular, or the arrangement would prove uncomfortable and injurious to the health of servants, whose constant active employments render regularity in their meals of great importance to them.

SUBSECT. 2.—*Dress of Servants.*

1468. *The dress of men servants* is regulated by the style and rank of the families whom they serve. Great neatness, and even a gentlemanly appearance, are expected at all times in the upper servants, and especially when in attendance on their principals. Whether servants be *in* or *out* of livery, they must, when attending at table, always appear in clean white cravats, and in white stockings, either of cotton or of silk. Men servants *out of livery* provide their own clothes, their wages being proportionally higher than those of livery servants.

1469. *Livery*, formerly the cavalier's badge of devotion to some fair lady, whose livery he assumed at "tilt or tournament," is at present only a mark of service.

1470. Livery, in some families of quality, is a part of the inheritance handed down to them in succession from one generation to another, and generally has some relation to the colours of the arms. Of those who have no long line of ancestry to boast of, the livery is often matter of fancy and choice only, and is costly or plain, according to the style, fortune, or taste of each family, and on whom, and not on the servants, the charge of providing it falls.

1471. A livery consists of a complete suit of clothes. The allowance of suits in the year to each servant varies, in the different families of genteel life, from two to one suit of dress livery, with one suit of undress clothes, to be worn during the hours of work, or during occasional absences from home of the family. One hat each year is generally provided by the master; but linen, gloves, stockings, and shoes the livery servant provides for himself. He also pays for his own washing, with the exception of his linen, jackets, and aprons, which are usually sent to the laundry to be washed, or with the family linen.

1472. At tables where style is kept up, servants are expected to attend in silk stockings, and with either silk or white kid gloves. In such houses the wages are, or ought to be, proportionally high. The use of gloves in waiting at table has superseded that of the table napkin wrapped round the hand of the servant employed in presenting articles to those at table. Neater in appearance, and less troublesome to the waiter, the use of gloves may be regarded as an improvement on the old fashion; but it is somewhat more expensive to the servant.

1473. For the rough business which footmen undertake to do, when they enter families where only one man servant is kept, the master usually provides his footman with a coarse jacket and large trowsers, which cover over the whole of his dress. Jackets of linen, or coloured cottons, and white aprons, are also allowed him, in which he may, without impropriety, answer bells in the morning. In this dress he usually performs much of his morning's work, and dresses himself either before luncheon, or before the dinner hour.

1474. *A coachman* has one livery, also two hats, and two pairs of boots, allowed him annually, and a box coat once in three or four years; also one or two stable dresses, consisting of *rowels*, a jacket, a waistcoat, and one undress frock-coat.

1475. *The under coachman* has nearly the same allowance of clothes. *To grooms* are allowed yearly two suits of livery and two stable dresses. To postillions three sets of jackets in two years, and a cap yearly.

1476. *The dress of female servants*, although usually left to their own discretion, may be, and generally is, influenced by the opinion of their employers as to its suitableness and consistency. A mistress may require her maid servants to expend a portion of their wages on neat and creditable clothing. Beyond this she may have no right to interfere; but by a judicious use of her influence she may restrain them from running into extravagance and inconsistency of dress, and, consequently, from many errors into which their vanity might lead them. Of late years the low price of most of the articles of clothing has introduced into many classes a more showy style of dress than they formerly indulged in, and among maid servants this is particularly evident.

1477. *Of neatness of dress* all must approve; it is inconsistency, in point of expense, of form, or of colour, with the means or daily avocations of any class of society, that alone is censurable.

1478. In large establishments of servants there are different ranks, as in more general society, in which the avocations vary, from those which are laborious to those comparatively light and easy. In the discharge of these different employments, a different style in dress may be not only admissible, but consistent. *The housekeeper and lady's maid* may, with propriety, approach nearer to the style of dress of their employer than the *house maid, laundry maid,* or *under servants,* though in all the same general principle should be the guide.

1479. *Cleanliness of dress,* whatever may be their employments, all servants should regard as one of their essential requisites. In the upper servants there can be no obstacle to its observance; the difficulty may be greater with those who engage in the more laborious duties of cleaning a house. Yet with them much depends on habit and management of their work. Some servants have the habit of getting through even the least cleanly part of their employments in a comparatively cleanly manner; with others the reverse is as evident. One servant will scarcely show by her dress, another scarcely hide, the nature of her employments; so great a difference in habits is there even in this one point.

1480. *To the habit of neatness* the same remark will apply. Neatness and cleanliness may indeed be regarded as inseparable qualities, the one being rarely found without the other. The same habit of mind tends to the cultivation of both; and *where* these qualities are found, *there* also we may look for *greater consistency,* for a better taste, it may be called, in dress.

1481. *To the love of finery* are often united habits of untidiness and uncleanliness. It is no uncommon thing to see *slovenliness* among domestic servants in the morning hours, and in the evening a dress inconsistent, both in expense and style, with their station and means.

1482. *In families requiring the attendance of maid servants during the morning hours* in the parlour, or at the house door, the neatness of their morning dress is as important as that of the evening, although, from the difference of their employment in these divisions of the day, a change of dress is both allowable and desirable.

1483. *Among the articles of dress* which must be regarded as inconsistent with any degree of domestic service may be enumerated silk gowns and silk stockings, blond, lace, feathers, and artificial flowers, bracelets, necklaces, rings, and ear-rings. Will it be considered as entering too much into particulars to mention with censure the common mode with which maid servants dress their hair? In the morning they are disfigured with tiers of curls in paper; in the afternoon sometimes decorated with long pendant ringlets, to induce which much time is bestowed at night, when, if rest be not needful to them, they might be better engaged in repairing their clothes. A servant of correct taste in dress would never appear in curl papers, nor keep her hair of such a length as to require more than very simple curling.

1484. The outlay in dress the wages of each servant should regulate. Those who have low wages will not, if they reason rightly, attempt to vie in dress with those who have higher wages. Propriety and prudence alike condemn such attempts in them, as much as in the wife and daughters of a man of small income, were they to compete in dress with those of superior means.

1485. *In servants' dress two thirds of the wages only* should be spent. The remainder, left in the hands of their principal, or placed in saving's banks to accumulate, may prove a means of comfort to them beyond comparison greater than the transient pleasure which a more expensive dress might give them. In the following tables will be found estimates sufficiently accurate to show, that with judgment in the choice of the materials, and a proper subordination of the inclination for dress to the means for obtaining it, a third part, or even more, of wages, may, in most cases, be untouched, and yet the personal appearance of the servant not neglected thereby, but rather improved, inasmuch as consistency in dress is always one of its most becoming attributes.

1486. *Tables of maid servants' dress consistent with wages.*

TABLE I.—*Wages £7 7s.*

	£	s.	d.
1 good cotton dress, at 8*d.*	0	7	8
2 common working gowns, at 6*d.*	0	7	0
Linings for the dresses	0	2	0
4 petticoats	0	8	0
Body linen	0	4	6
Stockings (3 pairs)	0	6	0
Muslin for caps and handkerchiefs	0	6	0
Bonnet and trimmings	0	10	6
4 checkered aprons, 2 white ditto	0	6	0
A shawl	0	12	0
3 pairs of shoes	0	12	0
2 pairs of gloves	0	1	6
Sundries	0	10	0
	£4	13	2

TABLE II.—*Wages from £12 12s. upward.*

	£	s.	d
3 gowns (making, &c.)	1	10	0
Petticoats	0	12	0
Body linen	0	6	0
4 pairs of stockings	0	6	0
Aprons	0	7	0
Caps, habit shirts, ribands, and gloves	1	0	0
2 bonnets and trimmings	1	0	0
Shawl	0	15	0
3 pairs of shoes	0	12	0
Sundries	1	0	0
	£7	8	0

SUBSECT. 3.—*Customs and Rules among Establishments of Household Servants.*

1487. In all large establishments of servants one rule invariably prevails. The men and women servants, during the intervals in their employments, are never allowed to sit together in the same room. Each, men and women, have their respective places of resort. At dinner and supper time only do they assemble together. This regulation it is the duty of both the steward and housekeeper to see observed, as experience has proved it to be favourable both to the morals of the individuals of establishments, and to the proper fulfilment of each branch of household work.

1488. *To the housekeeper's room* lady's maids repair for breakfast, tea, and supper, and at all other seasons of leisure. Here, also, butlers and valets are admitted to tea and breakfast, but not at other seasons. *The still-room maid* waits upon the housekeeper and those in her room.

1489. *The steward's or butler's* room is the place of resort for the upper men servants; and, in houses where a second table is still allowed, the dinners and suppers of the chief members of the establishment are served in the steward's room, the steward's boy waiting at table.

1490. *The still-room,* formerly the place in which waters of various kinds were distilled for domestic use, and where the housekeeper still prepares confectionary, and all the sweetmeats requisite for desserts, is also the place appropriated to the use of the female servants who rank below lady's maids. In this room they breakfast and have tea; and to this room, after dining in the servants' hall, they withdraw; and, under the superintendence of the housekeeper, the housemaids occupy themselves there in repairing or making the household linen.

1491. *The servants' hall,* in which both men and maid servants have dinner and supper, is also the place to which all the men below the butler repair, when disengaged from their several occupations. In this place the kitchen maid, and the boy who cleans the servants' knives and forks, wait at table. After each dinner and supper the parties separate, and adjourn, as above mentioned, to the several places appointed for them.

1492. *The nurseries* are the proper places for those who have the charge of the children in them to remain in during the evening. Their attention ought at that period to be given to the repairing or making of children's clothes. Nurses and under nurses always have their meals in the nursery. In some places the head nurse has the privilege of supping in the housekeeper's room, provided all her charges are well and asleep.

Order in which the members of a household establishment rank themselves.

MEN.		WOMEN.	
House steward.	Under butler.	Housekeeper.	Upper laundry-maid.
Valet.	Coachman.	Lady's maid.	Dairy-maid.
Butler.	Groom.	Head nurse.	Under housemaids.
French cook.	Steward's boy	Head cook.	Under laundry-maid.
Footman.	Stable boys.	Upper housemaid.	Kitchen-maid.
		Stillmaid.	Scullion.

1493. In establishments of the highest rank there are grooms of the chamber to be added to the above list. The duty of these individuals is to remain in the ante-room, ready to usher visiters into the drawing-rooms, and to superintend the appropriation of the several bedrooms, place, send off, and receive the trunks, &c., of parties visiting at the house.

1494. *In establishments* where there are neither steward, housekeeper, nor butler, the cook presides at table, and is, in some measure, regarded as responsible for decorum and good order being observed by all seated round it. In such small establishments there would be no use for many of the strict regulations which in larger ones are essential. When there is no servants' hall, the servants take their meals in the kitchen, and sit there also when they are disengaged from their routine of business. Footmen have their pantries, in which, if they have nothing particularly demanding their attention, they can occupy themselves in reading and writing.

SUBSECT. 4.—*Perquisites of Servants.*

1495. *The perquisites of servants* are, in many cases, so many encroachments on the property of their employers, who tacitly allow them, while they, in principle, condemn them. Perquisites are among the circumstances which tend to corrupt the morals of household servants, and as such their continuance is most objectionable. At the same time it would be difficult to eradicate the evil, which is, by prescription, become almost a domestic law. Why it has so corrupting an influence among a household it is not difficult to perceive. It places the interests of servants in opposition to those of masters. What is gain to the one is often loss to the other; and in taking only a short-sighted view of his interest, a servant's integrity is not always proof against the temptation of immediate gain. The barrier between honesty and dishonesty being once broken, who can say how often it will be passed?

1496. *Among the perquisites,* the first that may be noticed as objectionable is that of *vails* or gifts in money from visiters to servants. The custom is a species of bribery for services which ought to be performed without it, and it has a tendency to make servants less attentive than they ought to be towards such visiters as cannot give them great pecuniary rewards. For such gifts servants are seldom the richer; they often employ them in gratifications which it would be better for them to forego. The *custom* is growing into disuse, and some very respectable families make it one of the rules in hiring their servants that they shall accept of no such gifts, but when offered shall inform the visiter that it is contrary to the rule of the house to take them.

1497. *Perquisites of cooks* consist chiefly in *dripping*, commonly called "kitchen stuff." This perquisite is very generally allowed, probably from the difficulty of keeping any check upon the cook's use of it if it were not allowed. Every temptation to purloin should be in all houses as much avoided as possible; but in this particular instance it is scarcely possible to avoid it. If the perquisite be forbidden, no one can tell if the cook will not furtively secure it to herself. If it be allowed her, another temptation assails her; that of obtaining as much of it as she can by practices mean and despicable. A cook who grasps at making much of her dripping often over-roasts joints of meat, by which the fat is melted into the dripping pan. She neither protects the fat from the fire by covering it with paper, nor bastes the surface of the meat to keep it moist and rich. She trims from all joints all external fat, to add to her hoards; she uses for frying and for common pastry expensive materials, when she has that at hand which would answer as well, and would more honestly employ the melted fat which is obtained in roasting meat.

1498. *Perquisites of butlers, or of footmen* where butlers are not kept, are chiefly the ends of wax and mould candles; and in the department of the oilman's book many peculations are often practised undetected.

1499. *The dairy maid*, if she has charge of poultry, considers the feathers, when the poultry is killed, as her perquisite. As this may be an inducement to take proper care of the poultry, it may not be a privilege of so injurious a nature as those before noticed.

Subsect. 5.—*Hiring Servants.*

1500. *In hiring servants*, all will desire to have those who have spent most of their years of service, and especially their earliest, in families whose principles, habits, and *general* bearing in their rank of life, are of the best and most respectable description. It would signify little whether such families were of high or inferior standing in society, provided their habits of life enforced on all around them the love and practice of neatness, order, regularity, and cleanliness, and the still more essential qualities of integrity and sobriety. In hiring servants, it is also desirable to have those whose immediate relatives and connexions are respectable, however poor they may be. Those who hold their relatives and friends in respect will not be indifferent to their own characters; they will desire to do credit and not to disgrace an honest parentage, and thus the pride of respectability will be turned to its right use.

1501. *In regulating* the conduct of servants, it is requisite that the legal points in the business should be known. Indeed, the servant, equally with the master, should understand the rights which are mutually possessed, and in what respect the infringement of these rights on either part would affect their contract; in some cases they would find themselves amenable to legal process. Each party should know that servants may be legally punished for insolence, and for assaulting master or mistress; that they may be fined for *drunkenness, gaming, cursing*, and *swearing*; that if by misdemeanour they are legally detained from their master's house, the contract between them is void. On the other hand, if not chargeable with misdemeanour, the master cannot discharge them from his service without paying them that portion of the year's wages which was agreed upon between them on hiring, or allowing them to remain in his service for a stated time after giving them warning, unless the separation takes place by mutual consent.

1502. *On this head the usual agreement between principals and household servants* is to allow on each side a month's notice to be given, or a month's wages to be paid.

1503. *Register Offices*, sometimes resorted to by those who are seeking for servants, have not of late been in much repute, because servants of indifferent characters more frequently apply to them for places than those of a better description. In the metropolis, housekeepers who are constantly engaged in business prefer to avail themselves of the assistance of these offices in suiting themselves with servants, rather than to leave in search of them their lucrative employments. Such persons, not always requiring characters of those whom they take into their service, seldom give any on parting with them, and they reserve to themselves the power of dismissing such servants at a moment's warning; they, on their part, can, if their convenience or inclination induce them, leave their service immediately. Although the common Register Offices are little esteemed, there are institutions of more recent establishment, which at present bear a better character, and are founded on better principles. They have for their object the encouragement of respectable servants, as well as the convenience of housekeepers, and their security from the evils of disreputable and dishonest inmates. Servants whose characters cannot bear the strictest investigation will scarcely apply to such institutions if the promises and regulations of these establishments are observed; for they profess to be so scrupulously minute in their inquiries into characters as to preclude the necessity of those who are hiring from their office taking any concern or trouble in the business themselves. Of these institutions there is one called the Protector, and another the National Benevolent Institution; the former is in Great Russel-street, London, the latter in Bedford Row.

1504. The Protector Institution professes to combine other advantages besides that of supplying families with servants, the only object of a common Register Office. The conductors of the Institution engage, by the precautions they take in applying for characters, to lessen the difficulty of obtaining good and efficient servants. They profess to admit of no recommendation from parties of doubtful estimation, nor to consider slight, careless, and evasive answers to their inquiries as satisfactory. They endeavour to detect the fraudulent practices by which characters are obtained, and by a zealous and rigid investigation to secure their office from the application of those servants whose conduct will not bear the scrutiny.

Subsect. 6.—*Extent of Establishments of Servants.*

1505. *Establishments of servants*, considered according to their extent, may be classed under the following rates:

An Establishment of the First Rate, such as may be supposed to form the household of a nobleman of high rank, number from twenty to twenty-four domestics.

WOMEN.

Housekeeper.
A lady's maid for each grown-up lady of the family.
Cook.
Upper housemaid.
Laundry-maid.
Under housemaid.
Under laundry-maid.
Still-room-maid.
Kitchen-maid.
Scullion.

MEN.

House-steward.
Groom of the chamber.
Valet to each gentleman in the family.
Man cook.
Butler.
Gentleman's footman.
Lady's footman.
Under butler.
Gentleman's coachman.
Lady's coachman.
Couriers—outriders.
Grooms, in number according to the stud.
Under servants — Errand boys — Steward's boy.

To this establishment, that of the nursery (see "Nursery") may be added when requisite.

In an establishment of such magnitude, the duties of its members are perfectly distinct. Order and subordination must necessarily be maintained in it, by the proper administration of the household laws, and by the observance of "household et iquette ;" or anarchy and confusion, instead of convenience and comfort, would be found within this miniature world.

1506. *An Establishment of the Second Rate, suited to incomes of £5000 or £4500 per annum.*

WOMEN.

Housekeeper.
Lady's maid.
Upper housemaid.
Cook.
Laundry-maid.
Under housemaid.
Under laundry-maid.
Kitchen-maid.
Scullion.

MEN.

Butler.
Valet.
Two footmen.
Under butler.
Two coachmen.
Two grooms.

In this establishment the butler performs the duties of the house-steward as well as those of his own.

1507. *An Establishment of the Third Rate, suited to incomes of £4000 or £3500 per annum.*

WOMEN.

Housekeeper
Lady's maid.
Cook.
Upper housemaid.
Laundry-maid.
Under housemaid.
Kitchen-maid.

In this establishment of women-servants the under housemaid is expected to assist the cook in serving dinner, and the laundress on ironing and mangling days.

MEN.

Butler.
Footman.
Under butler.
Coachman.
Groom.

The butler here performs the duties of the valet, as well as those of the house-steward.

1508. *An Establishment of the Fourth Rate, for incomes from £2000 to £1500 per annum.*

WOMEN

Housekeeper.
Cook.
Housemaid.
Laundry-maid.

In this establishment the housekeeper is expected to superintend the cooking, and to act, if required, as lady's maid also.

MEN.

Butler.
Footman.
Coachman.
Groom.

1509. *An Establishment o the Fifth Rate, for an income of £1000 or £1200 per annum.*

Cook.
Housemaid.
Under housemaid. Expected to assist the cook when serving her dinner.
One man servant.

1510. *An Establishment of the Sixth Rate. Income from £700 to £600 per annum.*

Cook.
Housemaid.
Footboy.

1511. *An Establishment of the Seventh Rate. Income £500 to £450 per annnm.*

Cook.
Housemaid.

1512. *An Establishment of the Eighth Rate. Income £300 to £250 per annum.*

1 maid servant.
1 girl.

1513. *An Establishment of the Ninth Rate. Income £200 to £150.*

A maid of all work.

Incomes still less will admit of a girl only, or with the occasional use of a char-woman.

Sect. V.—Duties of Men Servants.

Subsect. 1.—*Duties of the House-steward.*

1514. The house-steward is the representative of his employer in all matters of business connected with the house: he hires, discharges, manages, and directs every subordinate member of the establishment of men servants, with the exception of the valet, whose conduct and qualifications come more immediately under his master's notice, and more materially affect his comfort than those of any other member of the household.

1515. *The steward purchases* every article consumed in the house; and it is necessary for him to have very sufficient knowledge of the qualities of the articles to be bought, and the right season for laying them up. He should never deal with any but tradesmen of known probity, whose interest it is to recommend to him only the best of their commodities.

1516. *In accounts the steward* must be ready, though domestic bookkeeping, not being of a very complicated description, requires great accuracy rather than proficiency in the science of figures. It consists chiefly in keeping a strict account of moneys received and disbursed. The mode in which his accounts are to be kept is sometimes directed by his employer. If left to his own arrangement, his desire should be to render them simple, or he may give his principal unnecessary trouble at the periods of their examination. Neither should he trust to memory, but make instant memoranda of all payments and receipts; nor, if he regard his own interest, will he pay any sum away without demanding in return a proper receipt. By not doing that, he may subject his master to the liability of a second payment, and himself to the loss of his situation and character. All current accounts are usually made up by the steward half yearly; and when examined by his employer and found to be correct, a receipt or acknowledgment of their accuracy is given him by his master.

1517. *In the room appropriated* to his use the steward keeps his books and files of bills. In the room also he makes a point of remaining for certain periods each day, that all the other members of the household may find him ready to hear their questions or complaints. This done, he then proceeds to the different offices to see that in each the duties of the day are properly engaged in.

The house-steward, in some instances, has the general superintendence of the stables, seeing into the fair and honest use of hay and corn; but this duty is usually performed by the coachman.

Whatever superintendence or investigation is usually given, in smaller establishments, by the principal himself, the house-steward must consider himself as bound to do. These duties all inquired into, the steward then examines into the state of the larder and stores, and prepares for market. The purchases are given into the housekeeper's hand, who, after weighing and examining them, gives him in exchange vouchers, which are afterward compared with the tradesmen's accounts.

Subsect. 2.—*Duties of the Valet.*

1518. *The valet,* in small families, is expected to assist as footman also; but his particular province is to attend exclusively to the personal accommodation of his master, Upon him he waits during all times of dressing and undressing; brushes, folds up his clothes, or places them in readiness for him. All repairs he sees done; and on putting away cloth clothes into a wardrobe, he uses the precaution of covering them with brown holland or linen wrappers, to secure them from dust.

Boots and shoes (cleaned by the under-footman) should be placed every morning ready in the dressing-room. The valet should see that the housemaid cleans the grate, lights the fire, and sweeps and dusts the room, while he prepares the washing-table by filling the ewer with soft water, and the carafe with fresh spring water, and by putting in their right places basins, towels, and brushes: hot water and the shaving apparatus should be at hand; the linen and slippers airing at the fire; and the rest of the apparel to be worn hung across the backs of chairs, and covered over with holland wrappers.

1519. *After the dressing is over*, the valet should take the earliest opportunity of cleaning and putting away the razors, and everything which has been used, in its proper place. See "Cutlery," Chap. XVIII., Book V.

1520. *For wet weather*, when his master may come in from riding, the valet should be always prepared, by having ready the necessary changes of linen and clothing, and by being himself in waiting, to remove the damp clothing, and to prevent its being injured in the drying.

1521. *Before putting damp woollen clothing to the fire*, it should be rubbed with a sponge, the way of the nap, until the smoothness of the surface is restored. If dried without this precaution, brushing will not be effectual in removing the roughness.

1522. *In preparing for journeys*, the valet should endeavour to ascertain the probable time of his master's absence, that he may be able to provide a sufficiency of linen and other clothing. At the inns he takes charge of these supplies, and, as at home, places everything in readiness for the periods of dressing and undressing. Besides this, if his master be unattended by his footman, it is his duty to attend to his accommodation generally, as well as in his dressing-room. Whenever his master needs his services, he must be at hand; even at table, if more than ordinary attendance be required, he must be ready to wait.

SUBSECT. 3.—*Duties of the Butler.*

The butler ranks as second in a complete establishment.

1523. *The butler is chiefly responsible for the management of the wine and ale cellars*, and for the direction of the various repasts of the family.

1524. He is also responsible for the plate, giving it out in due quantities to the under butler to clean. *His morning duties* are, *first*, at the breakfast table; *secondly*, in the wine and ale cellars, in which it is probable he may have to rack, fine, and bottle. *Thirdly*, he sees that the footman, under butler, and steward's boy are each engaged in his proper department. The immediate superintendence of these servants falls on the butler, who is responsible for the propriety, neatness, and cleanliness of everything at table, and which can only be effected by each department of duty being properly fulfilled. *Fourthly*, he dresses and stations himself so as to be at hand to open drawing-room and parlour doors to all visiters or members of the family passing to and fro. *At luncheon* he waits, unattended by a footman, unless, company being present, the size of the party requires more aid. *At dinner and tea* he also attends; and between these two repasts he answers bells and waits upon the company, while the footmen are engaged in clearing away, and cleansing whatever articles in their department have been used at dinner. *At bedtime the butler* brings up night candles; and, when the family and company are retired to their rooms, he locks up the plate, sees that windows and doors are secured, and fires left in no dangerous state.

In addition to these daily cares are those of the wine and ale cellar; the wine required each day he brings from the cellar himself a short time before dinner; decants it, and keeps it under lock and key till wanted. The servants' allowances of ale he draws himself; and at some seasons he has to fine, bottle, cork, seal, and place in the bins wine purchased in the wood. He has to make regular entries in his cellar stock-book of the number of bottles used, of the age and character of wines in each bin. The brewing, racking, and bottling of ale and other malt liquors, belong also to his department of duty.

1525. *The butler, in establishments of second and third rate*, undertakes some of the duties of the house-steward and valet, having, like the former, to market, pay bills, and to superintend all the other departments of the men servants as to the daily performance of the duties of each; and, like the latter, to give also personal attendance, at stated seasons, in his master's dressing-room.

SUBSECT. 4.—*Duties of the Man Cook.*

1526. The man cook is, in this country, found chiefly in the large establishments of princes and noblemen, or in those of very affluent families. He is also occasionally the superintendent of the kitchens belonging to public institutions, hotels, clubs, &c.

He makes out bills of fare, which are sometimes submitted to the principals for approbation. For this part of his duty it is requisite that he should be well acquainted with the high season of every dish (almost every dish having its season), and be able to perceive the exact state of everything he has to prepare. If he cannot make a good selection of the articles which are to be submitted to his skill, he will in vain exert that skill, and his employers will be disappointed in the result. No art can give excellence to an inferior article, or restore qualities which have been destroyed by natural changes in the substances themselves. *The man cook*, besides superintending the cooking generally, chiefly prepares the rich stews, ragouts, soups, and other dishes of a complicated description, not understood by ordinary cooks, whose greater variety of business precludes their attainment of the highest degree of proficiency in the art. Excellence in cooking can only be the result of practice and experience; united to which, it must be acknowledged that reflection and judgment are indispensable qualities in the character of a cook. As in chemical experiments one successful result leads a reflective man to attempt others, so, in cooking, one approved recipe may be productive of many varieties. In no dinner party would there be uniformity of taste; and the skill of the cook must therefore be exercised in meeting this with such various flavours as may give to every guest an equal chance of gratification.

SUBSECT. 5.—*Duties of the Footman.*

1527. *The footman's routine of business is, in a complete establishment,* of a subordinate description.

In the morning he assists in rubbing mahogany furniture in the dining-rooms and libraries; cleans windows; and sets ready for use, in the butler's pantry, all the articles which may be required for the breakfast tables, and which, after breakfast, he has again to clean and put by into their proper places. Afterward he cleans himself, and prepares to attend the carriage, to answer bells, or to obey any orders given him by his master or mistress. If he has to follow the lady whom he serves, or any of the female part of the family, in their walks, he is not to consider himself as a mere appendage which marks the condition of the family he serves, but as a protector from the inconveniences and annoyances which may occur to ladies walking in a thronged and busy place. For this end he should follow his mistress at such a distance as to be immediately at hand if his aid or interposition be necessary, and yet not so near as to hear conversation which may be passing between her and her companions. *At dinner* he again attends, having previously assisted to prepare the table for it. Dinner ended, his next duty is to clean and put away the same things, while the butler attends to the bells of the dining and drawing-rooms. *At tea* he again waits; and, generally speaking, his daily avocations end after the tea things are brought from the drawing-room, washed, and put away, the butler usually seeing to every subsequent duty.

1528. *The footman in small establishments of servants,* or in families in which only one man servant is kept, has more general and constant occupation than those who belong to "the complete establishment."

In the former case, not being under the control or dictation of a superior servant, the general arrangement and management of his employments devolve on himself; and, unless he has method, he will feel hurried and overdone, without being able to give his employers satisfaction. In describing the daily routine by which his occupations may be pursued with precision and method, it must be remembered that in each family there may be circumstances and customs to which the servants must conform, and adapt their business accordingly.

1529. *The mode in which a footman plans his work* on entering a new service, with the determination he shows to adapt that plan to the circumstances around him, and, when once settled, to adhere to it with as little deviation as possible, displays ability and a most desirable habit of order.

1530. *The sole footman* in a family has to perform some of the duties both of the superior and inferior members of the complete establishment; and if in a numerous family, or one which has frequent company, it will require all his diligence and activity to keep everything straight and in good order.

He must rise early, and endeavour to get some of the roughest part of his work done before his breakfast, and before he is required to appear in the breakfast-room. In order to preserve the cleanliness of his clothes, he should be provided with a complete overall suit, made of materials that will easily brush clean or bear washing. Covered over with these, he brushes the clothes of the gentlemen of the family, then cleans and polishes their boots and shoes, which the night before, if wet or damp, he had placed at a proper distance from the fire, to dry them gradually: an attention which enables him afterward to give them a finer polish. These done and set ready to convey to their owners, he then cleans the knives and forks, wipes them, and puts them away till wanted. After this he washes and cleans himself previously to the preparations for the family breakfast table. *After laying the cloth, and placing the required number of cups, saucers, plates, &c.,* he puts the heater into the kitchen fire, sees that water is boiling, and the supplies of bread, butter, &c., ready, and then is prepared for the summons for the urn. His own breakfast time is regulated by that of the family, the footman in some houses taking breakfast with the other servants, and in others in his own pantry on the remains of the family breakfast.

After the footman has himself breakfasted, washed, and replaced in the china closet whatever has been used of china at the breakfast table, together with the plate, waiters, and trays, he must direct his attention to the cleaning of candlesticks (see "Cleaning"), trimming of lamps (see "Artificial Illumination"), putting them in right places in his pantry till they are wanted. The mahogany furniture in the dining-room or library he must rub daily; and twice weekly he ought to wash away any spots it may have acquired, restoring afterward the polish it may have lost, by any of the means mentioned under "Cleaning." Some of the windows he should clean weekly, availing himself of periods in the day when the occupants of the rooms are absent from them. Afterward returning to the pantry, he should set himself to prepare something or other for the dinner table; either to rub the plate, to wipe the glass, &c., until it be time to prepare for the luncheon. During this part of the day he should be in such a dress as is not inconsistent with his employments, nor yet unfit for him to appear in if summoned by bells to the parlour or to the hall door. A coloured cotton or plain cloth jacket and white linen apron are usually worn by footmen while engaged as above described. *The parlour luncheon* being generally called for about one o'clock, he must have the tray set ready; when carried into the parlour, and properly arranged, he will usually be at liberty to get his own dinner, which is generally ready at this period of the day. When his mistress requires it, the footman should be ready to attend her, either with the carriage, or to follow her if she walks out. For this latter part of his morning's duty he should be neatly dressed; his clothes and hat should be well brushed; his shoes and stockings and gloves clean. A dirty-looking footman is a disgrace rather than a credit to a family. In giving directions to the coachman he should be quick and accurate; nor is it altogether needless to remark that, even in his announcing rap at the doors of the parties on whom his lady calls, there is a propriety to be observed as to its measure and degree; if too loud and long, it disturbs a whole neighbourhood; if too insignificant, it may be deficient in respect to his lady. In following her during her walks, he should preserve a steady decorum of manner, and be observant and ready in case any emergency should make his aid necessary to her.

1531. *Waiting at table* is one of the most important parts of his employments, and requires more skill and attention from him, if unaided by others, than when he is one among many attendants. Here, any neglect of his other duties will be apparent, and the censure must fall on him alone. Knives, forks, plate, and glass will all tell of his industry or of his negligence.

The general deportment of a footman, while waiting at dinner, should be quiet and quick, but not hurried or bustling: he should tread lightly, change plates, knives, &c., without clatter, and should speak as little as possible, and never in a raised tone of voice, unless it be necessary in answering questions. He should hand everything with the left hand, and to the left of the person he is assisting to anything. The tablecloth, in removing, should have each side and ends lightly thrown together, and be carried out of the room, and laid aside until a convenient opportunity for shaking it and folding it up. On formal occasions the tablecloth is left, and long slips down each side are used, and removed when dinner is over. It should be wrapped up in the folds previously made, and placed carefully in the table-linen press. *Dinner over, and the dessert and wine properly placed on the table*, the footman retires to his own pantry to wash glasses, &c., and to put everything once more in its right place. Then he prepares for taking up coffee and tea; puts the urn heater into the fire, places teacups, &c., on the board; and sets cakes, bread and butter, milk, &c., on his waiter, ready to carry to the drawing-room when required. At night he closes all window-shutters and locks up doors; carries up bed candles; takes the slippers to his master; and, lastly, collects, as far as he can, all small articles of plate, such as teaspoons, which are in constant dispersion during the day in most houses; counts all over; locks it up or places it in security—and thus closes his daily business.

1532. To place candles properly in the candlesticks, though not strictly a branch of cleaning generally, completes this part of the footman's work. Candles should be placed perfectly straight in the candlestick; any inclination from the perpendicular being not only disagreeable to the eye, but causing the tallow or wax to run wastefully down the sides, because the heat of the flame acts more powerfully on one side of the candle than on the other. The same effect is produced by dirt or soil on the surface of the candle, as also causing an irregular action of the heat. If the nozzle of the candlestick be too large for the candle, a small fold of paper must be put round the candle, not so wide as to be visible when the candle is placed in it. The wick of the candles, if they have not been previously lighted, should be just set fire to, and blown out. For this, when they are wanted, they will light the more easily.

1533. *In trimming candles* which have been previously in use, it is desirable to pare off the top, so as to form again the conical shape into which they had been originally moulded. The object of this is to prevent that surplus of melted tallow, caused by the heating of so large a circumference of tallow, and which the wick cannot at first consume, from flowing down the sides of candles, wasting as well as disfiguring them.

1534. *Candle ends*, mould as well as wax, ought to be used upon save-alls by the servants, and not put into the box of scrapings, to add to the perquisites of those whose office it is to clean the candlesticks.

SUBSECT. 6.—*Duties of the Under Butler.*

1535. *The under butler* is under the immediate control and direction of the head butler. The charge of the plate in daily use falls on him, he being responsible to the butler for the quantity given out to him, and for keeping it in proper order for the table. (See "Cleaning.") He also cleans the knives and forks used in the family, assists in laying the cloth, arranging the sideboards, and in waiting at table. With these occupations, he is not expected to answer summonses of the bell, unless particular circumstances render that necessary, when, this being specified to him by the butler or steward, he must arrange his other work accordingly. He must always be ready, when occasions press, to lend his assistance in any of the duties usually performed by the butler or footman.

1536. *In all business of the cellar*, such as brewing, bottling, fining, &c., he assists, and is expected to be almost as expert as the butler.

SUBSECT. 7.—*Duties of the Inferior Household.*

1537. *The duties of all inferior household* servants, men or foot-boys, consists in their sharing the inferior parts of the work with upper men servants, such as cleaning knives, and shoes, and windows, going of errands and sometimes attending the carriage, to open the door of which, and to give orders to the coachman.

SECT. VI.—DUTIES OF WOMEN SERVANTS.

SUBSECT. 1—*Duties of the Housekeeper.*

1538. *The housekeeper of a first-rate establishment* has, like the steward in his department, *the entire direction of the female servants.* Her value and importance to her principals depends mainly upon her vigilant superintendence of each branch of female service, and on her constant investigation into the efficiency, steadiness, and general good conduct of each individual under her charge. It is her duty to see that the business of the house is regularly and properly performed; that everything is done in its right season, everything applied to its right use, and kept in its right place. Order, with despatch, should be the law of the house: a law that carries on every business easily and tranquilly. Where observed, confusion and hurry rarely occur.

The care of the furniture, of household linen, of all culinary and domestic utensils, devolves on the housekeeper. The charge of the store-room belongs to her also. Whatever stores are purchased she receives, examines, and weighs them; notes down, either in the store-book, or on tickets which she gives to the steward, the weight of each article, such memorandums serving as a check upon the accounts of tradespeople. She stores the deposites in appropriate jars or vessels, and places each commodity in a situation best suited to its nature as to temperature.

1539. *With cooking generally the housekeeper has little concern.* Her care of the table is confined chiefly to pickling and preserving, and in preparing confectionary, arranging the dessert, and making the ice-creams. These preparations are all performed in the still-room, and with the assistance of the still-room maid. Fulfilling each branch of her duty faithfully, the housekeeper, at the head of a large female establishment, has no sinecure.

The early hours of the day are engaged in seeing that others are properly at work, then following her still-room employments, &c.; when all household business is ended, she has to set the maids to their sewing, placing in their hands the household linen which requires to be made or to be repaired.

Her evening should be occupied with preparations for the ensuing day. Lump-sugar is broken, raisins stoned, currants washed, cleansed, and dried. Spices pounded and bottled, oranges and lemons peeled, and the juice strained and bottled for use.

1540. *In her books she has then to enter expenditures of the day*, and to note down such articles as are required in her store-room. Half yearly, or at convenient periods, she has to compare the inventories given to her on entering the family, with the articles enumerated, and in making out new lists she makes notes of the deficiency which time or other causes have produced, and also of the articles which have been added to replenish such deficiencies

1541. *The housekeeper* at the head of a smaller establishment, in which there is neither house-steward nor man cook, has many other duties to perform besides those enumerated above; marketing in such a case falls on her, and the higher branches of cookery, together with the arrangement of the table.

SUBSECT. 2.—*Duties of the Lady's Maid.*

1542. The duties of the lady's maid, if not arduous, are unremitting, between her attendance on the *toilet* and her charge of the *wardrobe* of her lady. Her daily occupations commence with arranging the dressing-table, after the housemaid has swept and dusted the dressing-room, lighted the fire (in cold seasons of the year), and brought up hot water.

1543. *After setting out and preparing* everything which may be required, she awakens her lady at the proper hour, and then retires till summoned by the bell to attend her, to brush, comb, and dress her hair, and assist in the completion of her morning's toilet.

After replacing or putting away everything which had been used, she next directs her attention to the state of the wardrobe; occupying herself in making new, or in repairing any old articles of apparel, until her lady again requires her attendance, either in preparing herself for riding, walking, or in dressing for dinner. At night, also, she arranges everything for the retiring, as she had in the morning done for the rising, of her lady. A lady's maid needs possess, it is evident, very different qualifications and attainments from those of any other member of the establishment. *Her taste* in dress should be cultivated, or she will be unable to judge in the dressing-room of the effect which the *tout ensemble* of her lady's costume will have in the drawing-room. She should require a knowledge of the most agreeable combinations of colours, and of the effect these produce on different complexions. If she have also a ready perception of the proper *set* (to use a technical expression) of each part of a lady's attire, and have the art of giving this effect or *air* to the dress of her employer, she may be regarded as a skilful tire-woman. It is this art which gives more style and elegance to dress than the costliness of the materials; it is the finishing stroke, without which the *chefs-d'œuvre* of the dress-maker and milliner would be incomplete; for the proper set in dress is usually more apparent in a French woman than in that of an English woman, and thence the more frequent admiration of the dress of the one than of the other.

1544. *The use and mode of applying rouge and cosmetics* should also be understood by the lady's maid.

1545. *In applying cosmetics,* it is requisite that every lady's maid, as well as every lady, should know how far they are innocent or injurious. Ignorance of the nature of these external applications may be fatal both to the complexion they are intended to improve and to the health, the state of which has more effect upon the skin than any cosmetic whatever. It is probable that there are many situations as lady's maid in which the use of cosmetics and rouge is unknown; but whenever they are employed, the knowledge here recommended should be acquired. (See "Business of the Toilet," Book XIX.)

1546. In *hair-dressing,* the lady's maid should be skilful and ready in perceiving every variation of style which fashion may cause; these she should be able to adapt and render becoming to the countenance of her lady.

1547. *The charge of the wardrobe requires that in dress-making and millinery* she should be a proficient; although her skill in these arts cannot be supposed to be equal to that of the professed milliner and dress-maker, because her opportunities of studying fashion cannot bear any proportion to theirs. As a seamstress, expertness both in making and repairing linen will be expected from her; and she should consider that the contents of the wardrobe being under her care, she ought to be capable of using her needle in whatever way the different articles in it may require. Clear-starching, getting up laces and nets, washing gauzes, crapes, and silk stockings, removing stains of fruit, or soils from silks, preserving furs, woollens, and other winter clothing from moths, all belong to the duties of the lady's maid. (See Book XXII., "Laundry.") Nor must she neglect to note the quantity of linen sent to and returned from the laundry, nor to make occasional comparisons of the contents of the wardrobe, with the inventory given to her on her entering the service of her lady.

Should she be the attendant of an elderly or infirm lady, it may be requisite for her to be able to read aloud agreeably, and to write neatly: acquirements which may be easily gained with diligence and attention.

SUBSECT. 3.—*Upper and Under Nurse Maids.*

1548. *An upper nurse,* where there is an infant, takes entire charge of it, washes, dresses, feeds it, carries it out of doors, and when in the house only gives it to others to nurse when her other duties call her away from it: the other children in the nursery are all under her superintendence, as well as the subordinate assistants. These last, it is requisite, should be under her direction and control.

An upper nurse is always expected to live entirely with the children intrusted to her; that is, to have her meals in the same room with them after they have finished. Once or twice a week, if the children are well, and all asleep, she is usually permitted to sup in the housekeeper's room, as affording her a little change and variety; but unless all is going on well with her young charges, this indulgence she must forego. A post of such responsibility as hers, and for which she is usually liberally remunerated, must not be lightly abandoned to a junior servant; therefore, if her charges are feverish, restless, or otherwise indisposed, she ought never to leave them for any length of time, but to be at hand, and ready, should they need her attention and assistance. The children's clothing, also, is under her care. She should see to the repairs they may require being done, and that they are kept well aired, and ready for immediate use.

1549. *The duties of the under nurse* maid consist, if no girl under her is kept, in doing the work of the nurseries, lighting the fires, sweeping, scouring, dusting, making beds, emptying water, and replenishing the water ewers, bringing up and carrying down the nursery meals. Also in washing and dressing all the children in the nursery, except the infant; putting them to bed, and assisting them to arise in the morning. In the evening she must also assist to mend and make the children's clothes, and at all other times when there is nothing else to be done for them.

1550. *Sometimes a nursery girl* is added to the nursery establishment, whose duty consists in assisting the others generally, but particularly in the rougher parts of nursery work, such as in scouring, bed-making, washing children's clothes, cleaning grates, &c. She also is expected to carry up to the nursery coal, water, and everything required at the meals of the children. Her own meals are taken in the nursery, as well as those of her superior fellow-servants.

1551. *A nurse maid* in families of small income has generally the whole work and management of a nursery, assisted principally by the superintendence of her mistress; and in regard to the harder parts of her duty by the housemaid, in such a situation the housemaid is usually engaged to carry up and down whatever is required at the nursery meals, and to walk out once a day with the children.

SUBSECT. 4.—*Duties of Cook, Kitchen-maid, and Scullion.*

1552. *The routine duties of cook, kitchen-maid, and scullion being intermingled,* can scarcely admit of separate descriptions. The cook directs the whole business of the kitchen; the others assist in its performance; she is responsible for the mode in which it is conducted and performed, and must possess, therefore, adequate skill; they, on their part, have only to be active, cleanly, and obedient.

1553. *To these domestics, early rising* is of the utmost importance, and, as their hours of retiring to rest are less uncertain, and not dependant, as those of the servants in other departments, on the movements of the family, there can be neither hardship nor difficulty in their rising betimes, not later than 6 in the summer and 7 in the winter. If they fail in this, they will find that "an hour lost in the morning may be run after, but never overtaken the rest of the day." The inconvenience of late rising in these three domestics will not only affect their own, but the business also of many of the other servants.

1554. *The first care of the cook,* in rising, is to set her dough, if not done over night, for the breakfast rolls and cakes; *while the scullion* cleans grates and fire-irons, lights the kitchen and oven fires, and fills with water, boiler, kettles, and fountains, sufficient for the supply of the dressing-rooms, as well as for breakfast.

1555. *The kitchen-maid, at the same time,* is occupied in sweeping and cleaning the kitchen, larder, and other offices belonging to the kitchen; together with the halls, stone steps at the house entrance, office passages, kitchen stairs, &c. Besides this daily sweeping and dusting, she has to scour and wash all these places twice a week, and to scrub tables, shelves, and cupboards.

1556. *The scullion,* in the same manner, keeps her scullery clean, and all the metallic utensils used in the kitchen, as well as earthen plates, dishes, and other vessels.

1557. *These preliminary employments* usually occupy the three domestics till their breakfast hour, 8 o'clock. That meal over, their attention must be immediately directed to preparations for the different dinners of the household and family.

1558. *The kitchen-maid* generally dresses *nursery and servant's hall dinners;* at the same time, she has to clean and scrape fish, pluck, draw, and truss poultry, trim joints of meat and cutlets, wash and trim vegetables, laying them on separate colanders to drain (for, if heaped on one another when moist, the strong vegetables impart their flavour to the more delicate plants); all such offices she undertakes.

1559. *The cook* has only the charge of dressing and serving the principal meats. While everything is thus prepared for her, she is busy with her pastry (best made early in a summer's day), her ragouts, soups, gravies, farces, &c.; the stock or *consommé,* the basis of most made dishes, she keeps always at hand, as well as sweet herbs, pounded spices, eschalots, cloves of garlic, &c. From this time till the dinner is served the cook must never leave her post, nor allow her assistants to remit their occupations.

1560. *As the time draws nigh when the whole business must be achieved,* the clock must be consulted, and to each dish due time allowed for the fire to complete what has been thus prepared. Now the cook must be collected as well as busy, that there may be no oversight of any kind (see art. "Cooking"). The vegetables and sauces must, in their preparation, keep pace with the dishes which they are to accompany, so that the order of the dinner may be carefully observed.

1561. *The dinner hour* arrived, the cook commences serving such things as may, without injury, be covered over, and placed for a short time on the hot hearth, or in the hot closet (see "Kitchen Apparatus"). But choice or important dishes she refrains from serving until the order for dinner has been given from the drawing-room. Then all hands are at work. The cook takes immediate charge of fish, soup, and poultry. The kitchen-maid (in some houses assisted by the under housemaid) dishes vegetables, and pours gravies and sauces into tureens. The scullion waits the bidding of the cook. All are thus busy, and yet without confusion.

1562. The serving table (in some kitchens heated with steam) is covered with a clean cloth, and the first course is set upon it, and carried thence by the footmen, in regular order, to the butler in the dining-room. The cook's constant aim should be to serve her dinner neatly, and, above everything, to send it up hot. If cold, her painstaking in all other respects will avail little. *Also, of the second course* she should time judiciously the dishing; if deferred too long, an awkward lapse in the dining-room will occur; if too soon, some of the light and fancy dishes, such as omelettes and fondus, may be injured.

1563. *The serving ended,* the cook then sets her assistants again to the business of cleaning: the utensils are scoured; the scullery, larder, &c., cleared of everything that might betray negligence, or affect the atmosphere with unwholesome odours. The cook employs herself in the larder, putting away, on clean dishes, any remains of the dinner, and which are to be disposed of according to the custom of the family in regard to their table. In some families it is usual to send to table the following day some of these remains properly made up; in other places they are consumed at the second table; and in a very few houses, of the highest rank and equal affluence, these remnants are disposed of to the poor in the vicinity, to whom allowances are made according to the numbers of their respective families. Whichever of these customs is established in the family, the cook must, of course, conform to it.

1564. *The contents of the larder,* which is under the charge of the cook, require her daily attention; and, during warm and damp weather, she should investigate their state in the evening as well as in the morning. Undressed butchers' meat, poultry, and game, if moist on the surface, should be wiped dry; if fly-blown, the part should be cut away; and if still greater change be perceptible, if a flaccid state of the flesh, as well as moisture on the surface is perceived, it may be prudent to resort to more decisive measures to preserve the food from becoming utterly unfit for the table; and a single night may do this if precautionary measures are neglected. (See "Preservation of Food.")

1565. *The cook, even if she have a kitchen-maid* under her, must never neglect to see that the larder is kept clean, and that no unwholesome smells arise from droppings of meat, or gravies, milk, &c. The leaves of vegetables left to ferment must also produce exhalations detrimental, especially in hot weather, to all moist food.

Soups, gravies, and *milk* should each be put daily into clean vessels: unless this be done, they will soon begin to change. If soup or gravies are not immediately wanted for use, they should be boiled up, and then strained into cold vessels, and put into the coolest place to be found till they are wanted. All vegetable substances should be strained from them.

1566. *In second-rate establishments* the housekeeper usually superintends the higher branches of cooking, and the cook undertakes the minor duties of the kitchen-maid, either with or without the assistance of a scullion.

1567. *The cook engages in small establishments,* varying from three to five in number, to perform the whole of the work in the kitchen, and in some places portions of house work; she has also to clean the hall, passages, stone entrance, steps, and kitchen stairs, and occasionally the dining-room, or the whole of the ground floor. It is apparent that, with this variety of occupation, she must require *method* as well as activity, or she will be hampered and hurried, and perhaps perform no part of her duty well. *Method* must be her law; and it consists in a judicious division of her weekly, as well as of her daily work, and to her regular adherence to this division, performing in its appointed time each portion of her duty. It may be useful to give a detailed account both of the day's and week's routine of her business, to show how even this variety of household work may be easily and well performed.

1568. First. *The routine of the day's work. Early in the morning,* the kitchen grate or stove, oven, and boiler must be cleaned, the fire lighted, and the water set on for breakfast. The hall must be swept out, stone steps washed, dining-room grate and fire-irons cleaned and polished, carpets swept, chairs and tables rubbed, and windows dusted, curtains shaken and properly arranged, and the fire, if in the winter, either kindled or laid ready to be lighted. *After breakfast,* in places where it is required, the cook assists the housemaid with the beds, one pair of hands being insufficient to shake large beds and turn mattresses properly. After this is done she returns to her province in the kitchen, answering door-bells and single knocks until twelve in the day, in order that footmen and housemaid may pursue undisturbedly their respective business. At noon, however, the cook's business will require her constant attention, especially if she have two dinners to prepare. The early dinner she has probably forwarded before twelve, and been, at the same time, able to put her kitchen in order, and to clean and clear away any utensils that may have been used since the morning. During the hours of cooking she should be solicitous to keep her kitchen in order, removing out of it as quickly as possible all plates, dishes, and other articles that have been used into the scullery, to be washed in proper season. Nothing betrays want of method more than the neglected state of any servant's office; it brings confusion into the whole business of the kitchen. As, in families where there are small establishments of servants, the table is generally plainly served, the cook may find many intervals of time for washing up her earthen-ware vessels, and putting away all articles which are not likely to be wanted; and by constantly doing this, she will be less hurried at other periods of her business. After serving her dinner, her kettles, saucepans, and stewpans must be properly washed and cleaned, and ranged near the fire to dry. By the time these are done the plates and dishes will be returned to her from the dining-room, and must be immediately washed, and either ranged in the rack or put to dry before the fire. Then she makes up her kitchen fire, cleans and sweeps kitchen, larder, and scullery. In families where the dinner is late, supper is rarely wanted, so that the cook's employments are ended when all the operations above mentioned are performed. She may then clean herself and sit down to her own work, or to repair and make kitchen towels and cloths, until the hour for rest.

1569. Secondly. *The routine of the week's work. Monday,* in country families, is a baking day. The bread is often set over night, but is not kneaded and formed into loaves till the next morning, after the cook returns from assisting the housemaid with the beds. The cook has often more to do on this morning in washing up everything which her attendance at a place of worship, the previous day, had rendered it expedient for her to leave untouched. This, with her daily business, usually occupies all her spare time. *Tuesday,* her kitchen, larder, scullery, &c., to be scoured; tables and dressers washed. *Wednesday,* the dining-rooms and library more thoroughly cleaned than on ordinary mornings. These must be done as soon after the family breakfast as possible. *Thursday,* passages and oilcloth washed, together with the stairs and banisters apportioned to the cook. *Friday,* all tin saucepans, metal dish covers, copper saucepans, &c., to be scoured and polished; baking. *Saturday,* the kitchen, larder, &c., scoured; the oilcloth in hall swept clean and polished. In a place where the cook engages to wash her own clothes and kitchen towels, she must, at the stated periods, arise an hour or two earlier in the morning, and by getting on with some portion of her work, she will make time for this extra business. The ironing and getting up of her linen may generally be done in the evening.

SUBSECT. 5.—*Duties of Upper and Under Housemaids.*

1570. *The upper housemaid's duties* vary according as she has one or more assistant housemaids, upon whom the most laborious parts of the household cleaning devolve, in distinct proportions to each, and yet the upper housemaid is, in some measure, responsible for the whole of the household work being well done and in proper season. Hence it is requisite that she should herself be well versed in every detail of the work, and be able also to estimate the rate of time at which it ought to proceed, so as it may be always effected regularly, easily, and properly.

1571. *Daily work of the upper housemaid.* Her daily occupations commence, together with those of her assistants, in the rooms of which the use will be first required. The windows of these are to be opened in the first instance, weather permitting it; the curtains are then to be shaken, and hung up high enough above the carpet to remove them from the dust which, in sweeping, will rise from it. The sofas, couches, and choice furniture must be covered, if this have not been done over night, with loose sheets of coarse calico or brown holland, and the rest of the room is to be prepared for the sweeping of the carpet, by the removal of chairs, sofatees, small tables, &c., away from the sides and towards the centre of the room; damp tea-leaves being sprinkled over the carpet, will assist in catching the dust as it rises in sweeping, and thus prevent it from settling on the furniture or walls of the room. The sweeping, then, should be begun from the upper end of the room, and proceeded with towards the fireplace, or the lower end of the room, according as the pile of the carpet appears to be. The sweeping must not go against, but with the pile. When the sweeping is done, the upper housemaid proceeds to remove the chimney ornaments, as well as others from chiffonières and tables, in order to dust the places on which they usually stand. Marble chimney-pieces or slabs should be washed *occasionally* by the upper housemaid with a flannel, and clean soap and water. (See art. "Cleaning Marble.") The various ornamental articles that have been removed will require careful wiping or cleaning, and are then to be replaced The ledges, panels of doors, window-frames, the inside of the lower panes of the windows, the mirrors, chairs, sofatees, &c., and tables, are then to be dusted and put into their respective places; the frames of pictures must be dusted, but only with a feather broom, not with a linen duster. (See remarks in art. "Cleaning Gilt Mouldings," &c.) At last the curtains are to be neatly laid in folds and hung on their brackets; but, even when everything appears to be done, the housemaid should pause before she leaves the room to take a general survey of the whole, in order to detect omissions which may have occurred in any details of the business. When she has done her part in each room, and seen also that others have done theirs, her next business is with the dressing-rooms, into which warm water may be taken, and all things of the toilet laid ready for the lady she is serving, or other members of the family. When these matters are all settled, the hour of breakfast will probably be arrived, which, in regard to the establishment, generally precedes by one hour that of the family.

It may be as well here to notice the circumstance that, in families in which men servants are kept, the care of the dining-room mahogany furniture, together with the cleaning of mirrors and windows, are always under the charge of the men servants. (See art. "Cleaning Furniture.") Rosewood tables and chairs, or other French polished furniture now usual in drawing-rooms, requiring no cleaning, and nothing more than gentle rubbing with silken or soft linen dusters, are usually under the care and management of housemaids.

1572. *An under housemaid,* while an upper has been employed as above described, ought to be performing *her* distinct part of the business, that of cleaning the grates, fenders, and fire-irons.

After removing the hearth-rugs, she should lay down on marble hearths, to preserve them from being scratched, a coarse wrapper cloth about two yards long and one yard and a half wide, and which should always be one of the appendages of the box which contains her other implements and materials for cleaning grates, &c., as well as a pair of thick buck leather gloves, which may be purchased at oil shops for housemaids' use at one shilling per pair. These gloves are very useful, not only in protecting the hands of the cleaner of the grates from becoming hard, discoloured, and unfit for nicer work, but in securing also fine steel work and fire-irons from the touch of the hands, which, if moist, would injure them. Having cleared the ashes away from the grates, and cleaned the bars, fenders, and irons in the rooms used for eating or sitting in, she then carries her box of materials into the dressing-rooms or bedrooms in which fires are to be lighted.

1573. These rooms done, the housemaids repair to their breakfast, and afterward to such of the bedrooms as have been vacated. Here the windows are to be immediately opened (weather suiting), the bed-clothes removed from the beds, the beds shaken up, and with the bed-clothes, left open to the air of the window. The basins and the washing tables are next to be attended to; each article is to be properly cleansed, the jugs and carafes to be emptied, in order to be washed clean before they are refilled with fresh drawn water. When this is done, and the slops removed and emptied, the bucket washed out and placed so as to get dry, the beds are then to be made.

1574. "*Making beds*" is the term in daily use to express the re-arrangement of bedding or bedsteads after having been used. To *make beds* well is an art not unimportant to comfort, for it consists in shaking up the beds so sufficiently as to restore to the feathers within them all the elasticity which, from the pressure of those who have been sleeping on them, had been in a great degree lost. Unless well shaken, feathers adhere together and form hard lumps, which would prove uneasy and inconvenient to a healthy individual resting on them, but to invalids still more so; they would inevitably destroy the repose required by them.

1575. *To secure a bed being well made,* it is requisite that two persons should be employed to shake the feather bed, who, taking hold of its contrary corners, shake the feathers within it alternately from one corner to the other. This being done so as to convey the mass of the feathers towards the centre, the bed is then to be turned over, that side being brought uppermost which had been undermost the preceding night. If it is to be placed above the mattresses, it must be put aside or turned to the foot of the bedstead while the mattresses are turned over, in order that each side of them may be alternately used. The feather bed is then lifted upon it, and the feathers gently impelled by the hand from the centre towards the corners and sides, until they are equally dispersed within the case, which should form an even, level surface. The under blanket is then laid smoothly over it, and the under sheet is drawn from the foot of the bed and laid evenly across the bed, the seam of the sheet being placed exactly down the centre of the bed. The bolster, having been previously shaken between the persons employed in making the bed, is laid upon the upper end of the sheet and rolled neatly and tightly within it, and is then lifted close to the head of the bed, drawing up the sheet with it. The sides and lower end of the under sheets should at this period be carefully tucked under the bed, and especially at each end of the bolster, so as to fasten it up tightly within the sheet, preventing it thereby from being easily drawn off the bolster by any restlessness of the sleeper. The pillows are then to be shaken up and placed on the bolster, after which the upper sheet is to be laid on, as much of it being reserved at the bottom as will tuck well under the bed, so as to keep it straight; the rest of the sheet being drawn up to the head of the bed, is to be folded up neatly on the pillows, until the beds are to be turned down for use. The blankets are next to be laid over the sheets. The arrangement of these differs in some houses, for some persons prefer them to be laid so as not to be doubled down at the head of the bed, but to be turned up at the feet. They who require light covering over the chest and shoulders often need greater warmth over the feet, and hence housemaids should endeavour to remember which way is preferred by those for whom they are making beds. After tucking the blankets under at the sides and feet, and laying them properly, whether singly or folded, at the head, the counterpane is next laid neatly and evenly over, and the bed is made. In making beds with clean sheets, it is of no importance which ends of the sheets are put to the head or foot of the bed; but when once sheets have been slept in, they must be used always one way until they are again washed. As a rule by which to remember which way the ends of sheets were first laid, it is a good plan to put the marked ends of sheets always to the foot of the bed; also the inside of sheets should always be towards the sleeper, whom the rough edges of the seams might annoy. The laundress usually folds up sheets so as to prevent any necessity on this ground in the housemaid for completely opening them before she lays them on the beds. It may also be well to recommend a little attention from those who make beds to the feathers which escape from the case while the beds are shaken. If the housemaid fastens a small paper bag at the bed's head, in an unobserved place, she may easily collect the stray feathers each day, and enclose them temporarily in this paper bag; when the collection becomes considerable, all she has to do is to open a small part in one of the seams of the case, and to put them through it into the bed.

1576. *The hangings of four-post beds* are usually folded up and laid upon the bed, in the view of keeping them from the dust of the room. At night, when the bed-clothes are turned down for use, the curtains are drawn round either partially or entirely, according as the occupants of the beds are supposed to approve.

1577. *The hangings of tent beds* are usually looped up at the head and feet, and are easily let down to any required degree.

1578. *The hangings of French beds* are usually thrown back during the day over the frame of the bed, at least in England, for in France they are usually drawn closely round the bed for the purpose of hiding it from view.

1579. Before closing the subject of beds, we would add one or two remarks, chiefly however, respecting the general care and management of feather beds.

Sometimes, either from the effect of damp or from neglect in shaking them, the feathers become permanently lumpy. In this case, it may be necessary to unsew the seam of the case sufficiently to admit the hand within, by which the lumps may be broken, and the buoyancy of the feathers restored. Beds become lumpy if allowed to get damp for want of use; it is therefore requisite to shake them up, when they are not constantly in use, as frequently as if they were in use, and whenever possible, they should be exposed to the rays of the sun, or to the warm air of a stove.

1580. *Housemaids*, when called into the room of an invalid to make the bed, should be able to do it so gently as not to disturb or irritate the patient, and yet so effectually as to render it as comfortable to him as his state admits of. If the patient cannot be lifted out of bed, then one half of it only can be made at once; but of which the feathers must be worked up with the hands and separated from each other with as little shaking as possible. They must afterward be equally dispersed within the bed tick by the gentle impelling of the feathers towards those parts that appear to be most wanting of them. Half of the under blanket is then laid smoothly over that part in which the feathers have been so far shaken. A clean sheet, half of which must be rolled up lengthwise, is then laid upon the blanket and arranged neatly over the bolster; the unrolled half of the sheet is left as flat as possible until the patient has been lifted over it, or his body so far raised as to allow of its being passed under him.

An invalid may sometimes be lifted from the part of the bed on which he has been lying to that recently shaken, by two or more persons lifting him between them by the sheet on which he lies, and thus partially swinging him to the part of the bed prepared for him; this being done, the sheet which is to be changed may generally be drawn away by very little aid given by the patient in raising his body slightly. The clean upper sheet must be rolled up across, that is, from each side, and being put under the upper sheet about to be changed, it should be gently unrolled by a person on each side, and drawn up towards the top of the bed, where it is turned down over the blankets. As soon as this is effected, the sheet under which it has been thus rolled may be easily and quickly drawn away. The rest of the covering may be made smooth, and, according to the feelings of the invalid, can be lessened or increased in weight. The other half of the bed is usually left to be shaken up the next time the invalid is to be removed, or the bed linen changed.

1581. *The housemaids' duties* being so far performed, their next employment is to prepare the bedrooms for sweeping, by covering the beds, together with the dressing and washing tables, over with the proper sheets, so as to keep them free from dust.

Then to hang high up the window and bed curtains, and to turn up the bed valances. The carpets, if consisting of small, loose pieces, are best taken up to be shaken out of doors; but if fastened down, it will be requisite to sprinkle tea-leaves over them, and to sweep them carefully with a *hair* or with a *Dutch broom* (the latter some ladies prefer to be used only once in the week, as too penetrating for daily use; they imagine the hair broom to be sufficiently strong to clean the surface of the carpet each day, and yet not harsh enough to wear away the wool, in the same degree as the more frequent use of the whisk or Dutch broom might do). The upper housemaid generally makes these preparations, while the servant under her fetches her brooms to sweep them. Into each bedroom and dressing-room the upper housemaid precedes her assistant, who, after sweeping one, follows her into the rest successively, leaving the upper housemaid to return to those rooms that have been swept, in order to dust the ledges of doors and windows, together with the furniture, to replace the curtains and valances, and to remove and fold up the wrappers that have been thrown over the beds and tables. After looking around in each room to see that nothing belonging to the housemaids' duties have been neglected, the upper housemaid then repairs to the linen press to look out and to air before the fire what may be required for the next day's use, or to see what articles want mending.

1582. *The under housemaids*, having each done her part, cleaned and put away pails and brooms, &c., are required one day in each week to assist in the laundry, and also, at proper intervals, to wash and get up their own linen.

1583. *The under housemaids* are also usually required to assist the cook in serving the dinner each day. When many dishes are to be ready at once, any hands in the house not otherwise occupied are, on occasions of large dinners especially, called to the aid of the cook, but with the serving, and generally the assistance of the housemaids, they are then expected to be in the still-room to receive, wash, and replace the china used at dinner: these may be termed their extra duties.

1584. *The repairing of the household linen and of the stockings* of the gentlemen of the family is not an extra, but an ordinary part of the housemaids' work, which usually fills up what leisure time they have until the period in which they must return to the bedrooms and dressing-rooms, in order to replace everything that had been used during the dressing time of the members of the family; and also to turn down the beds, and to close the windows, and draw the curtains. Any leisure time between this last branch of their employments and the hour of going to bed is usually allowed them for their attention to the repairs of their own clothing. In some families the housemaids are allowed two or more of the six evenings of the week for their own work.

The daily duties of the housemaid usually end with the closing up of bedrooms, and with the other preparations for the night. The upper housemaid usually carries hot water, both night and morning, into each room, and warms beds when it is required.

Weekly and occasional duties of housemaids.—Housemaids who understand how to arrange their work will avoid allowing any greater pressure of business in one week more than in another, but will be able to arrange and divide the general cleaning so as to make it not greater at any time than what may be easily got through. In great houses the families are often absent from home, and on such occasions the general cleanings to which we shall allude should take place.

Scouring of bedrooms should take place once in every fortnight or three weeks, according as the weather is favourable or the reverse to the subsequent drying of the wetted rooms. *The window sills* should be washed one day in the week. Brass handles to doors, or brass work of every kind, should be rubbed with a leather. Mahogany work should be well rubbed, and painted wainscoting and walls (not distempered) should have every spot and mark washed off with a sponge, and warm soap and water; finger marks on doors should be also removed in the same way

Once in a fortnight, paillasses and mattresses should be brushed with a clean hand-brush, so as to remove all lodgments of dust from the sides and from the tufts of wool where the fastenings down of the mattresses occur. *Sheets* are usually changed once in a fortnight in beds occupied by the members of a family, once every week in those of guests. Every fresh guest, of course, expects to find clean sheets on the bed allotted to him in the house of a friend.

1585. *In establishments in which one housemaid only* is kept, the whole of the business, as above described, she has to methodize and effect without much aid from other members of the household.

In a family of regular habits, she may probably have the privilege of going early to bed. It will then be only proper in her, and it will be certainly most convenient to her also, to rise as early as six in summer and not later than seven in the winter. With the opening of windows, and with preparing the sitting-rooms, as above described, for the renewed use of the family, she will, of course, begin her day. After hanging up curtains above the carpet, and covering over the sofas, &c., to preserve them from the dust, she must clean the grates, fenders, &c.; and when this is done, sweeping, dusting the rooms, and replacing the furniture aright must follow. Whenever possible, she should also sweep the stairs; for if deferred till late in the day, the family will be passing and repassing while she is sweeping them, very inconveniently both to themselves and to her.

1586. *In going into the bedrooms*, her first care must be given to the proper airing of the rooms and bedding. She must open the windows, and after removing the bedclothes from the feather beds, shaking up the feathers, and leaving them open to the air, she must proceed to set to rights the washing and dressing-tables, and then to cover them over in preparation for the sweeping. The bucket carried from room to room to receive the slops must be, when done with, emptied and immediately cleaned out with plenty of cold water, and turned down in an appropriate place to dry. It is a slovenly habit to leave the chamber-bucket long unemptied; it spoils the bucket, as it also does to leave it uncleaned and wet. When it is sufficiently dried after it has been washed out, it should be put into the housemaid's closet, in which the rest of her utensils and materials for cleaning are usually kept. Two water-jugs should be among these utensils, one for hard or spring water, the other for rain or soft water. These being filled with a fresh supply, must be carried into each bedroom or dressing-room, out of which each ewer and carafe or water-bottle must be refilled. Towels that have been recently used must be dried either before an open window or before a fire, care being observed to replace each horse, with its respective towels, in the room to which it belonged, that there may be no exchange in the towels. When clean towels are to replace those which have been used, the housemaid should take care to dry those that are wet before they are put away for the wash. If left damp, linen will soon become mildewed, the marks of which are difficult to remove.

When the washing and dressing tables are put in order and covered over, the housemaid then calls to her assistance the other maid servants, whose duty it is to help her to make the beds. It is necessary to remind those who are called away from other employments to assist in making beds that they should previously wash their hands, and put off aprons which have been greased. Nothing can be more unseemly and disagreeable than marks of dirty fingers upon bed-hangings, sheets, or counterpanes; but with cleanly servants this can seldom happen. The beds being made, the curtains are to be shaken, folded, and laid on the bolster, and the valances to be turned up round the bedsteads. A large sheet is thrown over the whole, coarse wrappers over dressing and washing-tables, and the sweeping may then begin (see "Sweeping"): then she dusts every part and every piece of furniture; when the whole is completed, and she looks round and sees nothing neglected, her work is over for a time. She then resorts with her sewing to the still-room or kitchen, and sits there till it is time to put the rooms in order after dressing. In the evening she should pursue the same course as before mentioned. And during the week she should be solicitous to divide and arrange her work so as to get each day some portion of that done which may be termed the weekly business. By doing this, there would be no greater pressure of work on any one day more than on the rest of the week.

Subsect. 6.—*Duties of the Still-room Maid.*

1587. *The still-room maid*, less frequently required at present to assist at the still than in former times, when sweet-flavoured waters were to be prepared for the cook, aromatics for the dressing-room, and cordials for the invalid, yet she preserves her name, and in some houses her ancient avocations also. (See "Still-room," Book XX.) But whether these are entirely discontinued or not, she has always a distinct department to fill—that of the charge of the housekeeper's room. She is, in fact, the housekeeper's maid, lights her fire, cleans and dusts her room, prepares the table for her breakfast, waits upon her, and upon those of the establishment who breakfast with her, and, after clearing away the breakfast-table, she prepares to assist her in the preparations for second courses and desserts, or in distillation in those families in which this branch ot the still-room employments is continued. Neat, clean, active, and obliging she must ever be, and if observant also, there is no office in a gentleman's house more likely to fit her for undertaking in time higher and more responsible departments of household business.

Subsect. 7.—*Duties of the Laundry Maid.*

1588. *The laundry maid* is engaged generally to wash and get up only the household linen and the family clothes. The maid servants wash for themselves, or receive instead an allowance of wages. The men servants' washing, with the exception of the footman's linen jackets and aprons, is always at their own cost. This is customary, and if it seem hard that the men servants should not have the same advantages in this respect as the women, it must be remembered that their wages are much more considerable than those of women servants. On this subject, see also Book XX., "Economy of the Laundry."

1589. *The weekly business of the laundry maid is the following:* on *Mondays* the business of the laundress begins with collecting and sorting out the various articles to be washed, in preparing the coppers, filling them with water, and laying the fuel ready for kindling. On *Tuesdays* she should rise at 5 o'clock, light the fires under the coppers, and as soon as the water is hot, she should begin with her assistants to wash. As it is a main object to hang out early in the morning all articles (such as sheets and body linen) which may be improved by the whitening power of the morning air and sun, the first hours of the washing day should be diligently employed, and the evening, if the washing is finished, should be occupied with scouring and cleaning up the wash-house and the utensils which have been used. *Wednesdays*, the chief of the washing being completed, the business of drying and folding the linen for the mangle and iron is to be begun, as well as that of starching and clearing the fine linen. *Thursdays* and *Fridays* are occupied with mangling, ironing, and getting up the whole of the linen. *Saturdays* in separating it according to the marks affixed to it, and carrying each division into its appropriate place. The rest of the day is given up to the cleaning of the laundry, and putting into their places all things connected with the business carried on in it.

In families consisting of few in number, the laundry maid has often completed her business on Thursday evenings. She is then usually expected to assist the housemaid in repairing the linen either of the house or family.

Subsect. 8.—*Duties of Servants of All Work.*

1590. *A servant of all work*, though considered as holding one of the most humble places, may, if possessed of skill, activity, and integrity, be one of the most valuable of household servants, the comfort arising from the regular performance of the whole business of the house being solely dependant on her.

1591. *Generally, a young girl, on first going into service, commences her career as servant of all work;* and if she happen to fall into the hands of a clever, active mistress, she may be regarded as most fortunate; for, under her direction, she may prepare herself admirably for any other department of service. She cannot be in a better school for her education in household duties and virtues than in a family of orderly and neat habits, in which each day's occupations proceed in a regular and almost undeviating course. But, unfortunately, it is frequently the reverse; and a girl of unformed habits often finds her first service one of hard, yet irregular duty. If she entered it possessing any notion of order and neatness it is soon lost, and she falls readily into the habits of mismanagement and carelessness of the examples before her, habits which probably will affect her welfare to the end of her days: once contracted, they are seldom eradicated. In hiring maid servants to fill distinct departments in larger establishments, objections are often raised against those who have only served in the general character of servant of all work, objections arising from observations on the irregular management of their household duties, and their deficiency in neatness. It must, however, be remembered that a *good servant* of all work will make a good servant in any capacity, and may be taken into any department, not only without fear of her failure, but with every probability that she will fill the situation with credit to herself and with satisfaction to her employer. In some places, Scotland for instance, a *good general servant*, as she is called, is much sought after, and can demand higher wages than those who engage in only one department of service.

1592. *The routine of the duties of the general servant* depends chiefly upon the description of place she enters. Suppose her engagement is to serve a single lady in a small house in a town. Here her work will probably be regular, and not so heavy, but that with industry, activity, and a judicious division of the work, she will be well able to perform it. First, she must be an early riser; before her mistress gets up, her kitchen, parlour, and hall should be properly cleaned (see art. "Cleaning"), and she herself washed and neatly dressed, ready to attend on her mistress and to prepare her breakfast, taking her own also about the same time. After breakfast, and after washing and putting away the breakfast things, and receiving her mistress's orders for the day, she should repair to the bedrooms, and proceed to clean and arrange them, as described above (see "Housemaid's Duties"). From these employments it is probable that she may be occasionally called away to answer bells; and, on such occasions, she should look to her kitchen fire now and then, to keep it in readiness for the cooking, to which she will, in a short time, have to attend. When up-stairs work is done, she must return to her kitchen, and set about preparing the dinner. In some cases the mistress may, perhaps, assist her. It will be an advantage to the servant to have such an assistant and instructress who may be clever in the art of cooking.

1593. A mistress capable of directing the business of the kitchen and house is the best friend a young servant can have. Before dinner is served she should again wash her hands and change her apron, making her dress as seemly as the nature of her employments permit. In a service such as the one now described, the family usually dine first, and the servant afterward, on the remains of the dinner. As she brings it from table she should put it near the fire to keep it warm until she has time to sit down to it. If she does her duty to her employer, she may conscientiously attend to any little circumstances that may promote her own comfort.

1594. Her dinner over, the clearing away, scouring saucepans, washing dishes, with every other necessary act of cleanliness, will occupy some part of the afternoon, in the course of which she must find time to make up the kitchen fire, set on the tea-kettle, and sweep up the kitchen hearth. Her work completed, she again washes herself and changes her dress; she is then ready to wait upon her mistress at tea, and to attend in any other way to her comfort.

1595. The evening is occupied with closing doors and windows, and arranging the bedrooms for the night.

1596. *Besides the daily routine, she must contrive to bring into each day some portion of the weekly cleaning.* Her kitchen should be scoured twice a week, on *Wednesday* and *Saturday;* the parlour swept every other morning; the hall washed; bedrooms swept, and carpets taken up and shaken on *Tuesday* and *Friday; plate* cleaned on *Wednesday* and *Saturday;* block tin kitchen utensils, plated candlesticks, and brass work on *Thursday* (see "Cleaning"). Once a fortnight, or once in three weeks, the floors of bedrooms should be scoured (see "Scouring"), marks on painted wainscots washed off, windows cleaned, &c.

1597. *If the washing be done in the house*, the above routine will be occasionally broken into for a few days, though probably she will be allowed some assistance at the washtub, and will find her mistress ready to take on herself some portion of the lighter business of starching and getting up the fine linen.

1598. Although a multiplicity of occupations appear to claim her attention and time even in the smallest families, yet, by a judicious division of her duties, and by activity and diligence, she will find them all under her command, so as to get through them without any inconvenient pressure. In the appropriation of her occupations to time, and in the steady, regular performance of the same, consist the good management of the *servant of all work.*

1599. The following is given as the usual wages of domestics :

MALE DOMESTICS.					FEMALE DOMESTICS.				
	Out of Livery.		In Livery.			Rate of Wages, including the Allowance for Tea and Sugar.		Rate of Wages, where Tea and Sugar are allowed.	
	Highest Wages.	Lowest Wages.	Highest Wages.	Lowest Wages.		Highest Wages.	Lowest Wages.	Highest Wages.	Lowest Wages.
	£ s. d.	£ s. d.	£ s. d.	£ s d		£ s. d.	£ s. d.	£ s. d.	£ s. d.
House steward .	75 0 0	50 0 0	0 0 0	0 0 0	Housekeeper . .	42 0 0	26 5 0	36 15 0	21 0 0
Valet	47 5 0	31 10 0	0 0 0	0 0 0	Lady's maid . .	26 5 0	14 14 0	21 0 0	12 12 0
Butler	50 0 0	42 0 0	0 0 0	0 0 0	Upper nurse . .	31 10 0	15 15 0	20 0 0	10 10 0
Cook	40 0 0	30 0 0	0 0 0	0 0 0	Under nurse . .	16 16 0	10 10 0	12 12 0	10 10 0
French cook . .	150 0 0	100 0 0	0 0 0	0 0 0	Nursery girl . .	8 8 0	6 6 0	6 6 0	4 4 0
Porter	0 0 0	0 0 0	20 0 0	18 0 0	Cook	31 0 0	16 0 0	20 0 0	10 10 0
Footman . . .	42 0 0	31 10 0	25 0 0	18 18 0	Kitchen-maid. .	14 14 0	10 10 0	12 12 0	8 8 0
Under footman .	0 0 0	0 0 0	21 0 0	16 16 0	Scullion . . .	9 9 0	6 6 0	8 8 0	4 4 0
Foot-boy . . .	0 0 0	0 0 0	14 14 0	8 8 0	Upper housemaid .	16 16 0	10 10 0	12 12 0	8 8 0
Coachman . .	0 0 0	0 0 0	31 10 0	21 0 0	Under housemaid .	10 10 0	8 8 0	9 9 0	6 6 0
Groom	36 16 0	26 5 0	21 0 0	16 16 0	Still-maid . . .	10 10 0	9 9 0	9 9 0	7 7 0
Postillion . . .	0 0 0	0 0 0	21 0 0	16 16 0	Laundry maid .	16 16 0	12 10 0	14 14 0	10 10 0
Stable-boy . .	0 0 0	0 0 0	12 12 0	8 8 0	Wet nurse . .	31 10 0	20 0 0	26 5 0	18 18 0
Gardener . . .	50 0 0	20 0 0	0 0 0	0 0 0	Maid of all work	14 14 0	9 9 0	12 12 0	7 7 0

[In the United States the progress of luxury and extravagance has happily stopped short of the multiplication of servants to the extent which, as here truly represented, the British aristocracy and nobility have reached. Even among our *millionaires* there are none who retain so many male and female domestics in their home establishment. Although, in the Southern States, there are many planters who have hundreds of slaves, of whom they are the legal owners, and who are chiefly employed in their cotton and rice fields, or in their sugar and tobacco plantations; yet none even of these include in their household proper so many as 28 male and female attendants, nor are there any in the non-slaveholding parts of the country who employ half that number, however extensive their domestic establishment. Indeed, some of the official designations of servants here named are not recognised in America even by our English residents, many of whom do, nevertheless, retain many of their British notions and accustomed habits; but they find it impracticable to obtain competent and trusty servants in all these departments, however they might desire it.

Of male servants, our wealthiest families retain no more than a porter, footman, coachman, groom, gardener, waiter, and, in some few instances, a French cook, butler, and valet; and the housekeeper, cook, scullion, lady's maid, chamber-maid, laundry maid, nurse, and one or more maids of all work, constitute the whole of the female servants employed in the most extensive domestic establishments in America. Nor is it at all common to have any of the servants in livery except, in rare examples, the coachman, footman, and valet. Indeed, a vast majority of the wealthy merchants and capitalists of our country content themselves with less than half this number of servants, and find their household duties better attended to by requiring the most of their domestics to be servants of all work. The difficulty of procuring persons in this country who have been trained for special departments of domestic service would, of itself, be an insuperable obstacle to procuring an analogous classification of servants to that described above as common in England, unless they were imported for the purpose; and the rate of wages is so much less in America than in England, that no inducement could be held out sufficient to lead such to emigrate thither.

The mass of our population in the United States, however, have been trained to help themselves in the management of household affairs to an extent which renders them independent of so many servants, nor do they feel the need of them. The wife and mother, in multitudes of reputable and even wealthy families, prefers being her own *housekeeper* and nurse; the elder daughters consult their taste, and promote their health by attending to the chambers and cultivating the skilful use of the broom and hand-brush, or, where there are no elder daughters, some female relative, who becomes an inmate of the household, attends to these duties of choice. A maid of all work, or two or three of such if needed, together with a cook and washerwoman in the kitchen, with a servant to run errands, &c., are all the female servants kept or needed by very many of our most reputable and wealthy families; while one or two servants of all work are all the female help which a majority of American families retain.

Male servants, either white or coloured, are only employed by the wealthy, or those who choose to be reputed such, and are hence comparatively rare, especially in the non-slaveholding states; and a waiter or valet, a footman and coachman, constitute the number seldom exceeded. In most families these are dispensed with very readily, menial offices of all kinds being performed by public porters, bootblacks, barbers, washerwomen, &c., who, acting as outdoor servants, attend to these respective duties for a weekly or monthly stipend. The livery stables conveniently provide a stable-boy and groom, where a carriage and horses are kept, and multitudes of gentlemen choose to drive their own carriages when they give their families an airing, rather than to confide this trust to a coachman, often careless, and even drunken. Apart from the economy of these arrangements, Americans greatly prefer them in the general, and their commonness renders them reputable even among the higher classes, who thus rid themselves of the expense and, what is worse, the annoyance of so many servants.

The greatest trouble connected with housekeeping in American cities is, confessedly, the difficulty of procuring and retaining good servants, and private hospitality, to which our people are proverbially disposed, is necessarily limited by this circumstance ; and it is one the annoyance of which can scarcely be appreciated, and, though not easily described to strangers, may be readily accounted for.

In the Southern States, where slaves are trained by their masters and mistresses with special reference to the service of the family in the department of labour allotted them, the difficulty of which we speak is not realized to any great extent. Servitude is their lot, as it has been that of their ancestors, and they are, for the most part, ignorant of any higher destiny being attainable or even desirable ; and multitudes of them are contentedly happy, and free from any aspirations after a change of their condition, which, though one of bondage and dependance, is attended by no care or anxiety for the means of subsistence, which with them is the ultimatum of desire.

But in the non-slaveholding states, and especially in the northern cities, the case is widely different. The coloured people are free, and when they can find any employment, however menial, which they can conduct on their own behalf, they refuse to become hired servants, or the domestics in families, regarding such service as beneath them, approaching, as they seem to think, to the nature of slavery. And of those who are compelled, for want of subsistence, to enter domestic service, it is their misfortune more than their fault to say that, for the most part, they are mere eye-servants, and are not often found either qualified or trustworthy.

Their number being very inconsiderable, our population in the North have to be mainly dependant on the Irish and German emigrants, who constitute the great mass of our domestics ; for most strangely it has come to pass that white females, especially in the humble walks of life, however humble, regard the condition of hired servants as beneath them, and the domestic duties of the household too degrading for freeborn Americans! They prefer harder labour, coarser fare, and destitution of a comfortable shelter, if they can only be seamstresses, tailoresses, hat and shoe binders, book-folders, shopkeepers, milliners, or anything else except the hired girls, helps, or domestics of a family. Multitudes of them in all our cities toil from Monday morning until Saturday night in miserable garrets, hovels, and even cellars, working at prices which stint them for even the necessaries of life, wither their health, dim their eyes, and often sacrifice their lives, who might be actively and healthily employed in the bustling duties of domestics, at ample wages, with the comforts and even luxuries of life, and a good home. But such is their infatuation on this particular subject, that very few American girls, of suitable age for household service, can anywhere be found in the capacity of domestic servants.

It is for this reason that Irish and German domestics are almost universally employed in the northern cities, and these are, for the most part, wholly uninstructed in the duties of household service ; and however willing multitudes of them are to work for hire, they have to be taught by the mistress of the family even the most common kinds of service, being, for the most part, wholly ignorant of the plainest cooking, house-cleaning washing, ironing, &c., so that they often receive wages for months before they begin to make themselves useful in the family, or can at all be relied on for their every-day routine of duty.

By this time they often become corrupted by the intercourse they have with other servants during their frequent leisure, and are prompted to demand an advance of wages, and to make exactions of time for visiting their numerous cousins and other relatives from the old country, as well as to fill your kitchen with strangers, both male and female, until the annoyance becomes insufferable. Next they abruptly leave the family where they have been taught at great pains, and have but just learned the work they are required to do, either to seek a nurse's place, or some lighter form of service, for higher wages, or, perhaps, to get married to some one of their countrymen, whom you have allowed to quarter upon your premises rather than risk the loss of your servant, now that she has learned how to be useful. These are but a few items in the list of grievances which are perennially multiplied.

To remedy these and similar evils, societies are formed for the encouragement of faithful domestics, by whom premiums are given to those who continue to serve any family for a reasonable length of time, and testimonials of good character issued which secure them a perpetuation of employment. These useful institutions, however, are comparatively inefficient, for the reason that few out of the mass of servants are found to merit their rewards, either from a roving disposition, or mistaken notions of independence, with which they become filled in this "free country," where they seem to expect the most wages for the least work, and calculate to be well paid for doing as they please.

The only adequate protection to housekeepers from the endless troubles connected with their domestics is to be found in correcting the mistaken idea among our own young countrywomen, that there is anything degrading in the routine of domestic service, or that it is less respectable to labour at household duties for hire than to toil with the needle for the miserable pittance which speculators in female servitude allow such to receive as wages for their industry.

A young wife whose condition in life before her marriage has exempted her from the drudgery of the kitchen at her paternal home, and whose husband is in circumstances entitling her to similar exemption in her new relation, is, nevertheless, obliged to perform menial duties in her kitchen, not only to instruct her first servant, but she has to give similar lessons to every new servant which her frequent changes introduce into the family. However unwelcome such labour, no one imagines that it is in the least degree disreputable, after her marriage, to teach her servants by practical lessons, or to assist them statedly in the duties of the chambers or kitchen. And yet the same duties and toils, cheerfully performed after marriage by the mistress, and to which she has never been accustomed, are deemed by young women dependant on their labour for bread as beneath their fancied dignity; and pauperized seamstresses, &c., ground into the dust by their taskmasters, whose compulsory bill of prices fail to reward their hard earnings with even the necessaries of life, will turn up their noses in aristocratic pride by excluding from their society a young woman who is occupied in domestic service, either as kitchen maid, or servant of all work, and this though the lady of the house herself shares in the humblest of her labours.

How insufferably absurd is such folly, when this same seamstress, when she has luckily married some labouring man of her own degree in life, enters upon housekeeping for herself without a servant of any kind, and becomes reconciled at once to those very kinds of labour which she before regarded as humiliating and disgraceful; and when, by dint of industry and frugality, the young couple find themselves able to look out a servant to relieve the wife of her daily task, and share the burdens of an increasing family, she finds her former notions of the degrading character of domestic service so universal among her own countrywomen, that she is now convicted of her infatuation, and is compelled to take under her roof a raw Irish or green German girl, neither of whom know how to boil a potato or cook a beefsteak until they serve an apprenticeship in her kitchen.

Under such circumstances as here alluded to, it is obvious that the classification of servants recognised in England is impracticable in America. And, moreover, the high notions of equality and independence inspired by a "free country" would render such an army of servants in a household as unmanageable as a regiment of dragoons, and as dangerous to the peace and safety of a family as a "gunpowder plot." Indeed, there are very few in this country whose income would justify so large an outlay for domestic wages as the foregoing table shows, nor is there any family establishment for private residence in America which could furnish occasion for so many servants. The foregoing chapter, however, possesses much interest, and in the comparison of this feature in our domestic economy with that of England, will furnish our countrymen no cause for dissatisfaction or envy.]

CHAPTER II.

HOUSEHOLD CLEANING.

Sect. I.—GENERAL HOUSEHOLD CLEANING.

Subsect. 1.—*General Observations.*

1600. *Cleanliness, whether household* or personal, may be considered as one of the unalloyed advantages derived from civilization. If it may not be ranked as a virtue, it is, at least, the parent of virtues, and not unadvisedly was the old saying first pronounced, "Cleanliness is next to Godliness."

1601. As a habit, it has moral as well as physical advantages, personal as well as domestic; hence its claims on our approbation and daily observance. It evinces an absence of slothfulness; for, without activity and exertion, cleanliness cannot be practised: it is an emblem, if not a characteristic, of purity of thought and propriety of conduct. It seems as if it could not be associated with vicious pursuits, so rarely, in the habitually profligate character, are the active and wholesome habits of cleanliness perceptible. The squalid wretchedness which sometimes engages the pity of the philanthropist is oftener found, on investigation, to be the effect of vicious idleness rather than of unmerited misfortune; while cleanliness, if it cannot totally indemnify us from the evils of poverty and disease, can keep them far removed from utter wretchedness and misery.

Cleanliness is an unequivocal good; and, accordingly, we find that it confers a species of rank on all its votaries, to whatever class in the scale of society they may belong. The cleanly family, whether living in the cottage or the hall, is "respectable," "creditable"—a distinction which serves as capital or stock in trade to members of the industrious working class, and is not without its value in the higher walks of life, where honour and distinction are sought.

1602. In the former class, the respectability of a family (and we can scarcely allow respectability to be claimed where cleanliness does not prevail) is a sufficient recommendation to honest and creditable employments. An opposite term, given to an idle, slovenly family, would be an equal impediment to the worldly advancement and welfare of its members. Doubt and suspicion must inevitably cloud the prospects of all whose domestic habits could not promise for them that, in the world, when called upon to act, they would be diligent and energetic, not self-indulgent, or wanting in attention to any of the proprieties of life.

1603. *We shall first consider cleanliness in the house*, together with the *modes* of cleaning everything within its walls. Attention to the person will be treated of elsewhere. Under the head of "Ventilation," we have treated of the importance of preserving the purity of the air in our houses, and of those causes which deteriorate, among which the want of cleanliness is one of the chief.

1604. Whatever may be the exciting causes of infectious diseases, cleanliness has in its keeping the specific by which their progress is checked. Under its influence infectious complaints are often confined to some solitary instance in a family, and do not spread, as formerly they would have done, with the fatal rapidity of a pestilence. This specific allays the scourge, as well as giving exemption from contagion to all who practise it. Many other effects of cleanliness on health might be stated, with considerations of much importance in other points, relative to family comfort and prosperity.

1605. The economy of cleanliness is another recommendation to its observance; the uniform cleaning of house and furniture is among the best means of preserving both; we can neglect no wholesome practice in the whole cycle of domestic cleaning without inflicting an injury on some part of our property. We may even incur an entire loss by neglecting to clean in time some of the various articles of furniture which comfort and convenience require us to possess; so that to the other evils of uncleanliness we may fairly add that of *waste of property*. Thus, on domestic cleanliness how much depends! *comfort, economy, health, and respectability.*

1606. It must be acknowledged that, in this country, *the taste for cleanliness*, if the term be permitted, has long been cultivated, although there may be room still for improvement in it, as its universal prevalence depends upon the cultivation of more qualities than one.

1607. Yet here we must observe that, indispensable as the practise of cleanliness is, like many other good inclinations and habits, it may be carried too far. It may encourage an inconvenient fastidiousness, a nicety that must often be offended, and a consequent tendency to irritation of temper. Such effects would, in some degree, counterbalance the advantages of cleanliness.

1608. *There are families and situations* in life in which cleanliness can only be practised in generals, not in details; in such cases the love of it should be kept within the bounds of possibility, or it may become a daily cause of family uneasiness and discord. We delight to see the supremacy of cleanliness, its victory over dirt and smoke; but it can only yield such pleasure when known to be the result of a practical, orderly, and regular system, and not of the severe, hard, daily duty which we imagine to be the characteristic of an enslaved existence. Cleanliness, like every other good quality, must have its prescribed limits. If these be overstepped, it may prove a torment and inconvenience, instead of one of the sources of domestic enjoyment.

1609. We now proceed to such details respecting the practical part of our subject as may enable a mistress of a family or her housekeeper to form her system of household cleanliness, and to direct its daily course.

SUBSECT. 2.—*Cleaning Floors.*

1610. Floors of a house may be of several kinds — of boards, of brick, and of stone.

1611. *Boarded floors* are commonly either of *oak* or *deal*. The former, chiefly seen in country houses, or in the residences of the opulent, forms an excellent, substantial flooring, and is often only partially covered with carpet. Deal floors, on the contrary, are almost uniformly and entirely carpeted, except in the apartments assigned to children and servants: the mode of cleaning them is, consequently, of less moment, and less laborious than that employed in cleaning floors of oak.

1612. *Scouring*—for which the housemaid must be provided with a good-sized wooden pail for water, a wooden bowl for sand, a piece of flannel rather more than half a yard square, and a hard scrubbing-brush—consists in scrubbing floors with the brush, some sand, and clean cold water, and afterward in washing off the sand with the flannel. *Soap* is sometimes used with sand; but, instead of improving, it injures the colour of the boards when dry, giving them a blackish appearance.

1613. *In scouring*, the housemaid first dips her brush in the water, then sprinkles it with sand, and scrubs, with force, such portions of the floor as her arms can reach at a time. From these she washes off the sand with the flannel. drying and completing each portion at once, so that she need not tread over the boards until they are dry. *In bedrooms* it is desirable to scour first the boards beneath beds, chests of drawers, or wardrobes, that these parts, being less open to the air than others in the room, may have the more time to dry When bedrooms and nurseries are scoured in the winter, and when the windows cannot be long open on account of the weather, it is very prudent to have fires in each room to accelerate the evaporation of the moisture on the floors. The damp arising from newly-scoured boards is as likely as any cause whatever to encourage the inflammatory diseases of childhood, or the coughs of individuals subject to them.

1614. *For scouring, when necessary to be done in winter,* dry clear weather should be chosen. During very frosty weather it ought rarely to be done, the evaporation not being then rapid enough to carry off the moisture of the boards; or if it freezes on the boards, which is sometimes the case, it then requires two days, instead of one, to dry the room thoroughly.

1615. *Deal boards,* if not carpeted, should look white and clean; they may be improved, if the colour be indifferent, by the use of fullers' earth or pearlash dissolved in the water. In the use of clean water the housemaid should not be sparing; whenever it begins to look dark-coloured and becomes thick, she should instantly carry it away, and bring a pail of clean fresh water to her task If she does not change the water frequently, she will smear and not clean the floor. *Scouring, in most houses, is usually done at stated intervals;* in nurseries and offices, generally every week; in bedrooms, every fortnight, or once a month, according to season and situation; in sitting and eating rooms, which are carpeted, scouring is not done more than once or twice in the year, nor need dry-rubbed oaken boards be scoured more than once in twelve months.

1616. *Oak boards.* The effect of scouring oak boards with soap and water is to bring them to a dirty, dull white colour. To prevent this, the boards, after being scoured, are washed over with water, coloured either with *umber* or *yellow ochre.* With old boards, the umber is most commonly used; with new oak floors, the ochre. After the scouring and the washing with the coloured water has been done, the most laborious part, that of polishing, called *dry-rubbing* the boards, remains to be accomplished. For this work, the housemaid must have a large, heavy, hard brush, in length one foot or more, in width about eight inches, affixed to a long stake or handle. With this brush, and a little hot, dry sand, she must scrub the floor to and fro the way of the grain, until the polish, destroyed by scouring, be restored. Sometimes bees' wax is used to accelerate the reappearance of the bright surface; but bees' wax, in restoring the polish, at the same time renders the boards so slippery as to make walking on them scarcely less dangerous than on ice. Friction alone will, by frequent repetition, brighten the boards sufficiently, without the inconvenience of making them slippery also. After the *dry-rubbing* is over the sand is swept away, and for the next ten or twelve months these boards will only require sweeping every day, and a little dry-rubbing once a week.

1617. *In France,* where carpets are less commonly used than in England, oaken floors are seen in most of the great houses and in hotels. They are kept in a highly-polished state by men, the work being there considered as too laborious for women. The men perform this duty with their feet, to one of which they fasten the brush; and with great activity, and without much apparent fatigue, they soon bring a glass-like surface to the floors. They employ wax and other polishing substances to hasten their work.

1618. *For removing spots of grease* from boards, take equal parts of fullers' earth and pearlash—a quarter of a pound of each—and boil in a quart of soft water, and, while hot, lay it on the greased parts, allowing it to remain on them for ten or twelve hours, after which it may be scoured off with sand and water. A floor much spotted with grease should be completely washed over with this mixture the day before it is scoured. *Fullers' earth* and *ox-gall* boiled together form a very powerful cleansing mixture for floors or carpets. *Spirits of turpentine,* rubbed for a short time forcibly on grease spots, dissolve the grease in the floor, and make it readily unite with pearlash or soap, with either of which the parts should be afterward washed. *Drops of tallow* may be scraped off. *Stains of ink,* dried in on floors, are difficult to eradicate. Strong vinegar or salts of lemon will remove them. *Red wine stains* on boards may be removed by laying on them a strong solution of soda. If this be not sufficient, *the chloride of lime* or bleaching liquid, sold by chemists in half pint bottles, will remove them.

SUBSECT. 3.—*Cleaning the Sides of Apartments.*

1619. As oil paint is injured by too frequent scouring, it is necessary to use every means which may render the scouring of paint rarely needful; first, by cleaning the walls, edges, and mouldings from all lodgments of dust, frequently sweeping and daily dusting them with the proper hair broom, called the *Turk's head,* over which a clean linen duster should be tied. Every angle, the favourite nook of the house-spider, should be cleared, as well as the panels and ledges of doors. In sweeping the mouldings of the ceiling cornices, great care must be taken not to break them, they being made of plaster, and consequently brittle.

1620. *Partial washing of spots and stains on oil paint* may prevent the necessity of more frequent general scourings. Every week the housemaid should examine the paint, and remove with a flannel and soap and water any spots upon it, finger marks, &c., within her reach; having wiped them away with the flannel, taking care to wipe those parts dry, so as not to leave it visible where the cleaning has been done.

1621. *In washing or scouring paint* little soap should be used, the alkali of the soap having a tendency to injure oil paint. But water alone is not sufficient. After scouring with the brush and soap, plenty of water should be used to wash off what remains of the soap; otherwise, if left on the paint, it will cause its decay.

1622. *Oak wainscot* should, when necessary, be washed only with a sponge and warm water; after which it should be rubbed with a brush, like mahogany.

1623. *Stairs* in towns are frequently painted in oil, either white or of stone colour The parts which are not covered with carpet should be washed weekly with warm water and two sponges; one to wash, the other to dry the stairs with: by using sponges the edges of the stair carpet are not so likely to be injured, as by a brush or scouring

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flannel. *Painted stairs* look clean and neat while the paint remains on them; but the paint requires to be renewed almost every second year.

1624. *When walls are painted in distemper* (see Book I., Chap. VI., " Painting"), they will not bear the application of water, and therefore admit of no cleaning except that of sweeping down gently from them all the dust that may adhere to them.

1625. *Paper-hangings* of walls also admit of very little cleaning except that of sweeping them down with the hair broom, covered with a clean linen duster. Stains by smoke may sometimes be cleaned by rubbing them with the crumb of a loaf. *Grease* can scarcely, by any means, be removed from paper-hangings.

1626. Whenever a room is fresh papered it is desirable to reserve small pieces of it, that repairs may be made in the case of any part being torn off or injured.

SUBSECT. 4.—*Cleaning Marble and Stone Work.*

1627. *Marble floors, chimney-pieces,* and *hearths* are simply washed with a flannel or sponge, and soap and water, and wiped dry with linen cloths. If stained either with oil, wine, or discoloured with smoke, other means must be employed to clean them.

1628. *Oil* or *other grease* dropped on marble or stone may be removed by laying on the stains a mixture of *strong soap lees* with fullers' earth and pipe-clay well dried and powdered. When laid thickly on, a flat iron, made tolerably warm, must be put on and suffered to remain until the mixture is dried; and if on washing the part the stain be not eradicated, the mixture and iron must be applied either once or twice more.

1629. *Stone floors* and *stone stairs* are sometimes scrubbed with sand and water, sometimes with the hearth-stone, or with pipe-clay prepared after the following receipt:

Boil half a pint of size with the same quantity of whiting and pipe-clay in two quarts of water; the stones must be first washed clean with water, and this mixture afterward laid smoothly on them with a flannel; when dry, they must be rubbed with a dry cloth or flannel.

Stone floored kitchens and offices, stone hearths, stone steps, and balconies are usually washed with a flannel and water, and, while wet, scrubbed with the *hearth-stone.*

Steps at the entrances of houses are washed and whitened every day in town, in the country scarcely more than once a week; stone kitchens twice a week, balconies only once.

SUBSECT. 5.—*Cleaning Areas, Dust-holes, &c.*

1630. *In the areas of town houses,* together with the offices opening into them, cleanliness is as requisite to the comfort, and perhaps health, of a family, as in the interior of a house.

1631. *The dust-holes,* often opening into one of the areas of town houses, and being thus in close vicinity to the windows, cannot be suffered to remain long unemptied without considerable inconvenience, especially in the warm seasons of the year, when the fermentation, both of the vegetable and animal substances, produce noxious exhalations. On this account, it should be a rule not to throw any animal or vegetable substances into the dust-hole, but to dispose of them some other way.

1632. *In London,* parochial arrangements are established for clearing away from every house all its refuse at short intervals.

1633. The men employed in this business are not entitled to any direct remuneration from the inhabitants, their services being paid for by the contractors who employ them. But they often refuse to remove any unusual degree of rubbish in the shed-hole without being paid for it. It is well to know that they have no right to this, and a redress may be had by applying to the contractor himself.

SUBSECT. 6.—*Cleaning Windows.*

1634. *In large towns it is usual to employ glaziers* to clean the windows; and they being used to the business, do it most effectually and expeditiously; *the mode is,* first to dust them with putty-powder (sold at the oil shops under that name), enclosed in a linen bag, afterward rubbing it off with two wash leathers, one a little damp and the other perfectly dry; a sponge and cold water and soap some employ; but the panes, if wetted, are seldom so thoroughly and immediateiy dried as not to catch the dust again almost as soon as it has been cleaned off.

1635. To clean windows expeditiously, two persons should be employed, one within the room the other on the outside the window, the latter standing securely on the glazier's machine, unless the sashes are double hung, in which case the upper windows may be cleaned while the outside person merely sits on the sill, his legs being within the room, and his back to the street; but this is a dangerous practice for any one to attempt except a professed glazier.

1636. *Uncleaned windows* give a dismal and untidy appearance to a house.

When the cleaning of windows is to be paid for each time, there may be considerations of economy to be attended to which may prevent its being done as frequently as would be otherwise agreeable and desirable. Where no such reasons determine the periods of cleaning windows, it should be done in most of the rooms once in a fortnight. Where men servants are kept, and great attention to appearance paid, sitting-rooms should have their windows cleaned once a week, and even more frequently in rainy weather. Those who have to pay a glazier each time, who generally charges 6*d.* each window, if he clean both inside and out, content themselves with having it done once in three months, trusting to their housemaid to keep them in tolerable condition, which she may easily do by frequently cleaning the inside of the panes.

SECT. II.—CLEANING ROOMS AND FURNITURE.

SUBSECT. 1.—*Sweeping and Dusting.*

1637. *Sweeping* is an art of a simple nature, but which to do well requires practice and care. The broom, in the hands of a thoughtless girl, may do more harm than good, by raising the dust from one lodgment only to send it into another, instead of rolling it gently along until a mass is collected sufficient to be swept into the dust-pan and carried off. Before beginning to sweep, the housemaid should close the doors and windows; and, by throwing sheets over the furniture of the room, protect it from any lodgments of dust.

The floor, whether carpeted or uncovered, must be with prodigal hand sprinkled over with moist tea leaves. Let the housemaid remember that the tea leaves should not be mouldy, or they will impart no pleasant freshness to the air of the room, nor dried, or they will be useless in catching the dust. Taking her broom, she must first sweep gently the dust collected under the furniture, beds, drawers, &c.; and, when sweeping in the open room, she should avoid lifting her broom hastily or high above the ground, which would impel the dust upward, but she should endeavour to check its rising, while she quietly and gently rolls the mass of leaves and dust into one spot, from which she can most readily sweep it into her dust-pan.

1638. After sweeping, the essential work of *dusting* should be done. The window-curtains, which had been lifted up considerably above the floor during sweeping, should now be released, opened, shaken, brushed with the proper brush, and properly arranged over the hooks or bands for the day. Tables, sofas, with all the varieties of chairs and seats now in use, are then to be carefully dusted and arranged. Ledges of wainscots, panels of doors, and window panes must be swept with the small brush called the *banister brush.* Mirrors, and pictures with gilded frames, must be brushed with *feathers* or *silk dusters.* A linen rubber spoils them.

1639. Chimney-piece ornaments must be carefully removed, and the mantel-piece either wiped free from dust, or washed with soap and cold water; the ornaments, before being replaced, must be carefully wiped with a fine linen duster.

1640. Sweeping is, in most country places, a daily business, neither bedroom nor parlour being considered as properly done if this be neglected. In London, where the necessity for sweeping daily is still more urgent, it is customary to sweep the bedrooms twice, and the sitting-rooms only once a day.

1641. Under beds, wardrobes, and other immoveable furniture every particle of dust should be cleared away each day, either by employing a clean damp mop kept for the purpose, or a damp scouring flannel.

1642. *For sweeping boarded floors, the common hair broom* is used, which costs in purchasing from 3*s.* to 4*s.*

1643. *The carpet broom, or whisk brush,* is made of the dried leaves of a tough grass.

It is not desirable to sweep the carpet with this broom more than once a week, being rather too harsh for daily use. But after a carpet has been well swept with it, the common hair broom will keep it sufficiently clean for several days. The *drugget brush,* a short-haired broom, answers for stair carpets, and for rooms covered with drugget.

SUBSECT. 2.—*Cleaning and Preservation of Carpets.*

1644. *Carpets,* thirty or forty years ago, were regularly taken up during the summer months, and, after being well beaten, were rolled up and deposited in some convenient part of the house till autumn; the floors, in the mean time, being only partially covered with oil cloth or matting. This custom rendered *scouring* and *dry-rubbing* matters of more importance than they are at present, when sitting and even bed rooms are generally entirely covered with carpets at all seasons during which a house is occupied by a family; but it is requisite to have them occasionally taken up from the floors and well beaten, if possible, in the field.

1645. *The periods* at which this beating of carpets should occur must depend on the convenience of every family.

1646. *Drawing and dining room carpets* are, in some houses, taken up and beaten twice in the year, in the spring and autumn; in others only once, under the idea that the frequent beatings weakens the texture of the carpet. The best mode by which frequent beatings might be avoided would be to turn the carpets up once a week and sweep under them; but the manner in which they are now universally fastened down renders this next to impossible.

1647. *In former days, carpets* were not made to cover the whole room, as at present, and which renders it necessary for them to be closely and firmly united to the floor, but were wove, as the turkey carpets and Axminster still continue to be, square, or nearly so; and, being loose, could, without much additional trouble, have the dust which collected beneath them frequently cleared away; which, with the floors, being oftener washed than at present, tended materially to preserve cleanliness in the texture of the carpets.

1648. *Bedroom carpets* it is desirable to have made in such a manner as to admit of being frequently taken up and shaken well in a yard or garden. When this can be done, it should be as frequent as twice a week. In fine weather, bedroom carpets should be occasionally hung out on cords and beaten with small sticks or canes.

1649. *Grease in carpets* may be removed with spirits of turpentine, as well as by fullers' earth, or by soda, ox-gall, and pipe-clay; carpets cleaned by the dyer cost from 6*d.* to 8*d.* per yard. (See more on the subject of cleaning carpets in Chap. II., Book XXII.)

SUBSECT. 3.—*Cleaning Grates, Fire-irons, Fenders, &c.*

1650. *Parlour and drawing-room grates*, being of various kinds and forms, require different modes of cleaning. Fire-irons and fenders of polished steel, and such parts of grates as are of the same material, should never, in cleaning them, be touched with any substance that has sufficient roughness to scratch their surface; to preserve their polish, they require nothing but security from moisture, together with the daily rubbing with soft wash leather. Linen is an improper material for rubbing polished steel, as it is apt to be damp. Even the moisture of the hand, if impressed upon steel, is apt to cause spots of rust, if not rubbed off in time with a dry leather.

Once become rusty, steel is scarcely recoverable under the housemaid's hands, nor can the steel polisher entirely restore the even-polished surface. This fact should be impressed on the memory of housemaids, that they may not neglect to apply the leather each day to all the polished steel articles under their charge, and to rub carefully away all dull spots, which are the first indications of rust. The leather kept for this purpose should be frequently aired before the fire, and occasionally a little dried *putty powder* (which may be bought at oil shops), tied in a muslin bag, may be dusted over the steel and then rubbed off with the leather; but, in truth, good rubbing with the leather only is the best means of keeping steel work bright and unspotted.

1651. *When fire-irons* or other fine steel work is not likely to be wanted for some weeks or months, and during which period a housemaid may be away with the family she is serving, it is desirable to rub them over with a little Florence oil; when it is requisite to remove the oil from the steel work, a little dry whiting may be dusted over it, and the whole rubbed clean off with leather. Fire-irons in summer should be tied up in green baize bags, and hung up near the kitchen fire, or in any other office in which there is usually a fire.

1652. *Bright iron bars* of grates necessarily require a different mode of cleaning from that employed for polished steel; they are usually stained with the flame, and browned with the moisture or bitumen from the coal. To remove this, many plans are in use among housemaids; *a good one* is to cover the bars with a little sweet oil, which is suffered to remain on while the housemaid cleans away the cinders from the grate, and with her proper brush sweeps down all lodgments of soot as high up the chimney as her brush will permit. On this point it may sometimes be necessary to remind her, or the family may be inconvenienced by the falling of the soot, if not by the firing of the chimney upon any high flame or sparks flying upward and reaching some of these collections of soot.

This being done, and the grate cleared of ashes and cinders, the oil may be removed, and the bars polished, either by rubbing on them with the leather a little of the smooth white ash formed by the Staffordshire coal, or, where these are not used, by rubbing them either with the Bath brickdust, or with fine emery paper.

1653. *Cast iron grates and fenders* are cleaned with black-lead used in different ways. The housemaid commonly mixes a portion of black-lead with water, of a consistence rather thicker than cream; this, after having cleaned her grate of ashes, she puts on the sides and back of her grate with a small brush, and afterward, when that is dry, with a hard one she rubs the grate with force and briskness until the polish is brought. Black-lead need not be put on the grates more than once, or perhaps twice a week, but each morning the housemaid should brush her grates with the polishing brush.

1654. *Another mode* is to boil a quarter of a pound of best ivory black-lead in a pint of small beer, adding to it a bit of soap about the size of a walnut; this mixture is laid on with a painter's brush, and afterward polished with the hard brush, as above directed.

SUBSECT. 4.—*Cleaning Brass Work.*

1655. *Fenders, if of lackered brass, or any lackered brass ornaments*, admit of very little cleaning beyond that of rubbing with a clean leather; when the lacker is worn off, and they look dull or greenish in appearance, the plates or ornaments may be re-lackered at a trifling expense.

1656. *Fenders with common brass mouldings* may be cleaned, like other brass work in a house, either with oil and rotten-stone rubbed with fine dust of the Bath brick on leather, or polished with polishing paste.

SUBSECT. 5.—*Cleaning Drawing-room Ornaments.*

1657. *Glass lustres* require very careful dusting and rubbing with wash leather; when washed, cold water and soap, applied with soft flannel, is best.

1658. *Ormolu time-pieces*, or other ornamental drawing-room articles, although usually protected from the dust by glass coverings, require occasional dusting, but which should be done with a brush of feathers or silk dusters; the friction of linen, cotton, or any harsh substance, would injure them, as would also any moist application.

1659. *Alabaster figures or vases* can scarcely be cleaned by ordinary servants, and should be, therefore, generally encased in glass, and covered over, as much as possible, with silver paper bags.

1660. *Looking-glasses and mirrors* may be washed with a moist sponge dipped in spirits of wine, no more of the glass being wetted at once than what may be immediately wiped off, as damp, in altering the temperature of the glass, unsettles the backing of the tin coating, which gives it its power of reflecting objects. While wet the glass should be dusted with powdered blue, or whiting tied up in a muslin bag, and then rubbed off with a soft linen duster or silk handkerchief.

1661. *The gilding of pictures and mirror frames*, when it is what is termed *oil gilding*, may be cleaned by washing it gently with soap and water; but if of *burnished gilding*, which is most usual, it should never have any moisture applied to it. (See Chap. IV., Book V., "Gilding.") A brush of cotton wool or of feathers is best adapted for removing the dust which may settle on it.

1662. *To gilding the flies are the greatest enemies;* but if, during those periods of the year in which they are numerous and active, gilding were covered over with thin coarse leno or gauze, it might be preserved unsoiled for many years.

Sect. III.—cleaning articles in the butler's pantry.

Subsect. 1.—*China, Earthen-ware, and Glass.*

1663. *China and earthen-ware* should be washed in plenty of warm water and soap, rinsed clean in a second bowl of water alone, either warm or cold, should be then turned down to drain, and afterward wiped dry with linen tea-cloths. Settlings of any liquid which have been suffered to dry up at the bottom of earthen vessels may be dissolved generally by a little pearlash and water, or with soda instead of pearlash; either of these will also quickly remove any oiliness which may be on the surface of earthen-ware or porcelain. Neither porcelain nor earthen-ware will bear sudden immersion into hot water, when the weather is cold, without great danger of its cracking.

1664. *In washing glass* the above caution is still more requisite to observe than in respect to china and earthen-ware.

To put glass suddenly into boiling water in cold weather would be inevitably to break it. Glass should be washed in water moderately warm; and the quantity of water used should be abundant, and in proportion to the number of articles to be washed. When taken out of the water, each article should be at first turned down on a table or dresser, that the water may run off from them. Afterward they should be dried with a soft linen cloth, and, before they are placed for use, each should be polished with a clean soft skin of wash leather kept for the purpose. Glass should never be brought to table with the dull linty surface which negligence in wiping it would give it. *For cut glass*, the use of a soft brush may be requisite to polish it well; but if any brush or rubber of a harsh nature be applied, glass, which easily receives scratches on its surface, would lose irrecoverably its beauty and brilliance.

1665. *Glass discoloured* with the settlings of port wine may require more than common washing. A solution of soda will effect solution of the colouring matter. A bottle brush is sometimes used to remove the wine settlings, but it is liable to scratch the glass.

Subsect. 2.—*Cleaning Plate.*

1666. *Plate* is cleaned in various ways, and every butler or footman has a prejudice in favour of one or other mode. In cleaning plate, the objects to be attained (when it has been washed in hot water and soap immediately after it has been in use) is to erase all scratches and scores which it had received from being thrown carelessly together, or against substances of a harder and rougher nature than its own, and thus restore the polish. After washing it in hot water and soap, it should be rinsed in cold water; then, before putting it away, it should be rubbed with wash leather. But this may not be always sufficient to remove entirely the dim coating given by the oily matters it has been brought into contact with. If greasy, they will require being washed with a hot solution of alkali, such as potash, or soda and water, which will remove the grease and render them fit for polishing.

1667. *For cleaning plate* two good sized skins of wash leather are requisite, together with a brush of soft and fine bristles, for cleaning away from the cruets, ciphers, and chasings the ingredients with which the plate had been cleaned. With one leather, the plate is first rubbed with the powder employed to clean it, and afterward with the other, in order to give it a final polish. As this last-mentioned leather should be kept particularly clean, it should be washed occasionally with soap and water and dried, and used for no other purpose.

1668. *Polishing powders for plate* are sold in the shops; but, as they are apt to wear the silver, they should be used as sparingly as possible. One, called *rouge powder*, is much recommended by silversmiths; and though they find it very useful and effectual, yet, if used as often as plate requires cleaning in a family (perhaps twice a week), the plate would suffer considerable wear.

1669. *Finely-washed whiting is one of the safest plate powders.* To prepare this, mix some whiting up with water, and stir it well; then, letting the whole remain a minute or two, pour off the white fluid into another vessel, and suffer the sediment of the part poured off to settle. This sediment will, when dried, be the fine washed whiting desired, all the coarse gritty part having been left behind in the first vessel. Whiting, in general, is fine enough without being washed; but this operation secures it from containing any particles of sand. It is by some persons applied in its dry state, and rubbed on with the leather. Others mix it with water, and lay it wet on the plate, and do not rub it off till it is dry.

Rotten-stone, mixed with a little Florence oil, is sometimes employed for rubbing away the scratches which plate may accidentally have received; but this must be used with caution.

SUBSECT. 3.—*Cleaning Plated Wares and British Plate.*

1670. *Plated wares, and what is called British plate, nickel silver, &c.* (see "Alloys of Metals," in Chap. V., Book V.).—As plated goods consist of inferior metals coated with silver, this coating is easily rubbed off; and hence, in cleaning plated articles, the greatest care is requisite not to wear off the silver coating. All violent rubbing should be avoided, together with the use, in cleaning it, of any ingredient which would wear the silver. When tarnished, plated goods may be cleaned with fine washed whiting mixed with *sweet oil.* Warm water and soap, also, may be safely used.

1671. *Of plated candlesticks, snuffer dishes, salvers, &c.*, the *edges* and *mouldings* are now frequently formed of silver alone. This improvement has occasioned plated articles to be much more durable, as it was at the edges that the plating was first destroyed.

1672. *The sulphur* contained in the sulphuretted hydrogen gas, which exists sometimes in small quantity in the atmospheric air, is constantly acting upon silver, and produces a tarnish. On this account it is very desirable to keep all such articles not in daily use covered with wash leather, or with any soft material, to keep them, as much as possible, from the air.

1673. *Among the careless practices to be condemned* is that of scraping off, with a sharp knife, wax or tallow adhering to plate. If in this practice the surface be scratched, the scratches cannot be removed, except by rubbing off the silver around until it is levelled to the indentations; hence the injury to plated goods especially, in which the silver is merely a thin surface. Another careless mode, and one equally destructive to the articles, is that of exposing the candlesticks to the excessive heat of a fire in order to melt the adhesive wax or tallow. The hollow pillars and pediments of most candlesticks are filled with a composition which gives them weight and steadiness. This composition, with the soldering which unites together the different parts of candlesticks, is melted at the same time that the wax or tallow is dissolved by the fire, and thus the united parts are weakened, if not entirely separated. It is a safer plan to immerse in *warm* water the sockets and nozzles of candlesticks, and to let them lie until the substances become softened by this slight degree of warmth, when they may be easily removed without injuring the surface of the candlesticks. If this moderate warmth be not sufficient to clear away the wax, a little spirits of wine rubbed on it will loosen it, and allow of its being entirely removed. It must be remembered that very *hot* water will be as prejudicial to candlesticks as a hot fire. It is requisite that the water should not in temperature exceed that which the hand can endure if held in it for a minute or more. After the wax or tallow is entirely cleared away, the candlesticks must be wiped with a duster very dry, and afterward polished with the leather and fine whiting.

1674. *For the cleaning of candlesticks* two leathers and a soft brush are requisite, as well as for the cleaning of the plate used at table. A small skin should be kept for rubbing the articles with the whiting, a larger one for polishing them afterward, and the brush for removing the powder from the mouldings, &c

SUBSECT. 4.—*Papier Machée and Japanned Wares.*

1675. *Tea-boards*, either of *papier machée* or of *japanned iron*, should never be washed with hot water, because the heat of boiling water is sufficient to crack the varnish on the surface, upon which the blackened coating of either the papier or iron will begin to peel off. When any liquid dries upon tea-trays or waiters which has in it something of a glutinous nature, water must be employed to wash it off, but whenever simple rubbing with a soft linen rubber removes any spots on japanned wares, water should not be used. Tea-boards are easily cleaned by the use of a few tea leaves, when emptied out of the tea-pot; if tea-boards of japan or papier machée appear streaky, as if from grease, a little flour or whiting sprinkled over them, and rubbed off with a soft linen duster, will clean them. The fine polish to these wares is in their manufacture given by the use of olive oil, and the friction of the hand alone; hence any scratches on the surface, so slight as not to penetrate through the coating, may be removed by a similar application and means.

1676. *Japanned tea-urns* should, after use, have any warm water remaining in them poured out before it gets cold. The inside should then be wiped perfectly dry with a linen cloth, and the outside be rubbed with a leather kept for the purpose. If any spots caused by the water are rubbed while the urn remains warm after use, they will be soon obliterated then; but if left till the urn be cold, it will be a more difficult matter; they must in such case be removed by the use of the *urn powder*, which is to be purchased either at oil shops or at the shops in which japanned wares are sold.

In cleaning japanned candlesticks, the same caution must be observed as with other japanned wares—that of not employing great heat, either of the fire or of water, in removing from their surface any substance which has adhered to them; with care, these articles may last very long; with carelessness, they are injured immediately. When the coating on their surface is chipped or cracked, they cannot be very long serviceable. Every day's use and cleaning requisite thereon increases the peeling off of the injured surface.

SECT. IV.—CLEANSING KITCHEN UTENSILS OF METAL, ETC.

1677. In country places, where brick ovens used for baking bread are usually heated with wood fuel, the *wood ashes* may be procured, and answer the end of removing the grease from the inside surface of saucepans in which animal substances have been cooked; or a weak solution of potash, boiled in saucepans that require cleansing, will render hard scouring unnecessary, which is sure to wear off the tinning.

In Book V., "On the Materials of Household Furniture," we have shown the nature of *tin plate*, of which saucepans are formed, and the great injury they suffer by being frequently scoured with sand, which wears off the tinning rapidly, exposes the iron foundation, and causes the rust to eat it in holes. When any scouring is requisite, some soft powder should be used, as that of Bath brick and whiting, and sand as little as possible. Saucepans, after being cleaned, should be well dried by the fire before being put away, and the shelves on which they are put should be in a dry part of the offices. If iron saucepans and kettles remain long in a damp place, they will be spoiled by rust; if copper, by verdigris.

1678. *The corrosion on copper*, called *verdigris*, must be removed, in the first instance, by the application of sulphuric acid (oil of vitriol), and afterward by that of whiting rubbed on with a flannel; copper saucepans tinned should always be carefully examined before they are used. If the tinning of a saucepan be worn away and verdigris formed on the copper beneath, it is unsafe to use it for any purpose whatever, until it has been re-tinned; there having been fatal instances of poison unintentionally given to whole parties at a time, through food cooked in copper vessels from which the tinning had been worn off, and the verdigris formed on the uncovered copper.

1679. *Tea-kettles* should be well rinsed out every morning before they are filled with water. This rinsing is needful to clear away sediment the water in boiling may leave; but the incrustation formed by chemical action within the kettle on every side cannot easily be removed.

1680. The outside of metallic kitchen utensils kitchen-maids pride themselves often on keeping highly polished. That they are bright to look upon is very agreeable, especially as it may be inferred that the inside of the vessels corresponds in cleanliness with that of their exterior. But this pride will be carried too far, if it cause the metal to be worn off with needless rubbing, or retard, by the time it occupies, more important business in the kitchen. The soot adhering to the back and sides of kettles and saucepans ought to be brushed or scraped off, and the fronts, lids, and spouts polished daily; but to polish the whole exterior surface of vessels daily used over smoky fires would be waste of time.

1681. *The outside of copper coal-skuttles* are best cleaned with a polishing paste bought at the oil shops in London, and similar to the composition with which the brass-work on harnesses and carriages is cleaned. The same composition may be easily made of one ounce of spirits of hartshorn, half a pint of vinegar, one ounce of rotten-stone, and one ounce of soft soap. The soap and rotten-stone are to be mixed first together; the vinegar and hartshorn must be afterward added.

1682. *Iron coal hods* may be occasionally done over with a black varnish, which may be purchased at the oil shops, and which will make them last twice as long.

1683. *Steel knives and forks* are cleaned on either ash or deal boards, and sometimes with boards covered with buck leather, as being less likely to wear away the steel of the articles rubbed on them. The leather which covers knife-boards should be prepared by having a coating of mutton fat melted and laid on it with a piece of flannel. The dust of a Flanders brick is then sprinkled over the leather and rubbed well in; and the grease, when a knife is passed over it, ceasing to come through, is the test of the leather being fit for use.

1684. *An uncovered board* should have very little brickdust sprickled over it at once, lest, in rubbing the knives over it, distinct and visible scratches should be given to them. Knife-cleaning is, in fact, done by scratching the surface, but in so fine, regular, and uniform a manner as to brighten the whole surface.

1685. *The height* of the knife-board is another point to be noticed. It should be such as to allow the cleaner to incline his body towards it. Holding a knife in each hand—their backs towards each other—the cleaner should stand in front of the board, and, laying each blade flat upon it, he should bear equally on both, and rub them backward and forward, first on one side and then on the other, until a clean bright surface be restored to each. It is easier to clean two together than one alone. To give a good edge to the knives, the cleaner must scarcely let the blades touch the boards while he expands his arms, but must bear upon them more forcibly in drawing them together again. The edge given by this mode is better than that brought by the steel sharpener.

1686. *Forks* are quickly cleaned by running the prongs several times into a tub filled with a mixture of gravel, brickdust, or sand and hay or moss, kept a little damp and pressed firmly down. When clean, the prongs will require polishing with a thin bit of stick shaped like a knife and covered with leather. Knife-boards are often spoiled by the backs of knives and forks being cleaned upon them. This might be prevented, if a thong of buck leather were nailed at one end of the board, and the loose end held in the hand while the forks were rubbed up and down until perfectly clean and polished. It is also desirable to have a thick square brush nailed to the board, over which both knives and forks are passed, in order to remove the dust partly from them, but which must be more effectually done by the use of the knife-cloth.

1687. *In some houses lathes* are used for cleaning knives, by which, in ten minutes, as many may be done as would in the common way occupy the cleaner for one hour; but the advantage of celerity is counterbalanced by the injury done to the blades, which, in one year, will be as much worn away as knives that had been in use for many years, and cleaned in the usual way.

1688. When knives and forks have been cleaned, either on the board or by the lathe, they must be wiped free from the brickdust with the knife-cloth. The handles of knives and forks require attention, few things being more disagreeable than to feel the handles gritty or greasy.

1689. *Ivory handles* should be washed with a bit of sponge dipped in soap and water, or with a little spirits of wine and water; when a red wine or a fruit stain shows itself on the handles, it may be scraped off with a sharp knife without injuring the haft.

1690. *Silver and plated handles* are cleaned like other plate and plated wares.

1691. *Ebony hafts* should be cleaned with a little Florence oil, carefully wiped off.

1692. Knives and forks always, after being used, should have the blades and prongs dipped in warm water, to wash away whatever may adhere to them; afterward they must be wiped very dry and put into the box to be most thoroughly cleared on the board.

SECT. V.—CLEANLINESS, A MEANS OF EXEMPTION FROM TROUBLESOME INSECTS.

1693. Cleanliness, undoubtedly, can effect, better than any other means, the destruction of, and freedom from, those insects which nature leads to harbour in houses, and in the vicinity of beds. Such insects, in their first state of existence, are nourished by the dust which collects in the downy fabric of woollen articles especially. In the fur of the cat, and hairy skin of the dog, they also find the warmth and nutriment which brings them to maturity.

SUBSECT. 1.—*Fleas and Bugs.*

1694. *Of the flea*, one of the most annoying of such invaders of domestic comfort, particularly where children are inmates, it has been said that to destroy one in the month of March is to exempt a house of a hundred. The greatest security is that of keeping rooms as free from dust as it is possible.

Carpets, blankets, and everything manufactured from wool, should be so well attended to as to prevent any accumulation of dust from settling in them. The flea seeks to lay its eggs wherever dust and down are combined, for in them consist the nourishment nature has ordained for its offspring.

1695. The blankets used in the cribs and beds of children should, for this reason, be daily shaken, and, weather permitting, hung before an open window, that the air may pass through and clear from dust their loosely-woven fabrics.

1696. The vicinity of dog kennels and pigeon cotes are among the causes of the rapid production of fleas in some houses. Children, in particular, suffer from the inflammation and consequent irritation caused by flea-bites. Hence it should be a particular object to prevent its infesting the nursery. Many recipes for this purpose have been circulated, but none appear to be entirely successful.

1697. *A lump of camphor* left in the ewers whence the water is taken in which children are washed, and in which portions of the camphor are dissolved gradually in the water, it is said, renders the skin washed in it obnoxious to the flea; but this is very doubtful.

1698. *The bug* is chiefly found in large towns. It is a more formidable enemy than the flea, because it evades detection by the most rigid concealment during the day, emerging only at night from its dark lurking-places.

If not infesting the wood-work of old houses, or the cracks of the plaster-work, still it may be brought into our dwellings by many different channels. Sometimes bugs have been introduced between the leaves of old books; in wicker-baskets, which they are said peculiarly to affect; in servants' trunks; and even in the folds of fresh-washed linen from the laundress's house. Hence, in London, how *to prevent* their increase, as well as *to remedy* the evil entirely, is sometimes difficult.

1699. Prevention of the increase both of bug and flea in houses is mainly in the hands of housemaids. Let them carefully practise the cleanly arts of their department, and they will, with more certainty, effect the limitation, even to extermination, of this foe to personal comfort, than by the use of corrosive sublimate, or than that of any other kind of poison. The ground upon which cleanliness proves so effectual in checking the increase of the flea has been shown in a foregoing paragraph. It may be well to point out how similar effects may spring from the same cause.

1700. *As the bug* lives, it is said, only a year, the preventive means should be principally applied to check its amazing increase each year by destroying the eggs. These are deposited, generally, in scarcely-visible cracks and holes in the wood work of bedsteads and skirting-boards. There they might remain until the proper period should arrive for the commencement of their warfare on the human species. The great object of the housemaid must be to displace and wash away these embryo torments, and this, with her *scouring brush* and *cold soap and water*, she may very materially effect. The bristles of her brush will enter where no larger implement could, and detach them from the places where they adhere. If housemaids once in the week during the summer were to scrub with their brushes and cold water all the wood-work of each bed, and to carry the wet mop or scouring flannel under the beds daily and by the skirting-board, the increase of this odious insect would be prevented, especially if the bedding and hangings were also frequently cleared of dust by brushing or shaking them out in the open air.

1701. *Bedsteads much infested* should be taken to pieces twice a year, in the spring and autumn, and the joints and head-board should be well scrubbed with the scrubbing brush. For those who doubt this truth, are subjoined such recipes as have been adopted in some houses, and which for a short time may have checked the evil in them.

1702. 1. *Tar-water* washed over the wood-work of bedsteads. 2. *A solution of potash* also applied to the frame-work of bedsteads. 3. *A paste* composed of Scotch snuff and soft soap, to be inserted within the joints or cracks in the wooden parts of bedsteads. 4. *Bug poison:* spirits of wine, half pint; spirits of turpentine, half pint; crude sal-ammoniac, 1 oz.; corrosive sublimate, 1 oz.; camphor, 1 oz. This mixture should be inserted into the joints of bedsteads with a syringe, and with a sponge fastened to a stick; every other part of the wood-work must be washed with it.

1703. Spirits of turpentine also kills the insects, though it is more volatile, and therefore less preventive and secure than the former recipe.

1704. *Many poisons are to be purchased* at chemists for the destruction of bugs; but it is unpleasant, if not dangerous, to have such mixtures in a house; and with confidence we may assert that they are all far less effectual than the frequent application of the scouring brush and cold soap and water to the bedsteads, and daily searching habits of cleanliness in respect to the other parts of the bed furniture.

1705. We will add the following precautionary hints: *The heads of all bedsteads* should stand a few inches away from the walls. If there be any cracks in the paper behind the bed's head, they should be carefully pasted over with fresh paper; or, if the paper become loose from the wall, that also should be again closed fast. Bugs often harbour in plaster work; but, unless the paper be broken or loose, they cannot find their way through it. If it be suspected that the enemy is secreted under the skirting-board, it may be blocked up by pasting, or by glueing strong brown paper over the chink between the skirting-board and the floor.

SUBSECT. 2.—*The Moth.*

1706. *The moth* is a petty, yet formidable enemy in a house. In all woollen manufactures, *blankets*, *flannels*, *moreen curtains*, *carpets*, as well as in furs, and amid feathers, it seeks to form its nest and to deposite its eggs; whence in the spring of the year issue the larvæ which from such substances derive nourishment. In this stage of the insect's existence the ruin takes place of the fabrics upon which it feeds. This is visible in the innumerable small circular holes through which it has eaten, and which, destroying the strength and tenacity of the material, render it worthless.

Many persons suppose that *moths are produced* in clothes that are laid by, merely by their being shut up in closed places; but this is an error. None of the little larvæ or caterpillars of the moth, that really do the mischief, ever appear among clothes or articles of any kind, provided none of the winged moths can have access to them to lay their eggs there, for no insects can be engendered otherwise than by the usual method of propagation. The moth is an insect that, like all other winged insects, goes through three transformations. *The winged moth*, that flies about in the dark, *does not, cannot eat or destroy cloth of any kind;* but it lays its eggs in woollen articles, upon which alone nature dictates to her that her young must feed. These eggs, in time, produce little *caterpillars*, and it *is they that eat holes in and destroy clothes*, &c. After a time these caterpillars assume the pupa state, out of which burst forth the winged insect, to proceed, as before described, in laying eggs. From this account it is easy to see that, provided you can prevent the winged moth from having access to what you wish to preserve, no injury by moths can happen to them. For instance, if you tie up any article that is quite free from moths in a bag of linen, cotton, or paper, no winged moth can enter the bag to lay its eggs, and therefore the bag will be a perfect security. But it is to be observed, the winged animal is very cunning, or, rather, instinct impels it to search with great care for suitable places to lay its eggs; and therefore simply putting things into drawers, however tight, or covering them over with paper, will not be sufficient; if there are chinks by which the winged animal can insinuate itself, such places will not be safe from moths.

Nature has likewise given the instinct to moths, not to lay their eggs in places liable to be often disturbed; therefore, if you shake any articles very frequently, it is not likely that moths will deposite their eggs there; and if not, there can be no caterpillars to do mischief. These facts being clearly understood, the means of guarding against these destructive insects will be comparatively easy. Should any articles of wool appear to be beginning to be attacked by moths, beating and brushing should be resorted to, and, if possible, they should be put into hot water to destroy the young larvæ. It sometimes happens that, on discovering the *winged moth* in some places, they are driven out to fly about, when they resort to some other part of the house where they will be more safe. This must, if possible, be prevented; otherwise they will continue to propagate somewhere, and the breed will be kept up. Even if driven out of the house, they have been known to enter again at the windows.

1707. *Curtains of moreen or cloth*, when taken from the windows for the summer season, should be well cleansed (by brushing and shaking in the open air) from every particle of dust, and then folded and enclosed in strong unfractured linen, or brown holland wrappers, and laid away in some dry airy room or closet. If the moth have not previously deposited its mischievous embryo, the curtains so enveloped may be considered as safe, without farther notice, for the summer. But if any doubt be entertained on this point, it will be requisite to open the envelopes once or twice during the three or four months of the summer, and to take out and shake well in the open air, if the weather be dry, the curtains or other articles enclosed.

1708. *It is said that the cloth moth* declines as a receptacle for its eggs any spot in which it can detect the odour of the wood of the *cedar*, or of *camphor, Russia leather, black peppercorns*, and *the tallow of a rush-light.* It is, therefore, very usual to infold woollens and furs with one or other of these supposed specifics. But it is a fact that furriers adopt no other means of saving their stores of furs from the moth than that of frequently shaking each article in the open air and in the sun.

Subsect. 3.—*The House Fly.*

1709. *The common house fly* it would be vain to attempt to exclude from our houses entirely. Wherever there are food and warmth, there will they find entrance. The only remedy for the injuries they inflict on clean paint-work and whitewash, or on the cook's bright dish covers, is to wash and clean them as often as the spots become very apparent, and to cover over such articles as do not admit of being so cleansed.

Kitchens are the favourite resort of the common fly. In these a *fly trap*, as it is called, may be used to attract the fly to settle upon it rather than upon the walls or ceiling. Flies seem to incline to settle more on suspended objects than on any other; and thence the use of "the fly trap," which is usually formed of papers of various colours cut out fancifully, in order to render them somewhat ornamental as well as useful.

Fly poison is to be procured from chemists; but there seems little advantage to be derived from its use, as it attracts more flies into a house than it destroys. All are not alike tempted to taste of it. Quassia and sugar, with a little water, set about a kitchen in saucers, is a poison for flies, and not for human beings, and may therefore be safely used.

Subsect. 4.—*Mice and Rats.*

1710. *Mice and rats* are animals well known, and against which our best defence is the cat. In the absence of a good mouser, traps are employed, of which various kinds are sold in the shops. As neither mice nor rats can harbour where there are no holes for them to take refuge in, great care should be taken to stop up all such where they are discovered; to a neglect of this may be attributed frequent visits from these animals that might have been avoided. Holes in brickwork should be stopped with Parker's cement. As both mice and rats will gnaw wood, they will often make entrances for themselves into places where provisions are kept; as soon as any of these are discovered the carpenter or bricklayer should be sent for. We object to the employment of poisonous substances for destroying these vermin, on account of the fatal accidents that have been known to result from their incautious use. Rats frequently come from the drains, but the use of proper drain traps prevents this. (See Book I.)

BOOK VII.

ON FOOD.

CHAPTER I.

NUTRITION CONSIDERED PHYSIOLOGICALLY AND CHEMICALLY.

SECT. I.—GENERAL OBSERVATIONS.

1711. *The preservation of health depends so much upon a judicious selection of food, as well as on the modes of preparing it,* that we do not consider it necessary to offer any apology for soliciting the attention of our readers to a more than ordinary consideration of this subject. The general diffusion of knowledge, and its application to the ordinary purposes of life, are daily presenting various subjects under points of view hitherto neglected, and we are desirous of treating this branch of domestic economy in a manner commensurate with the advanced state of education. We feel the more anxious on this point, since, although it is one capable of exciting universal interest, yet sound and accurate knowledge of what may be denominated the philosophy of food, has hitherto been limited to a narrow circle, scarcely extending beyond the sphere of medical practitioners.

1712. *It is only by resorting to the sciences of physiology and chemistry* in aid of experience that the subject of food can be successfully investigated. The first makes us acquainted with the anatomical structure of the animal frame, and the nature of those functions upon which nutrition depends. The second teaches what are the component parts of the various substances usually employed as nutriment, and enables us to perceive substantial reasons why one species of food is preferable to another. Unless the subject be viewed in a scientific manner, it is impossible to acquire any other than the most vague notions respecting it, nor to possess the means of distinguishing, among the thousands of opinions afloat, such as have just pretensions to our confidence from those which are founded in error.

1713. *It may be imagined that thus to clothe our subject in a scientific garb* is only to render obscure that which might be made sufficiently intelligible without it. A sort of ridicule has sometimes been attempted to be thrown upon the employment of what are called learned terms in treating of the affairs of common life; and this may be just when they are used unnecessarily, or when they are carried to excess; but it is possible to pursue a medium course; we must have precise and accurate terms to express precise and accurate ideas. In employing such expressions, therefore, as are constantly used by all men of science, we are guilty of no affectation, but are influenced by the same necessity which they feel, not being able to convey our ideas without them. It is not, therefore, the employment of scientific terms that is ridiculous, but the using them when ordinary phrases would do just as well. This fault we shall endeavour to avoid.

1714. *It may likewise be objected,* that it is unreasonable to expect that those who are principally engaged in the preparation of food should, with their limited education, understand scientific descriptions. Our reply to this must be, that we expect no impossibilities; and if our readers were to consist of none but the ordinary operators in the kitchen, we should adopt a different mode. But at present we are supposed to address ourselves to persons of superior intelligence, and whose education qualifies them for comprehending what we have to say; at the same time expressing our conviction that, when the proper means shall be employed, there is nothing in the subject which may not be made intelligible to every ordinary capacity. Let not our readers, therefore, be alarmed at our presenting the various facts which we are desirous of teaching in what they may, perhaps, consider as a formal mode, for they will find that nothing is more simple than the manner in which we propose to explain them, and that to follow us satisfactorily will require only moderate attention.

1715. *We may add farther, that this subject is more important to various classes than is generally imagined.* Those who reside in large cities may be surrounded by plenty of every description, where well-supplied markets offer without any trouble the choice of all that can be produced, in abundance and variety almost perplexing; but it should be considered that many persons may be placed in situations very different, where some knowledge of the principles upon which the nutritious properties of various substances depend may prove highly important. The navigator, in long voyages, has often the opportunity of applying such information to the most valuable uses; and superior science may, with respect to food, as well as in many other cases, prove the safety of a crew. To the soldier and the traveller, likewise, who encounter many hardships, this kind of knowledge comes into play with advantage; and it has been remarked that the success of a battle has sometimes, in a great measure, depended upon a good meal. In short, it is easy to imagine a thousand situations in life where some acquaintance with the varieties of food, as well as the modes of preparing it, may prove of great utility to individuals who never expected to stand in want of such information. Nor is the subject more unworthy of the political than the domestic economist. A scarcity of food of various descriptions, even in such a country as this, has sometimes occurred; and to possess the means of improving and preserving it, or finding substitutes for articles of such necessity, it is essential to comprehend clearly their actual nature and properties.

SECT. II.—MANNER IN WHICH NUTRITION IS PERFORMED.

1716. *It appears to be a part of the system of our animal economy* that we experience a daily waste in all the various organs, which therefore require to be continually recruited by a supply of fresh materials. Of this waste, and the change that is consequent upon it, we are not, at first, sensible ; and few persons are aware of its being so considerable, that perhaps not a single portion of our bodies consists of the same substance that composed it only a few years before. It is to supply this continual decay that nature has given us an instinctive craving for food ; and it is the conversion of our aliment into materials calculated to repair the loss which we sustain that constitutes nutrition.

1717. *It is well known that all the substances received into the stomach with this view undergo certain chemical changes*, the whole of which is designated by the term *digestion*, of which we feel it necessary here to give a very brief sketch in order to render our subsequent observations intelligible.

In the first place, then, from the internal surface of the stomach there is secreted a peculiar fluid, called the *gastric juice*, to the action of which all the food which we take is submitted. This liquid differs from every other known fluid, but is said to consist of water, gastric mucus, and hydrochloric acid; it possesses so great a solvent power, that it reduces every species of aliment to a uniform and homogeneous paste, of a grayish colour, called *chyme*, in which the previous texture or nature of the food can no longer be distinguished. The chyme passes into the other digestive organs, where it meets with other secretions, called the *bile*, *pancreatic juice*, &c., by which it is farther altered into a milky-looking fluid named *chyle*. This is taken up by numerous minute vessels, called *lacteals* ; and, after undergoing processes which it is not necessary here to follow more minutely, is at last conveyed into the blood, with which it finally unites, and which, circulating through every part of the system, carries the necessary materials for the renovation which we have mentioned.

1718. *Nutrition, then, consists* in the successful conversion of our food, whether animal or vegetable, first into the substance named chyme, then that into chyle, and the farther change of this into blood as the renovator of the system ; and the perfection of the several processes by which this is effected depends upon the nature of the food, and the proper action of the digestive organs.

SECT. III.—CHEMICAL PRINCIPLES OF WHICH FOOD CONSISTS.

Having now treated concisely of the physiological part of our subject, we proceed to point out the correspondence between the chemical composition of the only substances fit for food and that of our corporeal frame, in consequence of which the former is enabled ultimately to become a part of ourselves.

1719. *Although the number of different substances which we find in nature* seems almost infinite, yet chemists have shown that the whole of them, whether animal, vegetable, or mineral, are composed of a very limited number of ingredients or principles. The substances which we usually meet with are compounds; and chemistry is an art by which a compound can be separated into the elementary bodies of which it consists. When the vast variety of natural substances are analyzed by the chemist, it is found that they are composed of only fifty-four elementary ingredients, each substance that we meet with containing two, three, four, or more, of these ingredients or principles united together; and since these ingredients cannot, by any known means, be farther separated into other materials, they are called the *simple or elementary substances.*

1720. *Formerly, it was supposed the elements of which all bodies consist were only four*, air, earth, fire, and water—an opinion which is stated in many books still to be met with: but this doctrine is now known to be erroneous ; three of them, air, earth, and water, being themselves compounds. We shall not here enumerate all the simple elements ; those who are not already acquainted with them may refer to any late work on chemistry. We propose at present to speak only of those which are necessary to our immediate purpose, namely, *carbon*, *oxygen*, *hydrogen*, and *nitrogen*. A few others will be mentioned afterward.

1721. *It is considered that there is no such thing as a conversion, either by nature or art, of any one of these elements into another.* They are, as far as we know, formed originally quite distinct, as gold is from silver or from copper, and, as these may be mixed or alloyed, and separated again, but cannot be changed one into the other, so, in like manner, when there is a compound of carbon, oxygen, and hydrogen, the chemist can detach these elementary principles from each other, and he can make new compounds by combining them again in different proportions; but he cannot alter the nature of the elements themselves; they are permanent, at least as far as is known, and he cannot change them in the slightest degree. Neither are any of the elements better or worse; they are never known to be imperfect; there cannot be carbon nor oxygen of different qualities; they can appear only to vary from having a slight admixture of other substances. This absolutely invariable nature of the elements it is necessary to keep constantly in mind.

1722. *Now all animal and vegetable substances whatever, including those of our corporeal frame, are composed or made up chiefly of the four elements* which we have enumerated, namely, carbon, oxygen, hydrogen, and nitrogen. They likewise contain a few other elements in very minute quantity, but we may omit the mention of them at present.

1723. *The element called carbon*, though it enters into the composition of every animal and vegetable substance, cannot be presented in a perfectly pure state, insulated or freed from all its combinations, except in the diamond, which is supposed to be elementary carbon crystallized.

Charcoal, the well-known black substance which remains after an animal or vegetable body has been burned, is the nearest to the pure state in which we familiarly see this element. We may here observe, that it is a common expression, "such a substance is burned to a coal, or to a cinder," and the vulgar idea is, that the substance has been *converted into charcoal or cinder* by burning. This, however, is not the fact; there is here no conversion; the carbon of the cinder or charcoal existed in the flesh or vegetable originally, but was so combined with the other principles, that its presence could not be perceived or even suspected, either by colour or any other circumstance. The act of burning has merely driven off into vapour the other elements, the oxygen, hydrogen, and nitrogen; and the charcoal, being less volatile, remains. This fact is quite obvious in the charcoal of wood, in which the organic structure of a branch is distinctly to be traced. The process of burning has, in fact, only effected the separation of the elements from each other; and then the body is said to be *decomposed*. But charcoal is never pure carbon; it always contains a small proportion of other substances; this vegetable charcoal has about 3 per cent., or more, of various earths, together with about 10 per cent. of water and other volatile matter. Animal charcoal, obtained by reducing bones to the substance called *bone black*, contains only 10 per cent. of carbon. The various properties of charcoal will be described when we consider it as fuel.

1724. *Hydrogen*, another of these elements, is best understood by calling it, as it used to be, inflammable air or gas; the gas burned for light consists of this combined with a little carbon. Although hydrogen exists in the solid state, as an ingredient in a great variety of substances, it cannot be detached and exhibited in this state; we can procure it separately in the form of gas only. It is one of the constituents of water.

1725. *Oxygen* exists also in animal and vegetable bodies in a solid state, though neither it, nor hydrogen, nor nitrogen can be separated as solids. Pure oxygen can only be procured, or made to appear in a distinct form, as oxygen gas; this was formerly called *vital air*, because it is that component part of common atmospheric air which alone supports life in respiration; this has been explained in the chapter "On Ventilation." Oxygen is the other constituent of water.

1726. *Nitrogen* is likewise solid in all animal substances, the fleshy fibre, albumen, and the caseine of milk, and also enters, though rarely, into the composition of vegetables. When separate it forms nitrogen gas, one of the components of the atmosphere. Some are of opinion that we may derive a portion of nitrogen from the air which we breathe, as well as from our food. The air of the atmosphere is composed of oxygen and nitrogen.

1727. *We have stated that the elementary principles of which the whole human frame and that of all animals consists* are chiefly those four which we have just described. This being the case, it is obvious that, to repair any loss of substance to which we may be liable, it must be necessary to find some materials composed of the same ingredients or elements as ourselves, and that these alone can constitute food or aliment. Since all animal substances consist of the same elements, though in proportions slightly different, every species of flesh contains the materials for nutriment. The carbon, hydrogen, oxygen, and nitrogen of which they consist may be made to supply any loss of those principles which we daily suffer, by using them as food. In like manner, vegetables may answer the same purpose, because they consist of the same elements, the nitrogen, however, being in much smaller quantity. Thus no substances can ever support life except they contain the elementary principles we have enumerated; and all such, if in an organized state, that is to say, in the condition of animal or vegetable bodies, may compose food under some management or other. Farther, the substance of vegetables and of brute animals are the only bodies in nature, except ourselves, which are composed of these four elements; and thence we see the reason why mineral substances, such as stones and metals, which consist of elements very different, cannot by any means constitute nutriment nor support life.

1728. *From this statement* we easily perceive how important, and, indeed, necessary, is the science of chemistry; since it is by its assistance only that we can determine accurately what class of substances is capable of being converted into nutriment, and what it is impossible we can employ in this manner; and it must be necessary to insist upon the value of that knowledge by which we distinguish, in the most correct manner, the substances *by which alone* life can be sustained.

1729. *It may be said that the experience of ages has apparently rendered this study very little necessary.* Mankind universally understand that animals and plants may supply them with food, and that they cannot extract nourishment from rocks and stones. Nevertheless, it is well known that the arts of civilized life have enabled man to multiply, in an extraordinary degree, the means of subsistence which he possessed in the savage state, when wild fruits, herbs, and roots, the natural produce of the soil, together with the flesh of such animals as were taken in hunting, were his sole support; and we know how scanty and precarious is the supply of these in most parts of the world. Some countries, as Australia, naturally produce few animals, and scarcely any vegetable food fit for the support of life. The result of this uncertainty with regard to the means of subsistence is, that tribes who have no other resource can have no fixed settlement, but roam about in search of some kind of food; among these, under such circumstances, civilization has made no progress, but they remain to-day as they probably were thousands of years ago. It would appear that the first step towards civilized life was the domestication of animals, and the raising of vegetables by cultivation. We all know the advantages which we derive from flocks and herds of cattle; but the astonishing changes and improvement produced in the vegetable kingdom by the ingenuity and industry of man can only be seen by studying the history of our culinary vegetables, many notices of which will be found when we describe the various kinds.

But not only has the gardener and agriculturist contributed largely to the improvement of mankind, by increasing his food, but chemistry has also afforded valuable assistance. Not to dwell upon an infinity of processes by which various alimentary substances have been improved, and are daily improving, through its means, we shall mention some extraordinary instances of the power of chemical science in its present advanced state. From dry bones, formerly considered useless as human food, a large quantity of wholesome aliment is now extracted by a chemical process. But the late discoveries of Braconnot and others are so wonderful that, were they not well authenticated, incredulity respecting them might well be excused. Even common sawdust has, by a very simple process, through the means of sulphuric acid and a little chalk, been converted into a substance closely resembling gum arabic; and this, by another process, has been changed into sugar. In a similar manner, gum and sugar may be made from hemp, flax, and, what is the same thing, linen rags and old ropes. Now, sugar and gum are substances that, to a certain extent, may be employed as food; and thus may dry and otherwise indigestible wood be converted into nutriment. It must be observed that this is not an extraction of sugar and gum from wood, but an actual formation of these substances during the process made use of. This may at first appear to be an extravagant case; but when the reader has studied what we shall have to say respecting the processes of fermentation, he will begin to perceive that these are merely a few of the interesting changes which are the result of natural powers, and which chemistry alone discovers and explains. The fact is, that the substances which we have just mentioned, namely, gum and sugar, are compounds, and consist of the same elements, carbon, hydrogen, and oxygen, though in different proportions; and very slight circumstances are sufficient to bring about such a change in the proportions of the elements necessary to form these different substances as to convert one into another. It is not pretended that science is yet able to turn such curious facts to much practical account, and to extract useful nourishment from every vegetable material; although we may add that sugar is actually manufactured in some places from starch, which is a similar conversion. The instances we have mentioned are rather for the purpose of illustration; but it is evident that by such discoveries a wide field is opened for research, and farther experiments may lead to more important results. Of this, at least, we are certain, that they will make us better acquainted with the nature and properties of the materials which we already possess, and enable us to select, upon principle, those which have the best claim to our preference.

SECT. IV.—ON THE CHEMICAL DIFFERENCE BETWEEN ANIMAL AND VEGETABLE SUBSTANCES, CONSIDERED WITH RELATION TO THEIR USE AS FOOD.

1730. No two classes can offer a stronger contrast than the two great divisions of organic bodies, animals and vegetables. It is well known that the substances of which they are composed have very different properties when employed as food, and it will be interesting to inquire whether chemistry can point out any marked difference in their constituent or elementary principles. We have already stated that both these classes are composed of the same elements, though not in the same proportions. One striking difference between them is, that nitrogen is scarcely ever absent in animal bodies, although it is rare in vegetables; it does occur, however, in certain parts of the latter, as well as largely in the mushroom tribe, and also in wheat; and when this is the case, such vegetables approach somewhat more nearly than the others to the character of animal bodies. Thus, to repeat what we have said, animal substances, in general, consist of carbon, hydrogen, oxygen, and nitrogen; and vegetables consist of carbon, hydrogen, and oxygen, rarely with nitrogen. This simplicity of composition, and both classes being formed nearly of the same elements, is the reason why one class can serve as nutriment for the other upon the principle which we have already explained. Many animals subsist solely upon vegetables, and man is capable of subsisting upon them alone, at least for a time; but he must select such as contain some nitrogen as the most nutritive, to which he adds animal food, which always contains a large proportion.

1731. *Since animal food contains* all the four elements which we have occasion for, nitrogen included, and from this chemical consideration alone, we might suppose that it would afford more powerful nourishment than vegetables, which we know to be the case. In the same manner, likewise, animal bodies, when decomposed, serve, in part, as food for plants, when given in the state of manure. In short, it is easy to perceive that the materials of animals and of vegetables are convertible one into the other by nature, both consisting of the same elements.

1732. This view of the subject is extremely useful, as it will guard us against falling into an error not uncommon. Since we stated above that the elementary principles are absolutely uniform and unchangeable in their nature, there cannot be any which are always of an animal, nor others that are always and necessarily of a vegetable nature; but the same particle of oxygen or hydrogen which one day formed part of a vegetable may, at another period, compose a portion of an animal. We perceive, indeed, through all creation, these different applications of the same matter continually taking place. Vegetables are the food of animals, and, being decomposed into their first or elementary principles by digestion, conduce to their nourishment and growth. Animals, in their turn, either serve as the food of a higher class of animals, or, when they die, contribute, by being decomposed and mixed in the soil, in part, to the support of the vegetable tribe.

1733. *Whether man was intended by nature to feed on animals as well as vegetables* is a question that has frequently been agitated. It has been maintained by some that, in the earliest ages, he lived solely upon vegetables, and that his devouring the flesh of animals was the result of degeneracy. His anatomical structure, however, appears to throw light upon this subject. Carnivorous animals are distinguished from the herbivorous class by their teeth and the organs of digestion: the first are formed in each class in a manner suited to the work they have to go through; and the latter, in such animals as feed solely upon vegetables, are of very great length, as their food requires to be detained longer in the stomach, being more difficult of solution. The omnivorous nature of man appears to be pointed out by his having these organs of a form intermediate between the two classes we have just named. In consequence of this, he enjoys a wider range in the power of extracting nutriment from a great variety of substances. Although he cannot live upon dry wood like many insects, nor digest bones like the hyæna, the great variety which he can subsist upon is eminently calculated for adapting him to different climates, and consequently extending his power to every region of the globe.

1734. *With respect to the effect which these two classes of food,* animal and vegetable, have upon his constitution, it is observed that the first is, in general, the most easily assimilated; that is to say, made to combine with and form part of his frame, which we might expect from the consideration that the elements of which it consists resemble more nearly the composition of his own body. And here we cannot help observing how admirably the productions of the earth are suited to the wants of man in different situations. In warm climates vegetable food is the most abundant, and it is also the most appropriate, since the flesh of animals, in large quantities, would form too stimulating a diet, and too much blood would be formed. On the contrary, in the frozen regions of the north, vegetables are rare, and the inhabitants subsist solely upon animal food, a greater stimulus in cold climates being necessary to keep up the requisite warmth of the body. The Esquimaux have no vegetables whatever, subsisting entirely upon fish and flesh. In temperate climates, a judicious mixture of both appears to be most conducive to general health.

1735. *There cannot be a doubt that the influence of food has been one of those causes that have tended to modify the human race*, and that it must always possess the same power. The strength of the body and the constitution generally must be affected by the nature of the substances by which the vital principle is kept in activity; and it is difficult to calculate upon the degree in which the intellect may depend upon physical causes. Considering the animal part of our nature, the various races of mankind must share, with all other living creatures, in those natural effects produced by climate and food, as well as by the habits and customs which depend more upon himself. All the circumstances respecting our domestic economy are therefore important, not merely as regards what have been denominated our *comforts;* but their effects are felt, and may be traced much more extensively; they bear powerfully upon the general well-being and comparative happiness of society, and act, in no small degree, as moral causes.

1736. *In the description we have given* of the chemical principles of which the substances used as food consist, we have hitherto confined ourselves to those four that are by far the principal ones, and which are never absent in animal and vegetable bodies. But besides these, there are several other elementary principles that are found, if not constantly necessary to the composition of the same substances, yet so generally, though in a very small proportion, that they cannot remain unnoticed.

1737. *Phosphorus* exists in the state of phosphoric acid, which is joined to lime, forming phosphate of lime, in all bones; and Dr. Prout states that the use of a minute portion of phosphorus, discovered by analysis in the yolk of egg, is to supply this element to the bones of the young chick. Phosphorus is likewise found in various parts of animal bodies, and particularly in fish. It occurs also in many vegetables.

1738. *Sulphur* is found in both animals and vegetables, though in minute proportions. It is manifest in the eggs by the blackening of a silver spoon; and the sulphuretted hydrogen, disengaged from putrefying animal matter, proves the original existence of sulphur in them.

1739. *Chlorine* is one of the ingredients of common salt, which is compounded of *chlorine* and *sodium;* both these elements are taken with our food, and it is thought are partly retained, particularly in the blood.

1740. *Potassium,* or the base of potash, must likewise be, in a small degree, a constituent of many animal bodies, and exists in considerable quantity in vegetables, as will be explained in the chapter "On the Laundry."

1741. *Lime,* which is an oxyde of calcium, forms, with phosphorus, the framework of bones, and, for this purpose, must be supplied by our food, in which it exists in very minute quantities.

1742. *Iron.* A minute quantity of this metal, in the state of oxyde, is detected in most animal and vegetable substances upon an accurate analysis; hence it enters into our food.

1743. *Water* is not itself an element, but is composed of hydrogen and oxygen chemically combined. It is essential to all the living functions, and constitutes a large portion of the substance of living bodies, as well as of their food and drink. Water exists in animals and vegetables, not only in its ordinary moist state, but likewise so united to other substances as to lose its usual properties. For instance, sugar and gum consist of carbon united to the elements of water, and yet these are solids from which the water cannot be separated without decomposing the whole; and the same is the case with respect to many other substances. But water in its moist state is necessary to many of the component parts in the animal economy, as the blood, the gastric juice, and all the secretions; water forms, perhaps, the natural drink of all animals, being necessary to supply the waste of this principle. As the blood contains 80 per cent. of water, and the flesh about 75 per cent., it has been calculated that of the entire human body three fourths of its weight consist of water. For the properties of various kinds of water, see Book VIII., Chap. I., "On Water."

CHAPTER II.

OF ANIMAL FOOD.

SECT. I.—GENERAL OBSERVATIONS.

1744. Our object in the following pages will be to give a popular, and, in some degree, a chemical description of all the various substances generally employed in this kingdom as food. As our intention in introducing the reader to the subject of chemistry is at present merely to enable him to *understand clearly* the nature of the several materials which are employed in the culinary art (and which, without *some little* knowledge of chemistry, we contend is impossible), we shall confine ourselves strictly to so much of that science as we consider essentially necessary. Although we do not hesitate to believe that excellent dishes are every day prepared and enjoyed by many persons who have no wish to enter into our subject in the way we propose, yet we cannot doubt that there are also many who are desirous of having a more enlarged view than is usually entertained of the nature of food, and that this species of knowledge will be found not only entertaining, but of real value.

1745. *We shall not here enter into the classification of animals adopted by naturalists.* Those who are desirous of understanding this may consult works on natural history. Our object being solely to treat of such animals as are employed among us for food, we shall only observe that they may be considered as divided into, 1, land quadrupeds; 2, birds; 3, fishes, including the crustaceous inhabitants of the sea; 4, reptiles; 5, insects.

1746. *As a general law, almost all animal substances may be safely eaten;* some are said to be poisonous, but these are confined to a few fish and insect tribes—animals that are among the lowest in the scale of organization. It is not difficult to give substantial reasons for our preference of particular animals as food; yet the accounts of travellers supply us with much curious information respecting the customs of various nations.

Dr. Johnson has remarked, "It is not very easy to fix the principles upon which mankind have agreed to eat some animals and reject others; and as this principle is not evident, it is not uniform. That which is selected as delicate in one country is by its neighbours abhorred as loathsome. The Neapolitans lately refused to eat potatoes in a famine. An Englishman is not easily persuaded to dine on snails with an Italian, on frogs with a Frenchman, or on horse-flesh with a Tartar. The inhabitants of Skye hold not only eels, but pork and bacon, in abhorrence."

From habits, probably, each nation acquires an artificial taste for what they have been accustomed to in early youth, and food the most disagreeable to one becomes delicious to another.

Legislative enactments, also, have prohibited the use of certain quadrupeds as food; and this has been, through prudential motives, not always easy to trace. Thus, pork was forbidden to the Jews, and in this country we never eat the flesh of the horse; but pork is esteemed by us, while horse-flesh is not only particularly prized by the Tartar nations, but is said not to be despised even by the artificers of a neighbouring kingdom; it is not very palatable, but there is nothing unwholesome in it more than in beef or mutton.

Although the various species of land quadrupeds, and the different parts of them, vary considerably in their flavour and nutritious qualities, yet there is no part of them that may not be safely used as food, and that is not, indeed, occasionally eaten in some parts of the world. The muscles or flesh is, of course, the most important part; but all the rest, the skin, the blood, the fat, and even the entrails, are equally capable of affording wholesome nutriment, where the animals have not been diseased. The bones themselves are not neglected, a considerable portion of them consisting of nutritious matter. With us, the following animals are never eaten, viz., horses, dogs, cats, mice, rats, eagles, vultures, ravens, and some others, yet all of them are used as food in some country or other. In stating these facts, we are not recommending such animals to the palates of our countrymen, our object being merely to explain whether or not they are absolutely unwholesome or injurious. Prejudices, being the result of ignorance, cannot be useful, and their destruction is all we aim at.

Sect. II.—Examination of the various parts of animals with a view to their employment as food.

Subsect. 1.—*General Remarks.*

1747. We do not propose here to enter into a description of the anatomical structure of animals, and we shall consider them as having passed through the operations which render them applicable to the purposes of the culinary art.

1748. *The most obvious practical division of animal substances* which come into the possession of the cook is into, 1, flesh, with the tendons; 2, bone and cartilage; 3, skin; 4, fat of various kinds; 5, blood, to which may be added membrane, brain, shell, horn, hair, and wool. Each of these substances, though belonging to different animals, has certain distinguishing properties by which they are easily recognised and named: thus it is easy to distinguish flesh from bone or fat. At the same time, each of them differs somewhat in the various animals from which they are procured: thus the flesh of the sheep differs from that of the hog, and from beef or the flesh of the ox. Our business, however, at present is not to consider these well-known and obvious distinctions, but to inquire *what is flesh? what is bone?* and *what is fat?* what, in short, is the chemical or actual nature of each of these substances?

1749. *A slight examination will be sufficient to convince us that each of these is not a single substance, but compounded* of several, which are every day separated from each other by the cook without thinking of chemistry or chemical terms. For example, when a piece of meat is boiled, melted fat rises to the surface; when that is skimmed off, and the boiling continued for a length of time till the meat is done to rags, as the cook would say, soup is made; and, if that be concentrated by evaporation by still farther boiling, a jelly will be obtained. The remains of the meat will be a fibrous or stringy mass, almost deprived of fat and juice. Here the meat is separated into fat, jelly, and the fibres of the meat. A similar jelly may also be extracted from bones, but what remains afterward is a hard solid mass, not resolvable into fibres, and very different from meat. If we pursue our examination with respect to all the parts of animals, we shall still obtain fat, the fleshy fibre, jelly, and bony matter not soluble, some parts containing more, and some less, of each of these; and we shall learn to consider all the various parts as made up of the materials we have mentioned, that is to say, that animal substances in general, without regard to the particular parts of the animal, consist of fleshy fibre, fat, jelly, bone, &c. What we have just been doing is, in fact, a separation of animal substances into their component parts; and here we have a division of them much more obvious than that which we considered before, namely, into oxygen, hydrogen, carbon, and nitrogen; the fibre, jelly, fat, &c., being things which we can see and touch, and with which every cook and every person is familiar.

Subsect. 2.—*Proximate Principles.*

1750. *To the well-known substances last mentioned we give the very useful name of the proximate principles of animal bodies,* to distinguish them from those which are termed elementary principles, or elements; and the connexion between these two is this: each of the proximate principles, as, for instance, jelly, is made up, or compounded, of the four elements, carbon, hydrogen, oxygen, and nitrogen, although this fact is not discoverable by any ordinary process of the kitchen. Neither fleshy fibre nor jelly is ever separated by the cook into the elements of which it consists, and for this knowl edge we are indebted to the chemist alone. By his art he is enabled to decompose jelly, fleshy fibre, &c., and to say what elements they are composed of. This kind of chemical examination he calls the *analysis* of the substance, and the process he calls *decomposition,* that is, he decomposes jelly, and finds it to consist of the elements oxygen, hydrogen, carbon, and nitrogen. We are aware that we are now employing terms not in use among those who do not possess a smattering at least of science; but these terms are neither numerous, nor difficult to be understood, and they are coming rapidly into popular use. We trust, however, that the reader will have a little patience with us, and consider what we are saying with attention, and we promise that we will not leave him until the whole has been made as plain as he can desire.

1751. *We will now enumerate the proximate principles of animal bodies under their scientific names.* They are, 1. *Fibrin;* 2. *Gelatin;* 3. *Albumen;* 4. *Oil and Fat;* 5. *Osmazome;* 6. *Casein.* These are the chemical names, which it is best always to employ, without fearing to be considered affected or pedantic. *Fibrin* is the fleshy fibre of meat when it is boiled to rags. *Gelatin* is only another name for animal jelly, but which it is necessary to use for distinction, because there is a very different kind of jelly from fruits. *Albumen* is familiar to every one, being the same thing as white of eggs. *Oil* is well known; and the only stranger is *osmazome*, which we shall describe in its place. Now when we are asked, what is flesh? what is bone? what is skin? we have to consider which of these proximate principles each consists of; and also in what proportions they exist together. We would say, then, that flesh consists of fibrin, gelatin, albumen, oil, and osmazome; in fact, it contains the whole list: but if we are to describe what skin is composed of, we should say that it consists almost wholly of gelatin and fat. We intend this merely as an example, for we shall speak of each of the proximate principles in detail before we proceed farther. Now the reader will no doubt recollect and understand that none of these proximate principles can be simple bodies, because we have several times alluded to their being compounded of our four elements, carbon, xygen, nitrogen, and hydrogen.

1752. *We may farther observe, that the proximate principles of animal bodies are not the same as those of vegetables*; the latter contain no fibrin nor gelatin, but consist of other proximate principles, as gluten, starch, &c. But we propose to treat of animal substances first, and then vegetable substances will follow. Notwithstanding the near approach which vegetable substances make to those of animals in their composition of the simple elements, they differ most essentially in their general properties; and no art can convert the one into the other, nor is it probable that it ever will, because the elements of each have been combined by means of the living principle in a manner of which we have no idea, and which is beyond human means to imitate.

We will now proceed to describe the properties of the proximate principles of animal bodies, and this description must *precede* that of the various parts of animals, namely, flesh, bone, skin, &c., which come into the hands of the cook, because we should not otherwise be understood in describing the nature of these several parts.

1753. *Fibrin.—When a piece of meat is boiled for a long time in water*, the greater part of the soluble part is extracted, and what remains is a stringy matter, which is the fleshy fibre, and is termed *fibrin* by the chemist when obtained quite pure. This forms the basis of the meat, and is the most abundant animal principle. All the red, fleshy part of animals is composed of bundles of these fibres, which are called *muscles*. But by the above-mentioned process, namely, boiling in water, we do not obtain fibrin in a state of perfect purity; for there is still adhering to it a quantity of fat and gelatin. It may be tolerably freed from these by repeated boiling till all the soluble part is extracted. To procure this principle in a state of absolute purity, the flesh must be steeped for fourteen days in cold water, changing the water each day, and squeezing the pieces: if the weather be cold, no putrefaction will take place. After this it must be boiled several times in water, when, at last, it will become quite white, and very little liable to putrefy. When moist, the fibres are somewhat elastic; but when dry, they are brittle, hard, and semi-transparent, like horn. Fibrin is insoluble in spirits, ether, and water, except it be boiled for a long time in the latter, particularly under pressure, and then it is dissolved.

1754. *The red colour of flesh is owing* to the blood dispersed through it in extremely minute veins. When the colour of flesh changes in cooking, it is from the coagulation and change of colour in the blood. When pure fibrin is analyzed, it is found to contain in 100 parts, carbon, 53·36; hydrogen, 7·02; oxygen, 19·68; nitrogen, 19·93.

1755. *Fibrin, when accompanied by gelatin and other principles, as it always is in ordinary boiled meat, is highly nutritive and strengthening;* it is likewise of easy assimilation; but, when deprived of all its gelatin by long boiling, it is rigid, and difficult of solution in the stomach.

1756. *Gelatin.—Gelatin is that part of the meat which, when dissolved and extracted by water, forms a jelly when cold.* Gelatin is found, more or less, in the flesh of all animals, in the form of membranes surrounding the fibres of the muscles, and in bones; the true skin or cutis is composed almost entirely of this principle, the cuticle or scarf skin consisting of albumen. Fine glue may be taken as an example of gelatin. It is procured by dissolving skins by boiling. Pure gelatin or glue, when dry, is colourless, semi-transparent, and nearly tasteless. It is softened by long-continued immersion in cold water: in hot water it readily dissolves, and forms a solution of a slightly milky appearance, which, if sufficiently concentrated, concretes, in cooling, into the colourless mass called *jelly*, and which is easily soluble in water; when this is dried in a gentle heat, it regains its original appearance, and is soluble as before. When once dry, gelatin undergoes no change; but, exposed to the air before it is dried, it soon becomes mouldy, and then putrescent.

1757. *Gelatin does not, properly speaking, combine with oils; but it causes oil to mix with water*, and then forms a kind of emulsion. From this we see the reason why a very weak soup will suffer all the fat to come on the top, but a stronger soup will allow the fat to be united with it. From what has been said, it will readily be seen that the strength of meat soups depends upon the gelatin which they contain: they will be strong or weak in proportion as they contain more or less of this principle. Gelatin has a very strong tendency to gelatinize, or become a stiff jelly: if water contain only a hundredth part of gelatin, it will assume the form of a jelly on cooling; therefore water or soup, having a very small quantity of gelatin, may appear a jelly when cold, a circumstance which is very apt to mislead in judging of the quantity of animal matter contained in soup. The water, in this case, is chemically united with the gelatin, forming a compound that may be termed *hydrate of gelatin.* If this jelly, after being solid, be warmed, the water contained in it dissolves the gelatin, and the whole again becomes fluid.

1758. *Gelatin being dispersed more or less through all parts of animals*, jelly may be extracted from them by boiling; but some parts afford a greater quantity of it than others; and it is obvious that those parts are the fittest for making jellies that are composed wholly, or almost so, of this principle. The flesh of young animals abounds more in gelatin than that of old: as animals advance in age, the gelatin disappears and is replaced by albumen. Veal is therefore preferable to beef for broth, as are also parts where there are ligaments, tendons, &c. In calves' feet the gelatinous matter is abundant: hence calf's-foot jelly. Gelatin is also extracted in large quantity from bones, which consist of this principle, and an insoluble part, which is phosphate of lime.—(See "Bone.")

1759. *Hartshorn jelly* is made from the white part of the stag's horn rasped down and boiled to a jelly. The stag sheds his horns annually about the end of February; when they begin to grow again, they are soft and full of bloodvessels, and are covered with a downy cuticle; but as they increase in size, the blood ceases to flow through the vessels, and the horns become hard and compact. The horns consist of twenty-seven parts of cartilaginous gelatin, the rest being phosphate of lime; so that they resemble bone, and not horns, in general, which consist chiefly of albumen. Hartshorn jelly does not appear to differ from jelly made from other parts of animals. Ivory, which is the tusk of the elephant, is scraped down and used for the same purpose. Several parts of animals yield much gelatin, as calves' feet and heads, cows' heels, sheep's trotters, &c., which are employed in soups and other preparations.

1760. *Portable soups* consist of dried gelatin, and are, in fact, a species of glue made from meat. The gelatin has been dissolved out of meat by boiling, and when dried till it has become hard, it is capable of being preserved, and dissolved again when wanted. The difference, therefore, between portable soup and glue consists merely in the superior quality and cleanness of the animal substances from which the former is prepared. From the insipidity of this principle by itself, portable soups have generally some addition to give flavour. It must be observed, that the jelly we have been considering above is entirely a different substance from the *jelly procured from vegetables*, as currant jelly. In the latter there is no gelatin whatever, and vegetable jellies have not the same nutritive properties as animal jelly. (See "Vegetable Jellies.")

1761. *Isinglass* consists entirely of gelatin, and is the purest variety of this principle: it is a substance prepared from the sounds or swimming-bladders of certain fish, chiefly the sturgeon, which afford the finest kinds. The sounds are cleaned, and the outer coats removed. Like other solid gelatin, it dissolves in boiling water, and becomes a very transparent jelly, that is much used by confectioners for blanc-mange, and other dishes of that kind. The best isinglass is brought from Russia; some of an inferior kind is brought from North and South America, and the East Indies. The several varieties may be had from the wholesale dealers in isinglass in London.

1762. *In choosing isinglass for domestic use*, select that which is whitest, has no unpleasant odour, and which dissolves most readily in water. The inferior kinds are used for fining beer, and similar purposes.

1763. *Jellies were formerly supposed to be particularly nutritive:* at present physicians appear to be of the opinion that they are less so, and even less digestible, than the flesh or muscular parts of animals: still, when acidulated with lemon-juice, and flavoured with wine, they are very proper for some convalescents. In broths and soups gelatin is combined with fat or oil, and it then acquires different properties; but there are various opinions respecting the nutritive and digestible properties of this kind of food.

Gelatin is much disposed to pass into the acid state, and hence it has been supposed to be less completely animalized than the softer parts; for it is one of the characters which distinguish animal from vegetable substances, that the former evolves alkali, and the latter an acid, during their spontaneous decomposition.

1764. *Gelatin is found to contain* from 13 to 7 per cent. of albumen. It yields by chemical analysis, in 100 parts, carbon, 47·881; hydrogen, 7·914; oxygen, 27·207; nitrogen, 16·998.

1765. *A solid gelatin for dietetical use*, in thin plates and strings, has lately appeared in the shops, to be used instead of isinglass, on account of its inferior price. The best is transparent, and is brought from France; it is prepared from the gelatin of bones, by digestion in diluted hydrochloric acid, and long boiling in water Another kind, called Nelson's patent opaque gelatin, is prepared from cuttings of skins, and is therefore a kind of glue. None of these are equal to isinglass in nutritive power and digestibility, properties which, it has been shown, are diminished by long decoction; and the sources from which they are procured are not calculated to recommend them.

1766. *Albumen.—This principle enters into the composition of many of the solid parts, and more largely than any of the other principles into the fluid parts, of animals.* White of eggs is nearly pure albumen with four fifths of water, and may serve to illustrate its properties. This can be beat up with cold water, making *glaire of eggs*, which will dry, if laid on thin, into a hard, transparent substance; but if white of eggs be put into water nearly boiling, it will, as every one knows, coagulate or *set*, as it is called, into a pearl-white substance. In the living animal there is a solid albumen as well as liquid. Liquid albumen exists in great quantity in the serum of blood, where it is held in solution by water, and it may be obtained in an uncoagulated state, like glaire of eggs, by evaporating the clear serum by a heat of 120°. A solid albumen is found in several of the membranes, cartilages, skin, glands, and vessels.

1767. *Though albumen naturally exists as an adhesive fluid, mixible with, and soluble in, water, either cold or warm, yet, when subjected to a temperature of about* 142°, *it experiences a remarkable change in its properties;* it is then converted into a solid no longer capable of being dissolved in water; and if, after coagulation, it be gradually exposed to a higher degree of temperature, it is reduced to a firm, transparent body. When solid, it approaches nearly to the nature of fibrin, and it acquires some flavour by coagulation, for in its liquid state it has little or none. Albuminous liquids have always a little free soda, and the white of egg contains also a small quantity of sulphur, the latter of which is the cause of its blackening a silver spoon. Dr. Bostock has shown that when one part of dry albumen is dissolved in nine parts of water, the solution coagulates by heat, and becomes solid; but if the albumen amount only to $\frac{1}{13}$ of the liquid, though it coagulates in some degree, yet it does not do so completely, but the liquid may be poured from one vessel to another. When one part of albumen is dissolved in 1000 parts of water, the solution becomes cloudy when heated. Uncoagulated albumen soon putrefies, except it be dried; but it keeps longer when coagulated; hence cooked meat and eggs keep longer than when raw. The presence of albumen in a solution, though not in quantity sufficient to coagulate by heat, may be ascertained by putting in a drop of the saturated solution of corrosive sublimate: if the water contain only $\frac{1}{2000}$ part of albumen, a cloudiness will appear. It can form a soap with alkali.

1768. *Fluids are often clarified by means of albumen*, through its property of coagulation. When any kind of it, as white of eggs, or the serum of blood, is put into a liquid that is muddy from substances suspended in it, on boiling the liquid the albumen coagulates in a flocculent manner, and, entangling with it the impurities, rises with them to the surface as a scum, or sinks to the bottom, according to their weight.

1769. *Albumen, when analyzed*, is found to contain in 100 parts, carbon, 50·00; hydrogen, 7·78; oxygen, 26·67; nitrogen, 15·55.

1770. *Animal Oil.—Under this head is included every species of fatty matter in animals;* and it exists in a state more or less fluid, or approaching to solidity, in various animals, and in various parts of their bodies. Some varieties, as suet, have considerable solidity, and others, as fish oil, are mostly in a liquid state. Carbon and hydrogen, with a very little oxygen, form the elements of pure oil, without any nitrogen, in which this differs from the rest of the animal principles. Indeed, from analysis, it appears that animal oil is very analagous to the fixed vegetable oils, both in composition and properties. The nature of the various animal oils has been more particularly considered when treating of "Artificial Light." See, also, "Fat," Subsect. 8.

1771. *Osmazome.—This substance is procured from an extract of meat;* it was discovered by Thouvenet, and is supposed to be the principle that gives the peculiar flavour to meat when roasted, or in soups. Berzelius, however, does not admit it to be a distinct principle, and thinks that it is formed during the culinary process. When procured separate and pure, it has a brownish-yellow colour, with the taste and odour of soup. It is most abundantly developed in the outside of roasted meat.

1772. *Casein.—Casein abounds in the curd of milk* coagulated by means of rennet, of which cheese is made. It is very analagous to albumen, although now considered as a separate proximate principle. (See "Milk.") Casein is very easy of digestion, and is very nutritive.

Having now described those proximate principles into which all the parts of animals are resolvable without final decomposition taking place, we proceed to state which of these principles, and in what proportion, the *various parts of animals* are composed of.

Subsect. 3.—*Skin.*

1773. All animals have an exterior covering to protect them from the surrounding elements, as well as to perform other functions. In the lowest classes this covering is frequently hard and crustaceous; but in the higher classes, it is usually soft and pliable. In man, as well as in the ordinary quadrupeds used among us as food, it is composed of two parts: a thin elastic layer on the outside, called the *epidermis*, or cuticle, and a much thicker layer beneath, called the *cutis*, or *true skin.*

1774. *The cuticle* is that part which is raised in blisters, and is easily separated from the cutis by maceration in hot water. It is insoluble in cold water, and is considered to be a modification of albumen. It has little tenacity, and is destitute of blood-vessels, nerves, and fibres; consequently, has no sensibility. It is dissolved by alkalies and lime. In some of the inferior classes of animals it consists of scales or plates, and in others it is extremely soft and smooth, almost resembling mucus.

1775. *The cutis or true skin*, in quadrupeds, is a thick, dense membrane, composed of fibres closely interwoven, and disposed in different directions like the texture of a hat; the interstices being filled up with gelatin, of which the principal part consists. It is obviously organized, and is filled with innumerable blood-vessels and nerves, which occasion its extreme sensibility when cut.

Common glue is made by boiling skins, in which process the gelatinous part is extracted. Those skins that are the most flexible, as that of the eel, dissolve the most readily, and afford the greatest quantity of gelatin, but make the weakest glue.

Size is a preparation made by boiling skin to a jelly.

Leather is likewise formed from skin, but it is by combining the gelatin which it contains with the tannin in bark, the result being a peculiar substance which is no longer soluble in water, cold or hot; and this constitutes the process of tanning. See "Gelatin."

SUBSECT. 4.—*Cellular Membrane.*

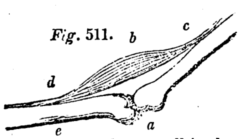
1776. *This is a very soft, spongy substance that lies between the skin and the flesh; and a similar material is dispersed* through every part of the body, frequently entering into their substance, connecting the several parts with each other, and preserving them in their proper places. It is composed of numerous minute cells formed by a very thin membrane, which are filled with a fatty matter, that varies in quantity according to the species of animal, and the condition of the individual. It is the proper receptacle of the fat. In some animals, as the ruminating quadrupeds, it is only partial; but in others, as the hog and the whale, it extends, with its fat, under the whole of the skin: the membrane itself consists partly of albumen and partly gelatin, and is not soluble in water.

SUBSECT. 5.—*Flesh.*

1777. *The flesh of animals, and which is the principal part employed as food, consists* entirely of the various muscles, the use of which is to enable them to move and to perform their several functions. Each muscle is composed of a bundle of those minute fibres, which we mentioned when speaking of fibrin. It is bound together, or united at each end or extremity, where the fibres compose a firm, close texture of a silvery colour, and possessed of great tenacity. These terminations, which differ altogether in appearance from the muscle itself, are called *tendons* or sinews. If the muscles be examined with care, it will be seen that each bundle of fibres is enclosed in a very fine membrane, and they are often divided interiorily by other membranes into smaller bundles; also, that the tendons are semi-transparent, very elastic, and strong, being securely fixed to the bones.

1778. Although it is not absolutely necessary to our subject, still it will illustrate the nature of muscle to show its proper use in the animal frame, which is, to perform the various motions of the body. The manner in which these motions are effected is the following: The bones form what is called the skeleton, and there are joints where it is necessary we should move certain parts at our will. Let *a* be the elbow joint, which is to be bent; a muscle, *b*, or, as we have said, a bundle of fibres, is bound together or united at each end into a tough substance, called a tendon, *c* and *d*, and these are fixed, one to each bone of the arm, above and below the elbow. Now, when we wish to move our arm, we can, merely by our will, through means incomprehensible to us, cause this muscle to swell in the middle, and, consequently, to contract in its length; the consequence of this shortening of the muscle from *d* to *c* is, that the bone, *e a*, is raised upward, and the arm, of course, is bent. In the same manner all the motions of our bodies are performed; one end of a muscle is fixed to one bone, and the other end to another bone, and our will causes the muscle to swell in the middle, or *belly* of the muscle, as it is called, and thus give rise to motion.

Fig. 511.



1779. *The fibrous structure of flesh is best seen in meat that is dressed, but particularly in boiled meat*, as veal or leg of beef. The nature of a muscle is easily perceived in cutting up the leg of a fowl that is sufficiently entire; for, when meat is cut for sale, the muscles are usually divided across, so that portions of them only are visible in one piece. The fibres constitute what is usually called the *grain* of the meat; thus, we speak of cutting across the grain when we divide the fibres across. The quality of meat is judged of, in some measure, by the coarseness or fineness of these fibres: in very large animals, as the elephant, rhinoceros, &c., they are very coarse and unpalatable; on the contrary, the fibres of the flesh of very small animals, as the mouse, are very small, and the flesh is very delicate, and, although not eaten in this country, was highly prized by the luxurious inhabitants of ancient Rome, who fed them for the purpose. It is a curious fact, that the actual fibres of flesh are so minute that the smallest one visible to the eye is composed of many others still smaller, laid close together.

1780. *In the muscles is intermingled a small quantity of fat and gelatin*, the proportions of which is different in those of different animals, and in different parts of the same animal, or according to their condition. *Thus, flesh consists* chiefly of fibrin, or the pure fibre, which, as we have stated above, is of itself white, together with some blood, gelatin, a small portion of albumen, and a large quantity of water. There is likewise a minute portion of salts, as will be seen by the analysis. By boiling, the gelatin is dissolved, the albumen sets and hardens, a very small portion of the fibrin is also dissolved, but the greater part remains in the fibrous form.

1781. *Berzelius made a careful analysis of lean flesh:* about three fourths consisted of liquids. The following were the constituents which he obtained: in 100 parts, fibrin, vessels, and nerves, 15·8; muriate and lactate of soda, 1·80; albumen and colouring matter of the blood, 2·20; phosphate of soda, 0·90; extractive matter, 0·15; albumen holding in solution phosphate of lime, 0·08; water and loss, 77·17. From this analysis we perceive that the greater part of a portion of flesh consists of water, and that there is not an ounce in a pound of solid matter that can be assimilated; but this ounce, it may be supposed, is extremely nutritive.

1782. *The solution of the gelatin of flesh forms soup by boiling*, and, from its presence, liquid soup is liable to become sour in keeping, acetous acid being formed.

1783. *The flesh of various animals, as is well known, differs in flavour*, and, in a slight degree, in composition. The quantity of blood in it augments with the age of the animal; and the flesh of young animals contains more gelatin than of old: that of the same species varies, as has been observed previously, by the circumstances of sex, feeding, age, &c. The digestibility is likewise much affected by the modes of cooking.

1784. *The muscular fibre is likewise possessed of a property called contractility*, that is, it has always a tendency to contract in length. This is shown when a muscle is divided across during the life of the animal, or soon after it is dead; for the wound opens very wide, from the contraction of the part on each side, and this is the basis of the operation called *crimping* in fish, which is cutting across to cause the fibres to shrink and become firmer. The state of the fibre after death is also influenced by the manner in which the animal has been killed. If it be killed suddenly while in full health, the muscles are firm and contracted, and they remain a long time rigid without undergoing putrefaction; whereas, on the contrary, if death ensue after violent exercise, the muscles are relaxed and soft, have lost all their contractility, and much sooner become putrid. This is the origin of the barbarous practice of baiting cattle previous to slaughtering them, in order to make the flesh tender.

1785. *The liability of flesh to become putrid, Hatchett supposes, is chiefly owing to the gelatin;* for, when this is removed, the remainder of the fibres, if dried, is not liable to putrefy. When flesh is submitted to combustion by fire, all the proximate principles are decomposed, and the elementary principles are dissipated, except perhaps the carbon, which remains in the form of a black cinder.

1786. *Tendons* consist chiefly of gelatin with a little albumen; consequently they dissolve partly in long boiling.

Subsect. 6.—*Bone.*

1787. *Bones compose the solid framework of the body:* they are the fixed joints against which the muscles act to produce motion. When a bone is divided longitudinally, so as to disclose its internal structure, we observe that the external part is the most compact, and the interior more cellular or spongy. The proportion of the compact to the cellular part depends upon the particular bone and the species of animal, as likewise upon its age, the bones of young animals being softer, and those of older animals becoming more dense. Certain parts of bones also are hollow, or filled up only by a very open texture consisting of minute fibres crossing like network. In the cavities of bones the marrow is contained, and all through the spongy or cellular substance there is dispersed more or less of an oily matter, very analogous to marrow, but more fluid.

1788. *When bones are examined chemically* they are found to consist chiefly of an earthy base, called phosphate of lime, which is lime and phosphoric acid. Of this material, together with cartilage, the skeleton of the bone is composed; and the numerous minute cells and interstices are filled up with gelatin and the oily matter above mentioned.

1789. *The structure of bone and the existence of the phosphate of lime may be easily shown.* If a bone be burned in the fire, it will generally, at first, flame and become black in the same manner as flesh; this arises from the combustion of the oily matter contained in the cavities or cancelli of the bone; and as the hydrogen of the oil is the element that affords the flame, when that is dissipated, much of the carbon is left, which gives the black colour to half-burned bones; but, by a continuance of the heat, the carbon likewise flies off, and the bone will become red hot; in this state it consists only of phosphate of lime, deprived of all animal cement. When the bone cools it will be of a white colour, and then the internal structure may be easily observed by breaking it across and viewing it through a magnifying glass. This white substance, when ground to powder, is called bone-ash, and is used for various purposes; among others, polishing, under the name of burned hartshorn.

1790. *When bones are broken to pieces and boiled* for a considerable time in water, the gelatin and oily matter are extracted, the latter rising to the surface as fat, leaving only the cartilage with the earthy matter, which are not soluble in water, or scarcely so; and every cook knows how to procure a certain portion of gravy by this means. The extraction of the soluble part is much promoted by rasping the bones, since thus all the cells in which it is contained are laid open; while the bones are only broken in pieces the greater part of the gelatin remains still locked up in the hard substance of the bone. A method of extracting the whole of the gelatin for the purpose of soup will be shown when treating of "Soup from Bones."

1791. *The bones of cattle slaughtered in London were formerly of such vast accumulation*, that it became necessary to consume them from time to time. This process was reserved for some holyday, or period of public rejoicing, when fagots and combustible materials were collected for the purpose of illumination. At present, bones are applied to a variety of purposes. They are useful to mechanics when ivory would be too expensive; they are essential in the formation of sal-ammoniac and phosphorus; produce an oil much used by coach and harness makers, called neat's foot oil, and, when ground to powder, form a valuable manure, &c. Since bones with us can be so profitably employed, perhaps it is not desirable to imitate our continental neighbours in making soup from them, particularly as this is not a favourite food in England.

Subsect. 7.—*Cartilage.*

The ends of the bones at the joints are capped by a smooth white substance, somewhat softer than themselves, upon which they move and turn; this is cartilage. It is the first part of the bone which is formed in the fœtus state of the animal, and the earthy part begins afterward to be deposited when the animal comes into the world and obtains food. Cartilage consists of coagulated albumen, with a very little gelatin, and therefore is not soluble in boiling water, except by long-continued boiling under pressure. In very young animals the bones are almost all cartilage, the elasticity of which is the reason that they are so little hurt by a fall: as animals advance in age, the bones become harder and more brittle, having more albumen and earthy matter, and less of gelatin. In some fishes, as in the skate, the bones are entirely cartilaginous.

1792. *Teeth* consist of the same material as bone, except the enamel on the exterior, which is phosphate of lime and carbonate of lime, in the proportion of 78 parts of the former and 6 of the latter.

1793. *Ivory* is nearly the same as bone, with a large proportion of gelatin.

1794. *Horn* differs from bone in containing scarcely any phosphate of lime, being composed almost entirely of coagulated albumen with a very little gelatin; they are therefore not much different from cartilage. Horns soften by heat, so as to be moulded into any form, but do not dissolve in boiling water. The horns of some animals, as those of the ox, are hollow, and have the central cavity filled up by a bony part called the *core*. The horn of the stag, however, is a remarkable exception; it differs entirely from the horns of the ox or sheep, being more analogous to bone, and consisting of much gelatin, with some phosphate of lime; hence, as was observed before, it is soluble in water, and from it is made *hartshorn jelly*.

1795. *Hoofs*, *nails*, *feathers*, *hair*, and *wool* are very similar to horn in their composition.

Subsect. 8.—*Fat.*

1796. *Fat is an animal oil of various degrees of consistency, according to the kind of animal, or the particular part of the body* in which it is situated. It is contained in the minute cells of the cellular tissue or texture above mentioned, and is chiefly collected between the skin and the muscles, or in the interstices between the muscles, or round the viscera. While the fat remains in the living body it is always in a fluid state, or semifluid; but its consistence changes when it is extracted and exposed to the common temperature of the atmosphere. When examined by a powerful microscope, this fat or animal oil is seen to be contained in extremely minute hollow cases, which are of different shapes, spherical, or even polygonal, according to the animal, as in man, oxen, sheep, and other quadrupeds. The case itself resembles the nature of spermaceti.

1797. *Of the varieties of fat in quadrupeds, suet is the firmest;* the next in hardness is the fat of bones, and the next to that the fat in the muscles. The fat of the hog is the least solid. The fat of birds has little solidity, and in many species it is always fluid: this is usually distinguished by the term *grease*, as goose grease. The fat of fish is always in oil or fluid, except spermaceti.

1798. *Suet* is the fat which invests the kidneys of oxen or sheep. The internal fat of all ruminating animals is harder than that of others, and is slightly brittle; when melted and separated from the membranes in which it is contained it constitutes *tallow*.

1799. *Lard* is the fat of the hog separated in the same manner. It differs from suet little but in being of a softer consistence. Its use to the cook is well known. The hog's lard that is sold in bladders is prepared by chopping the raw lard fine, or, rather, rolling it out to break the cells in which the fat is lodged, and then melting the fat by a water-bath or other gentle heat, and straining it warm into bladders; or by melting the raw lard in water, and skimming it off when cold; but by the latter process a quantity of water is always contained in it, and this kind of lard grows sooner rank than when melted by itself.

1800. *To obtain animal fat, in general, in a pure state*, it is to be melted and strained from the investing membranes, and a little water is added, while melting, to prevent its being scorched. When thoroughly purified, it is white, inodorous, and tasteless, while quite fresh, and is then very analogous to fixed vegetable oil (see Sect. 10, Chap. VII., Book VII.); it, however, becomes sooner rancid than the latter, if exposed to the air: a change which is owing to an absorption of oxygen, and the consequent formation of an acid, which is named the *sebacic acid*, or acid of fat. If this acid is abstracted by washing by means of water, the sweetness of the fat may be sometimes restored.

1801. *Different kinds of fat liquefy at different temperatures:* lard melts at 97°; tallow requires a heat somewhat greater; but the fat extracted from suet by boiling requires 127° to liquefy it. The great inflammability, and the bright white light it gives while burning, renders the most solid kind, tallow, eminently serviceable for producing artificial light. Tallow itself will not inflame: it is only the vapour of tallow that inflames; and it does not boil till it is heated to 400°. Fat acts upon some metals; thus, if copper be covered with it, the surface soon becomes green, and a poison is formed.

1802. *It is now known that fat is not to be regarded as a simple principle*, but as consisting of two distinct principles, which may be separated from each other, a fact which we stated before, when treating on "Candles." One, called *stearin*, is always solid at the ordinary temperature, and melts at 100°; when pure it is white, brittle, and without taste or smell: the other, an oily substance, more fusible, is called *elain*, and is always fluid at the common temperature, becoming solid at 45°: it is generally of a yellow colour.

1803. These two principles, *elain* and *stearin*, exist in very different proportions in various fatty substances, as will appear from the following table:

	Elain.	Stearin.		Elain.	Stearin.
Butter made in summer	60	40	Goose fat	48	32
Ditto, in winter	37	63	Duck's fat	72	28
Hogs' lard	62	38	Turkey's fat	74	26
Beef marrow	24	76	Olive oil	72	28
Mutton marrow	74	26	Almond oil	76	24

The stearin and elain seem to be mechanically mixed in animal fats, for they can be obtained in a separate state merely by squeezing tallow between folds of blotting paper: the elain is absorbed by the paper, and the stearin remains by itself as a solid. To procure the elain by itself, the paper which has absorbed it must be soaked in warm water, and the oil will swim upon the top. It is the elain which gives the peculiar smell to the various fatty substances, and tallow deprived of it is both more solid and white, without any smell. This discovery has been applied to the improvement of candles. They may also be separated from each other by means of alcohol. If fat oil be boiled in alcohol the stearin crystallizes as the spirit cools, and the elain remains in the solution. See farther under "Soap."

1804. *Marrow* differs from other fat only in the fineness of the membranous texture in which it is contained, the fluidity of the oil, and its situation within the bones.

1805. *Fat, as well as all fixed oils, is difficult of digestion*, particularly by weak stomachs, and therefore is not proper for dyspeptics. It is apt to cause bile in the stomach. But fat is rendered still less digestible when subject to high temperatures in some culinary processes, as in frying. All meats and fish that contain much oil or fat are apt "to lie heavy at the stomach," as it is called, or, in other words, to be difficult of digestion; and then they are apt to occasion heartburn and other injurious effects. It is thought, however, that bacon and salt pork are more easily digested than fresh fat.

Subsect. 9.—*Blood.*

1806. *Blood consists of two parts: the coagulum, clot, or crassamentum,* and the *serum.* It is well known that blood, soon after it is drawn, separates into these spontaneously. The coagulum is the part which becomes solid, and contains the red colour; it consists of exceedingly minute coloured globules, to be seen only by a good microscope; these float in a transparent fluid. The red globules themselves consist of fibrin and albumen, according to Berzelius, and the colourless serum consists of albumen dissolved in a saline fluid. The coagulum of blood is very analogous to flesh, and seems to possess equal nutritive properties. The serum is very analogous to the white of egg, and, like it, coagulates by heat. It contains no gelatin. The red colour of the globules appears to be owing to a peculiar colouring matter; and it may be removed by washing the coagulum repeatedly in water: the coagulum will then appear of a whitish colour, being pure fibrin. The blood of animals is used as food, and is very digestible and wholesome; that of the hog and of the ox is used for making black puddings; as likewise that of the goose in some places.

Subsect. 10.—*Mucus.*

1807. *Mucus is a substance generally liquid*, and which appears to be employed by nature for the purpose of lubricating moveable parts, or of protecting them from the action of other substances. It has a resemblance to gelatin, but is distinguished from it by being soluble in cold water, and not gelatinizing or becoming jelly; nor is it coagulable by heat, like albumen. Mucus is coagulated by subacetate of lead, which does not affect gelatin. It is in too small quantity to be considered as very important in the subject of food.

Subsect. 11.—*Shell.*

1808. *Shells of eggs, of oysters, muscles, periwinkles, and other animals of the molluscous class, differ from bone in consisting* of carbonate of lime, or the same substances as chalk, with a little animal matter: when they are burned in the fire they give a very pure quicklime. A few shells contain also a little phosphate of lime.

The crustaceous coverings of crabs, lobsters, &c., consist of phosphate of lime and carbonate of lime, with a little animal matter.

Subsect. 12.—*Internal Organs.*

1809. *The various internal organs, as the heart, lungs, usually called lights, liver, sweetbread, kidneys, &c., consist* of fibrin, gelatin, albumen, &c., in different proportions, according to the particular organs, which, intermixed with blood-vessels and nerves, are too various to describe in detail. The heart, liver, and kidneys are not of such easy digestion as meat in general; but the sweetbread is a favourite dish for convalescents. Few things are so readily digested as *tripe*, which is the stomach of ruminating animals, as the cow.

1810. *It is proper to mention that eminent physicians have stated* it as a well-known fact that "the bodies of animals who are diseased are capable of communicating fatal diseases to the human species;" and Dr. Paris observes, that "experience has shown that such animal poison is particularly energetic in those parts that are commonly called the *offals*, in which term are included the *intestines*." To account for the deleterious changes of which those parts appear to be occasionally susceptible, it is not in the least necessary to suppose that the animal died in a state of disease. We are informed by Dr. Kerner of Wurtemburg that the smoked sausages, which constitute so favourite a repast in his country, often cause fatal poisoning. In one instance thirty-seven persons died out of seventy-six who had eaten them; and, though the most able chemists analyzed the meats, no trace of any known poison could be discovered. The following details respecting this remarkable fact are from Professor Graham's work on "Chemistry:" "In Wurtemburg the sausages are prepared from very various materials. Blood, liver, bacon, brains, milk, bread, and meal, are mixed together with salt and spices; the mixture is then put into bladders or intestines, and, after being boiled, is smoked. When these sausages are well prepared, they may be preserved for months, and furnish a nourishing savoury food; but when the spices and salt are deficient, and particularly when they are smoked too late, or not sufficiently, they undergo a peculiar kind of putrefaction, which begins at the centre of the sausage. Without any appreciable escape of gas taking place, they become paler in colour, and more soft and greasy in those parts which have undergone putrefaction, and they are found to contain free lactic acid or lactate of ammonia—products which are universally formed during the putrefaction of animal and vegetable matters. The death which is the consequence of poisoning by putrefied sausages succeeds very lingering and remarkable symptoms. There is a gradual wasting of muscular fibre, and of all the constituents of the body similarly composed. Sausages, in the state here described, exercise an action upon the organism, in consequence of the stomach and other parts with which they come in contact not having the power to arrest their decomposition; and entering the blood in some way or other, while still possessing their whole power, they impart their peculiar action to the constituents of that fluid." Similar effects have occurred in Paris; and it has been conjectured that animal matter in peculiar states of disease or decomposition may constitute an *actual poison*, hitherto not understood, and only evinced by casual effects. Sir Benjamin Brodie has remarked that, on several occasions, he has met with evidence of the acrid and poisonous nature of "dog's meat," as sold in the streets of London, which manifested itself by producing ulcerations of a peculiar and distinct character on the hands, accompanied by swellings in the axilla.

Sect. III.—ANIMALS USED FOR FOOD CONSIDERED AS INFLUENCED BY SIZE, AGE, SEX, SEASON, MODES OF FEEDING, ETC.

1811. *Size.*—As a general rule, the flesh of the largest animals is, as might be expected, of a large fibre, or, as it is called, *coarser in the grain*, and less palatable than that of smaller animals. The flesh of the elephant and rhinoceros has been found to be very coarse, but we know little of their properties, being scarcely known as food. Even the larger kind of oxen affords coarser beef than the smaller breeds. Mutton is more delicate, in general, than beef; and, descending to much smaller animals, *mice are said to* be particularly good eating. The same observation will apply to birds and fish; the larger, in general, being the coarsest food, and the smaller more delicate and tender; but it does not appear that the nutritive qualities are in proportion to the fineness of the fibre and the delicacy of the meat.

1812. *Age.*—In general the young animals of any species are more gelatinous than the older of the same species; hence their flesh is more soluble, and yields more to the action of boiling water; boils more tender, and is more nutritive to weak stomachs than that of older animals; but as they increase in age, the gelatin gradually diminishes; they contain more fibrin, albumen, and osmazome; hence the flesh affords a stronger food, and has more flavour, until age again destroys these qualities, and renders it stringy, dry, and indigestible. By the increase of albumen the membranes become more solid, and motion more difficult; and, at last, sometimes the ossification of those parts takes place. But though the flesh of young and old animals varies considerably in its properties, some being too soft and flabby, and others too tough, yet at no period of life is it absolutely unwholesome, provided the animals are in a healthy state. Calves and lambs are seldom killed until they arrive at a certain age, on account of deficiency of flavour. In young animals, not only is the fibrin more tender and delicate, but the fat in quadrupeds is distributed differently from what it is when they are older. In the latter case, it is chiefly collected in layers external to the muscles; in the former, it is more dispersed through the muscles, so as to give the flesh a marbled appearance, which renders it more desirable for the table. This mixture of marbling never happens in birds. But though the flesh of young animals is more tender, it is not always more digestible; on the contrary, veal is less digestible than beef, lamb than mutton. Birds are most easily digested when young. It is on account of the greater proportion of gelatin contained in the calf than in the full-grown animal, that the feet of the former are employed for preparing strong jellies; and every one must have observed how much more gelatin is contained in the soup made from veal than in that from beef.

1813. *Sex.*—The flesh of the female is almost always more delicate and finer-grained than that of the male, which is often strong-tasted.

By a particular process in reference to sex, at an early age, in all animals, quadrupeds, birds, and even fishes, a remarkable alteration takes place in the flesh. It is much improved for the table, becoming fatter, larger, more tender, and more easy of digestion; there is also a greater deposition of fat between the fibres, as we see in the ox, capon, pullet, &c.

1814. *Season.*—It is well known that certain kinds of animal food are not always *in season*, that is, equally good at all times of the year. This is owing to many causes, according to the species of animal. The abundance or scarcity of food at particular seasons affects the condition of some kinds: thus, full-grown cattle, in general, are in the best condition in the first winter months, in consequence of their having had the advantage of plenty of fresh summer food. After that, the turnips and other vegetables on which they are fed, in consequence of the deficiency of grass, injures the flavour of the meat; and in spring it becomes lean from bad or insufficient provender. It is so managed that tolerable beef and mutton are always to be had in London, and they are there never absolutely out of season; yet they are, in general, best in November, December, and January. Females, in general, are out of season when they are suckling, or have lately suckled. The condition of quadrupeds is not much affected during the first months of pregnancy, and the time when they are most in season is that when the young have acquired the proper age for being killed. This is naturally in the summer months, when lamb, veal, kid, and fawn are most abundant. Though there is a season of the year when each species of animal is more naturally inclined to breed, yet, by treating them in a certain manner, this season may be advanced artificially. Thus breeders contrive to procure lamb, as an article of luxury, as early as November and December; certain breeds, as the Dorsetshire, are selected for this purpose; on the contrary, by keeping the ewes on cold, poor hill pasture, the lambing season is retarded.

1815. *The manner in which animals are fed*, and the food upon which they are kept, affect considerably, as we might expect, the fatness and flavour of the flesh, and its fitness for nutriment. The improvement of animals by careful breeding has been very considerable; but it has not always the same objects in view. Some of the methods affect the size of animals; but, though these produce a greater quantity, they do not always improve the quality of the flesh. Thus, sheep fed in the rich pastures of Lincolnshire grow large and fat, and produce much wool; but the meat is coarse, insipid, and rank, compared with smaller breeds. The flesh of well-formed, small animals, both of cattle and sheep, is finer grained, has a finer flavour, is more intermixed or marbled with fat, and affords a richer gravy than that of large animals of the same species. It is well known that the Welsh mutton fed on the hills, where there is short grass and wild herbs, is high-flavoured, and tender without being fat.

The flesh of all cattle fed in stalls, particularly when oil-cake is used, is not of so fine a flavour, and in some cases, probably, not so wholesome, as of those which have daily exercise in the open air, since the fat produced by confinement is often a species of disease. Fresh air and exercise are essential to the life and health of every living creature; and this is, no doubt, one reason why the mutton from sheep fed upon downs and mountains, which have a long way to roam for food, is superior to any other in high flavour, although it be lean. Methods of fattening are often resorted to, unnatural, and even cruel. Some of the means depend upon supplying the animals with a great quantity of food, and depriving them of exercise. Ducks and geese are prevented from going into the water, which would hinder them from becoming fat. Fowls are fattened for the London market by keeping them in a dark place, and cramming them with a paste made of barley meal, mutton suet, with some treacle or coarse sugar mixed with milk, which in a fortnight has the desired effect. If kept in this manner for a longer time, the fever that is brought on by this mode of treatment renders the flesh red, and often kills them. The flesh of poultry fed in this way is never so well flavoured as when they run loose in the barn yard, and probably it is not so salubrious.

1816. *The methods resorted to by epicures* to produce an unnatural enlargement of particular parts of some animals—as the livers of geese and turkeys—are so cruel that we do not think it necessary to record them, as we never wish to see the palate gratified at the expense of so great a loss of feeling as must be the result of such practices.

1817. *Animals seldom become fat in their wild state*; but, from the quantity of exercise which they take, and the free air which they breathe, they are, generally speaking, in a more healthy condition than those which are domesticated; and their flesh, though tougher, more fibrous, and sinewy, has often a higher flavour, and is more nutritive. Their good qualities as food are improved by exercise previous to their being killed, as is the case in the hunting of game. Wild birds are more highly flavoured than fowls which are domesticated.

1818. *The mode of killing animals has a considerable influence upon the quality and flavour of the flesh.* Animals that die a natural death should never be eaten, as their death is generally the consequence of disease, and their flesh is then unwholesome; and it was a wise injunction of the Jewish legislator not to use these as food. This observation, however, does not apply to the case of animals being killed by accident, as by being drowned, hanged, or frozen, by a fall, or by a ferocious animal; these are only defective in being not at all or imperfectly bled, which is the case with those that are snared, and with such as are killed by hounds.

Whatever exhausts or destroys suddenly the irritability of the living muscular fibre tends to induce rapid decomposition: thus, when animals are killed by lightning, putrefaction soon takes place.

This is the case, likewise, with animals killed after being long hunted: the violent exercise they undergo exhausts the irritability, and causes the fibre to be less rigid, or more tender after death, from the greater liability to decomposition. Formerly it was a barbarous custom, sanctioned by an express law, that all bulls were hunted or baited with dogs previous to being slaughtered, from the known fact that baiting or hunting had the effect of rendering the meat more tender; but this cruel and dangerous practice is now very properly laid aside. The completeness of the bleeding, or emptying the vessels of blood, appears to be important; as, when the meat has not been well bled, it changes sooner, and is dark-coloured. Veal and pork, particularly, depend much upon the bleeding for their whiteness; accordingly, most of the animals slaughtered for food are either bled to death, or are bled as soon as possible after being killed in some other way. The Jews bleed their meat more completely than Christians, on account of their law which forbids them to eat blood.

1819. *The method of slaughtering large animals among us* is this: They are commonly kept without food for some time; because, if killed with full stomachs, their flesh is considered not to keep well. Oxen are made to fast for two or three days; smaller animals, as calves and sheep, for a day: but if this practice be carried too far, the object will be defeated, by the animals falling off or becoming feverish.

Oxen are killed by striking them on the forehead with a pole-axe, to stun them and cause them to fall, and they are then bled by dividing the blood-vessels of the throat. As this method has the appearance of cruelty, and is not free from danger if the operation is unskilfully performed, some, and in particular Lord Somerville, have recommended a mode practised in Barbary, Spain, and Portugal, called *pithing*, which consists in thrusting a sharp knife at once into the spinal marrow above the origin of the phrenic nerves, by which the animal drops down in an instant without the smallest struggle, after which it is bled by dividing the arteries about the heart. Notwithstanding the apparent advantages of this mode, it is but little employed in Britain; and it is said that the method is only apparently less cruel; for, though the puncture of the spinal marrow renders the body motionless, it does not destroy feeling, and that the animal is even made to die a more painful death; whereas, in the usual method, a concussion of the brain is caused by the blow, by which all feeling is destroyed. It is said also that the flesh of cattle killed by pithing is dark-coloured, owing to imperfect bleeding, as the action of the heart ceases before the bleeding is attempted, in consequence of which the blood does not flow freely.

The method of slaughtering practised by the Jews is very effectual in bleeding completely; and they will not eat flesh except the animal has been killed by one of their own persuasion. Their method is to tie all the four feet of the animal together, bring it to the ground, and, turning back its head, cut the throat at once with a long and extremely sharp knife, in consequence of which all the blood-vessels are severed, and the blood is discharged quickly and completely. All calves, pigs, sheep, and lambs are killed by dividing the blood-vessels of the neck.

1820. *It is highly desirable that, in adopting the most judicious method of performing such necessary operations*, all unnecessary cruelty should be avoided, not only on account of the animals themselves, but also of the bad effect produced on the minds of those who have to practise the art of butchery. It has been stated that some butchers resort to cruel practises; such as suspending calves by the hind legs with the heads downward, and bleeding them thus to death slowly for the purpose of whitening the veal.

1821. *Sheep and some other animals appear to have an instinctive dread of blood*, and cannot be readily induced to go where it is found in their track, on which account it is extremely difficult to make them enter slaughter-houses, which has given rise to scenes of uproar and brutality. The Society for the Prevention of Cruelty to Animals have recently carried plans into practice in Whitechapel market which, in a great measure, obviate this difficulty. They take care to place hurdles covered with straw over the kennels on market days, and near the entrance of the slaughter-house a skin of a sheep, stuffed so as to resemble the living animal, is placed on wheels and kept in motion: this is readily followed by the sheep, without the necessity of employing coercion by men and dogs.

CHAPTER III.

QUADRUPEDS USED AS FOOD.

SECT. I.—INTRODUCTION.

1822. *Quadrupeds are divided into two great classes*, according to the substances on which they subsist, which modify, in a considerable degree, their properties when employed as human food. These are the *carnivorous* and *herbivorous* classes, or those which feed upon the flesh of other animals, and those which live on vegetables. Beasts of prey are generally lean: their fibres are tough, and the flesh coarse and disagreeable: they are never employed as food in any part of the world, except among savage tribes, or in cases of necessity. Herbivorous animals afford the most agreeable, as well as the most wholesome nutriment. Animals of these classes do not readily change the nature of their food, yet, when they are brought to do so by the influence of domestication, their flesh partakes of this change. Thus dogs, which are naturally carnivorous animals, when fed entirely upon vegetables, as in the islands of the Pacific, were found by Europeans to be excellent when cooked. Some animals are partly carnivorous and partly herbivorous: of this kind is the hog. The bear is chiefly a carnivorous genus; but the brown bear, parts of which are eaten in Northern Russia, and also in North America, is an herbivorous animal.

1823. *The flesh of quadrupeds varies considerably in colour, and occasions a distinction between red or brown, and white meats.* The red colour, when raw, depends upon having a great number of small arteries, and, consequently, more globules of red blood, interspersed among the muscular fibres. White meats are considered as the least stimulating, and, in general, are the most gelatinous. The effect produced upon different animals by the food with which they are supported, as well as other circumstances relating to their habits, have been carefully described by naturalists. It is remarkable that all the researches of travellers, aided by the lights of zoological science, have hitherto failed to ascertain the true originals of most of our domesticated animals; and it is known that some of these no longer exist but as the servants of mankind.

1824. *The supply of animal food to the United Kingdom* has of late years very much increased, and, of course, the consumption. This must be attributed to the improvements in agriculture, particularly the extension of the turnip and clover cultivation, by which a greater abundance of food for the cattle has been produced: the breeds have also been improved in the weight and quantity of the meat and of the milk. This kind of melioration began in the last century, and was the result, in a great measure, of the skill and enterprise of Mr. Bakewell of Dishley, and Mr. Culley of Northumberland. Their success roused a spirit of emulation, and the rapid increase of wealth arising from commerce and manufactures produced a greater demand for butcher's meat.

1825. In the following description of quadrupeds employed as food, we shall first describe at length those which are consumed in Great Britain, and then slightly notice some others that are not used for this purpose among us, although they are in some parts of the world

SECT. II.—THE OX (*Bos*, Linn.).

1826. *The tribe of animals which naturalists designate by the name of Bos consists of several species*, each of which is divided into many varieties, which arise from climate, domestication, and other causes. The principal species are the common domesticated ox, the buffalo, and the bison: the first only is known to Britain.

1827. *The common domestic ox* (*Bos taurus*, Linn.), in the earliest ages of society, became an object of interest and regard; for we read in Genesis that "there was a strife between the herdsmen of Abraham's cattle and the herdsmen of Lot's cattle;" the flocks of each of which were so numerous that "the land was not able to bear them, and they could not dwell together." The ox became a propitiatory sacrifice in the case of Abel's offering up the firstlings of his flock, and Abraham was directed to sacrifice a heifer as an offering for the promise of a son. This animal was held sacred by the Egyptians, and elevated into one of the twelve signs of the zodiac (Taurus); a representation of the ox became an object of idolatrous worship, as in the golden calf erected by Aaron. At this day among the Hindoos in India the cow is sacred, and held in the highest veneration; the flesh is forbidden to be eaten. All these instances prove the value and great importance of this animal in the earliest times; nor is this to be wondered at when we consider the various advantages we derive from this useful animal. The flesh affords the most nutritive, wholesome, and generally used animal food, and every part of its body is applied to some economical purpose. The hide is tanned into durable leather; even the hair is employed to mix with mortar; the tallow affords us artificial light; the horns are manufactured into a variety of useful and ornamental articles, and the refuse of these and of the skins is made into glue; the intestines and the bladder are brought into use in domestic economy; the bones are formed into various implements, being a substitute for ivory, and are employed as a valuable manure. The female supplies us with milk, the most nutritious of aliments; and as a beast of burden and draught, or even for riding, the ox is employed in many countries, where its patience and docility are acknowledged. Another of the advantages of this quadruped consists in its being so readily acclimated in almost every part of the world: in the Northern parts of Europe, and also under a tropical sun, the ox is found domesticated, and the servant of man.

1828. *The early history of the ox in this island* partakes of the same obscurity with that of its human inhabitants. Cæsar describes the Britons in his invasion as subsisting chiefly on milk and flesh; and this animal is doubtless indigenous here. There are several varieties, usually termed breeds, of it in the domesticated state; and, although they are all descended from one common stock, it is now uncertain what was the original, if, indeed, it still exists. These varieties have been produced by cultivation, and care is still taken to preserve the different breeds as perfect as possible; yet by intermixture, and various improvements, the varieties have now become numerous. Of late great improvements have been made in cattle, both for the dairy and the butcher.

1829. *The different breeds are chiefly distinguished by the presence or absence of horns, or by their length and flexure, and by the various proportions of the parts of the body.* It is observed, in general, that long-horned cattle give beef of the finest grain, more mixed and marbled than the short-horned, but affording less tallow. The short-horned give the richest milk; a cow of the short-horned Yorkshire breed will yield twenty-four quarts of milk per day. The Galloway breed, which is without horns, and small, affords beef of the finest quality; and many of these are annually driven to England, four hundred miles from their native pastures, and sold to the butcher. The Ayrshire breed appears to be the most improved in this island, not only for the dairy, but in feeding for the shambles. The Alderney cows, with the crumpled horn, give the richest milk, though small in quantity. The Hereford cow gives a large quantity of milk.

1830. *The quality of the beef depends upon a variety of circumstances,* such as the breed, the sex, the age of the animal, and likewise upon the food with which it has been supplied. *Bull beef* has a strong, disagreeable flavour, dry, tough, and difficult of solution; it is rarely eaten, except in sausages. The flesh of the *ox* is more soluble; the fat is better mixed; the meat is more sapid; it is highly nourishing and digestible, if the animal was not too old. The flesh of the *cow* is sufficiently fit for nourishment, but it is inferior to ox beef; *heifer* beef, or that of the young cow, is much esteemed, but that of an old fatted cow is bad. The larger varieties of the animal are inferior in the delicacy of their beef to that of the smaller breeds, when the latter have been properly fattened. The beef of the larger breeds of oxen is in perfection when the animal is about seven years old; that of the smaller breeds a year or two sooner; cow beef, on the contrary, can scarcely be too young. It is remarkable that a tendency to fatten, and to give a large quantity of milk, are never united in the same animal. As marking the distinctions among domestic animals, they are often denominated *neat cattle,* and sometimes *black cattle.*

1831. *The food upon which cattle are fatted* in summer is grass, commonly on pastures, but in some instances cut and consumed in feeding-houses or fold-yards. In winter, by far the greater number are fattened on turnips and other roots, as carrots and potatoes, along with hay and straw. Oil-cakes, and other articles, are used occasionally. A considerable number of cattle are also fatted on the grains from distilleries. There is a very large establishment for this purpose at Booth's distillery, in Brentford, calculated to hold six hundred head of cattle, that are fattened upon grains, and mashes of barley meal and clover-chaff, with a little green food. It is said that a very large proportion of the beef sold in the London markets is from stall-fed cattle living upon oil-cake and grains, a sort of food that is well known not to produce meat of the finest flavour, though it may in this manner be made sufficiently or even extremely fat. London is partly supplied by cattle which has been brought in a lean state from Scotland, Wales, and Devon, and fattened in the rich pasture of Essex; but there is a great quantity of dead meat sent up from the country, generally speaking perfectly wholesome, and fairly and honestly slaughtered, although it is said that the flesh of some animals that did not come to their death by the hands of man has occasionally found its way to the London market. There are inspectors appointed, who very impartially look after this: a place in Newgate market is called the "dead market." Cattle are generally fatted in three months ready for the butcher, though, from improvements in agriculture, they can be supplied with food at all times of the year, and hence good beef is always to be had in the metropolis; yet it is generally best everywhere in the first of the winter months, that is, in November, December, and January. The cattle fed out of doors are then in the best condition, after having had the advantage of plenty of grass and summer food. In the winter, from the turnips and other vegetables on which they feed, the meat often acquires a worse flavour, and in the spring it is apt to be lean from the quality and insufficiency of nutriment. The loin is generally reckoned the finest part of beef, called *sir loin,* from having been jocularly knighted by Charles II. Two sirloins make a *baron.*

1832. *Veal*, or the flesh of the calf, is tender and nourishing, but not so easy of digestion as the prime parts of beef and mutton, although the contrary is often supposed. Veal, particularly if it be young, contains much gelatin, as is the case with all young animals, and therefore yields a great deal of soluble extract when boiled long in water, particularly if under two months old, and is, in consequence, much used for soup or broth, which has occasioned it to be supposed that veal is more nourishing than meat less soluble; but this does not follow, for the gastric juice in the human stomach acts differently from water, and can dissolve what that fluid cannot.

There is the same difference in the quality of veal as of beef, arising from the mode in which the calves have been reared. The method most commonly employed for fattening them is to allow them to suck, which is the quickest and most effectual. Another method is to give them milk, and then they are kept in pens in a close house well littered. These two methods, when well managed, are nearly equal. When calves are killed too young the veal is insipid; it is best when the animals arrive at the age of eight or ten weeks, according to the season of the year. Calves of the largest size are fatted in Essex, where the business of suckling seems to be best understood. All that appears necessary, however, is to give them abundance of milk, and to keep them clean and dry in good air.

Whiteness is generally considered as a test of the goodness of veal. This, however, is not always a true one, since the butchers, it is said, sometimes produce whiteness by frequently bleeding the calves. Veal does not keep so well as beef and mutton. If ill-fed, its flesh is sometimes red; but the bleeding which is resorted to, in order to improve the whiteness, is of no avail in making it more wholesome. It is a common practice to give chalk to calves that they may lick it, and it is erroneously supposed by some persons that this is intended to make the flesh white; but the use of chalk is to correct the acidity which sometimes exists in the stomach, and which prevents their fattening.

In the immediate neighbourhood of London, where the fatting of calves is an object of great importance, milk is too valuable for feeding them, and a great variety of other food is resorted to. They are generally fattened with balls of linseed jelly, gruel, grains, potatoes, pollard, and some other nourishing preparations, with hay tea to drink.

1833. *It has been remarked that most of our animals serving as food* preserve their Saxon names while living; but when they are killed and dressed their names immediately become French. Thus, it is *ox*, *calf*, *sheep*, *deer*, and *pig*, while alive, but *beef*, *veal*, *mutton*, *venison*, and *pork* when brought to table. This might arise from the superiority of our neighbours in the art of cookery, which gave rise to the names of our dishes, though not to the animals from which they were derived.

1834. *The terms applied to cattle of different ages* are, when male, a *bull*, or *bullock*; when castrated, after the first year, a *stirk*; a year old, a *stot* or *steer*; at five years old, an *ox*: female, a *cow*; first year, a *calf*; after the first year, a *heifer*; when about to bring a calf, a *young cow*. A castrated female is called a *spayed heifer*. Certain of the Welsh and Scotch cattle of rather a sturdy kind are often called *runts*.

Sect. III.—SHEEP (*Ovis aries*, Linn.).

1835. *The sheep was probably one of the earliest domesticated animals*, owing to its gentleness of character, and it appears to have formed the principal wealth of the patriarchal tribes. They were spread over Western Asia at a very remote period; but it is not known at what time they were introduced into Europe. Sheep have an advantage over most other quadrupeds, that they can be reared in situations and upon soils where black cattle could not live from the scantiness of the herbage; and in usefulness they may rank next to the cow. They are found in almost every part of the world, and their fleece varies remarkably, according to the temperature of the climate. In cold countries the wool is extremely fine, while in warm regions it is little better than hair, nature adapting the covering of the animal to the necessity of its being kept warmer or cooler. It is not a little remarkable that the domesticated sheep depends almost entirely upon man for his support; left to itself, it becomes the subject of disease and the prey of ferocious beasts.

1836. *The varieties of sheep that are dispersed over the globe are almost endless*; even in this country they are so numerous as scarcely to be described with accuracy. Of the varieties of British sheep, some are particularly valuable on account of their fleeces, and others for the good quality of the mutton which they afford. Some are of large size, and fatten readily; others are of a smaller breed, and, though they do not become so fat, they are distinguished by the fine flavour of their meat. The English breeds may be divided generally into, 1, the *mountain breed*, as those in Wales and the Highlands of Scotland; 2, the *short-woolled breed*, as the south-down and Norfolk; and, 3, the *long-woolled breed*, as the Leicestershire sheep. It is not certain what was the original stock.

1837. *The quality of the mutton varies much in the different breeds.* In the large, long-haired sheep it is coarse-grained, but disposed to be fat. In the smaller, and short-woolled breed, the flesh is closest grained and highest flavoured; but the quality of the flesh is probably most affected by that of the food upon which the flocks are fed. Those which range over the mountainous districts of Wales and Scotland, or the chalk downs of England, and feed upon the wild herbage, possess a flavour very superior to those kept in rich pastures and on marsh land. The Welsh mutton is particularly small and lean, but of the finest flavour, and the south-down mutton is also excellent. Marsh-fed mutton often becomes extremely fat, but the meat has a rank taste. Turnips, hay, chaff, bran, corn, and other vegetables, as likewise oil-cake and grains, are employed for fattening sheep for the market; but such mutton is never so good as that produced where the animals can range in freedom. It is to be observed that the management favourable for cultivating long wool is unfavourable for the production of fine mutton.

1838. *Mutton, as food*, is considered as highly nutritious, light, and easy of digestion; but *tup mutton*, or the flesh of the ram, has a strong, disagreeable flavour, and is usually very tough. *Ewe mutton* is good if under two years old; but after that, when the ewes are called *crones*, the mutton becomes coarse and tough. The mutton of the *wedder* is the most esteemed. In sheep, more than in any other animal, the meat improves in a certain advanced period of its life. It is in perfection at five years old, and is not so good younger. It is then sapid, full-flavoured, and firm, without being tough, and the fat has become hard. At three years old, as commonly procured from the butcher, it is well tasted, but is by no means comparable to that at five years. Mutton younger than three years is deficient in flavour, and is pale in colour. Meat which is half mutton and half lamb is very unpalatable. Mr. Ude says, "Always choose mutton of a dark colour, and marble-like." The hind quarter, or the leg, when intended for roasting, is generally hung up in winter for several weeks, with the view of making it more tender, or in summer as long as it can be kept without a taint. By this a dark colour is induced.

1839. *Sheep are liable to many diseases*, but none of these is so fatal as what is named the *rot*, which often carries off immense numbers, and is supposed to be produced by the wetness of the soil on which they feed. The mutton of such sheep as die of this disease is unfit for food.

1840. *In England, the working classes often prefer very fat mutton*, which they cook with vegetables, particularly potatoes; but this is certainly not so wholesome and nutritious as meat somewhat leaner, and it is seldom or never brought to the tables of the affluent.

1841. *Lamb, as food*, is milder, more tender, and less exciting than mutton. Lambs are sometimes fatted on grass for the butcher, and sometimes reared by suckling, or by hand, on milk. Those which are suckled by the mothers, and fattened in houses, and hence called *house lamb*, are the earliest in the spring season, beginning to be ready in December, and continuing till February, before the natural lambing season commences; but in great towns it may be had almost all the year round. The Dorsetshire breed of sheep has the peculiar property of producing lambs at almost any period of the year, and they are particularly valued for supplying the London market, through the year, with house lamb. If lambs are allowed to be suckled by their mothers for six months, or a little more (and it is the same thing with veal), the flesh becomes more nourishing and digestible than if they are weaned at two months, as they generally are. As in all similar cases, great attention to cleanliness, and to giving plenty of nourishing food, are found to effect the objects of rearing most expeditiously and completely.

1842. *The grass-fed lamb* comes next in season, in April and May, and continues till Christmas.

1843. *It is sometimes the practice of farmers to manage the ewes* so that they may produce lambs almost at any time of the year, long before the natural season, and as early as September and October; and, by keeping them in cold or hilly pastures, retard their lambing until November and December.

1844. *A species of sheep is common in Asia Minor*, as at Aleppo, and likewise in the south of Africa, remarkable for their *large and fat tails*. This part of the animals in these countries consists almost entirely of a mass of substance between fat and marrow, which is used in cooking, and often instead of butter. One of these tails will often weigh from twenty to fifty pounds; and when they are very large, it is customary to fix a piece of thin board beneath to carry the tail, and prevent injury to it, as the under side is not covered with thick wool like the upper. Some have even little cars which they fix to the sheep to lay their enormous tails upon.

Sect. IV.—swine or hog (*Sus scrofa*, Linn.).

1845. *The swine, pig, or hog is one of the most useful of all the domestic quadrupeds*, and its flesh forms the chief animal food among the labouring classes. The wild hog, or *boar*, is about the same size as the domesticated breeds, but is distinguished by its ferocity and the superior length of his tusks, which form very dangerous weapons. Hunting the wild boar is still an amusement on the Continent, as it was with our ancestors.

1846. *All our domesticated breeds are derived from the original stock of the wild boar*, which still exists in the forests of Germany and other parts of Europe, and was formerly common in Britain, though now extinct. Tame hogs are found in most countries, except where the cold is very severe.

1847. *We have several varieties of the hog*, produced by crossing our indigenous breed with foreign ones, as the Chinese, black African, the Spanish, and the Portuguese, which have improved our own, by giving them greater delicacy of flesh and aptitude to fatten. The greatest improvement in pork has been received from crosses with the southern stock, or with the wild boar of the Continent.

The fat of the hog differs from that of every other quadruped, not only in its consistence and quality, but in its mode of distribution over the animal's body; the fat of those animals that have no suet, as the dog and the horse, is equally mixed with the flesh; but the fat of the hog covers the animal nearly all over, and forms a thick and continuous layer between the flesh and the skin.

1848. *The well-known culinary division of swine's flesh* is into *roasting pig*, *pork*, *fresh* and *pickled*, *bacon*, and *ham;* and hogs are generally fed and killed with a view of being chiefly employed in one or other of these ways. The large breeds answer best for bacon hogs, producing the finest flitches, and the smaller for fresh or pickled pork.

1849. *Swine have different names according to the age at which they* are sold to the butcher. They are called *pigs* when a few weeks old, and these are commonly roasted whole. *Porkers* are of the age of five or six months, and are used as fresh or as pickled pork, and not made into bacon. Full-grown *hogs*, named *bacon hogs*, are from eighteen months to two years old, and are converted into ham and bacon. For the manner of preparing these, see "Preservation of Food."

1850. *The flesh of the hog* has been variously esteemed among different nations. It was highly valued in ancient Rome, but is held in abhorrence by the Jew and the Turk. In hot climates its flesh is not good; and the animal being there subject to scrofula and leprous disorders, and from its habits generally considered as an emblem of filth, sloth, and gluttony, it has been reckoned unclean; and this will account for its proscription by the legislators of the East. But no other animal affords a larger series of savoury viands to the table of the European Christian. Every part comes into use. Of the backbone are made the chine and the griskin; the thinner portions of the ribs form the spare-rib; the sides make the flitch; the hind legs the ham and the hock; the neck and collar make brawn; of the shoulders are made gammons and bladebones; the sides of the head are called cheeks; the tongue is pickled, and the ears are made into souse; of the heart, the liver, and lights, with morsels from the throat, are made the harslet or fry; of the spare lean parts are made sausages; the larger intestines, stuffed with grits, mixed with the blood, make black puddings; the smaller intestines make chitterlings; and the feet of the sucking-pig furnish the petitoes.

The flesh of the wild boar is of a higher flavour than that of the domestic hog, and was formerly very much esteemed when existing in this island. The boar's head was considered as a great delicacy; and the finest Westphalia hams are still made from the wild boar.

1851. *Pork and bacon, like other kinds of meat, vary* according to sex, age, and feeding. The flesh of the sow is strong, and makes bad bacon; it is the flesh of the male that is in common use for the best pork. Pork, in general, is a very savoury food, and is much relished in England, though not among our northern neighbours. It is, however, with some persons, not very easy of digestion, although others digest it readily; and it is, upon the whole, not the most wholesome food. Although for bacon a great deal of fat may do, and even be preferred by some, yet for roast pork the fat should never exceed a certain proportion, and there should always be a considerable quantity of lean. In very fat pork, the little lean there may be is of a greasy quality and insipid flavour. Bacon is nutritive and easily digested by robust, labouring people; but it excites much thirst if eaten in quantity, and is probably too much used in England. The hog differs from all other land animals, with respect to the adipose substance, or fat: some bacon consists almost entirely of fat, and would demand the addition of much vegetable aliment to form wholesome food.

1852. *No animal is more affected, as to the wholesomeness of its flesh, by the mode of keeping than the hog.* It is naturally indolent and filthy in its habits; yet, perhaps, no domestic animals are more pleased with a clean and comfortable sty, and on none is the advantage of cleanliness more obvious in making them thrive. The kind of food given to swine has a very great influence on the quality of the flesh. Skimmed milk and peas, oats and barley meal, rank first in excellence as food for making delicate pork. Milk will fatten pigs entirely without the addition of any other substance: a practice sometimes followed in the dairies; and milk-fed pork is the most delicate of any. Corn-fed pork is next in value; peas, oats, and barley being the best adapted grain. Pork fed on beans is hard and ill-flavoured; that which is fed entirely on grains has the fat spongy; fermented grains and the must of cider render the hogs bloated, and liable to fits of the gout, from being kept in a state of constant intoxication. Potatoes make a light, insipid flesh; hence the Irish pork and bacon is inferior to the English, and the market price is in proportion. Oil-cakes make a flesh little better than carrion; and butchers' offal causes the flesh to be full of gravy, but to have a disgusting strong taste and smell. For bacon and flitches, the hogs are fattened on purpose, and then their food will depend on the circumstances of their owners. In breweries and distilleries, grains, and in dairies, buttermilk, form the chief part of their food: with farmers, the food is turnips, potatoes, grains, and whatever happens to be the produce of the farm. Compared with the general consumption of pork, the real *dairy-fed* meat bears a very small proportion, and the sale of it in the metropolis is in very few hands, and always commands a superior price.

Round the forests in England it is the custom to drive the pigs in at the proper season, that they may feed on acorns and various kernels which fall from the trees. It is said that the Westphalia hams owe much of their excellence to a similar practice. The astringent property of acorns may, perhaps, harden the flesh, and communicate a peculiar flavour.

1853. *Of all animal food, pork takes salt best, and preserves best:* hence its great use in naval stores. A smaller quantity of salt will keep it than any other meat; it acquires saltness more slowly than any other; and with the same degree of saltness it remains succulent and sapid.

1854. *The hog is a very prolific animal, and of very rapid growth,* consequently no other article of flesh provision can be raised and prepared for market so soon and at so little expense as pork: in consequence, it must be materially instrumental in the production of plenty, and in restraining the exorbitant price of the first necessaries.

A remarkable instance of the fecundity of these animals occurred in this country lately. A sow belonging to Mr. Thomas Rishdale, Kegworth, Leicestershire, had produced in the year 1797 three hundred and fifty-five young ones in twenty litters.

Leicestershire, Northamptonshire, and Hampshire are famous for hogs, which seems owing to their being clayey counties, where much peas and beans are sown. The Western pigs, chiefly of Berks, Oxford, and Bucks, make excellent bacon and hams; but the pork of Essex, Suffolk, and Norfolk is smallest, and most delicate for roasting, &c. The demand for porkers in London, which is very great, and continued throughout the year, is chiefly supplied from the dairies within reach of the metropolis; but the winter months are the principal for pork or pig meat. Swine for pork are killed at from six to twelve months old.

1855. *This animal affords a preparation called brawn,* that cannot be made from any other. It consists chiefly of the adipose membrane, or that which contains the fat, rolled up and closely compressed, so that much of the oil is squeezed out, while the cellular texture remains so closely united as to form a semi-transparent substance. It is very nutritive for those persons whose stomachs can dissolve it.

1856. *Sucking pigs* are killed when about three weeks old. They are fattened with milk and whey, with the addition of barley meal. By some persons their flesh is considered as a great delicacy; by others it is found to be too luscious; it is very nutritive, but not so readily dissolved in the stomach as might be supposed. They may be had in London all the year round, but are not reckoned wholesome in hot weather.

Sect. V.—Deer (*Cervus*, Linn.).

1857. The old huntsmen called the flesh of every animal that was hunted *venison*, but with us this term is restricted to animals of the *deer* kind.

In the hunter state of society, men chiefly subsisted on the produce of the chase; they lived much upon venison, which is certainly not only a delicious, but a nutritive and wholesome food. Fallow deer is, upon the whole, the best, though the flesh of the wild stag is the highest flavoured, and very palatable in autumn, when it is in its most perfect state.

1858. *There are three species of deer in this country:* the stag, the roe, and the fallow or common deer.

1859. *The stag, or red deer* (*Cervus Elephas*, Linn.), is the largest of our deer tribe. It is found in nearly all the temperate countries of Europe, particularly the woody parts of Germany; it is also met with in Asia and North America, but attains its largest size in Siberia. From the branchiness of its horns, which are divided into many round and sharp-pointed processes, the elegance of its form and movements, and the strength of its limbs, it may be regarded as one of the principal embellishments of the forest. This animal, the colour of which is a strong reddish brown, is supposed to have been introduced into England from France; and the hunting of the stag was formerly a favourite diversion with royalty and the nobles; but, being of a nature sometimes extremely fierce, it has latterly been made to give way to the fallow deer, much more gentle in its manners, and more valuable as food. At present it is rarely to be found in England; but in the Highlands of Scotland it yet exists in its original wild state. A stag of five years old is called a *hart;* the females are termed *hinds;* and the young ones are *fawns.* This species is considered by some as affording the most sapid venison; but it is usually lean, and rather tough.

1860. *The fallow deer* (*C. Dama*, Linn.) is smaller than the stag, and it has great elegance, connected with a much more tractable disposition. It abounds in almost all parts of Europe, except in the cold regions of the North, where its place is supplied by the reindeer.

It is said to have been first introduced into Scotland by King James I., out of Norway, and afterward placed in his chases of Enfield and Epping. It is scarcely seen in France and Germany, and has never been known to exist in America. In Spain these deer are extremely large; and they are met with in Greece and China; but in every country, except our own, they are in a state of natural wildness.

The fallow deer, so called from an early word, *falow*, to be pale, is the species generally seen in our parks, where they are confined; but some have kept them in a small yard with a shed, and fattened them in the same manner as cattle for their venison. There are several varieties, as the Spanish deer, the mottled deer, and the Virginian deer. The fallow deer is distinguished by having the horns dilated into a broad, flat, subdivided expanse at the upper parts.

The *buck* of the fallow deer may be killed at six years old, but is better at eight years of age. The female, in general, being naturally more tender, and getting tough rather than mellowing by age, is sooner in perfection.

1861. *The males of the deer tribe are in highest season* from the middle of June to the middle of September, after which they become thin and exhausted. Buck venison is preferred as the choicest meat, and the haunch as the finest joint. Does which have had no kid, or soon deprived of it, are in season from the middle of November to the middle of February. Venison is more sapid than any butcher's meat, and is considered as very digestible. Its grain resembles most that of mutton, but its taste is different.

1862. *The roe deer* (*C. Capreolus*, Linn.) is the smallest of the deer tribe that are natives of Europe. It is generally of a reddish-brown colour, and differs in character from the stag and fallow deer. Instead of herding together, they go in separate families. It is never tamed, and is to be found at present only in a few districts of the Highlands, delighting in vales, as the fallow deer does in plains. Venison of the roe buck is excellent when the animal is in good order, but otherwise it is but indifferent and lean: after two years of age, that of the males is tough.

1863. *The moose deer, or elk*, of Northern Europe and America (*Cervus Alses*, Linn.), affords a venison that is extremely sweet and nourishing. The Indians say they can travel three times farther after a meal of moose than of any other animal food. The tongue is excellent, and the nose is considered as the greatest delicacy in Canada. It is the largest of the deer tribe.

1864. *The reindeer* constitutes the chief wealth of the Laplanders, and supplies that simple and harmless people with many of the chief conveniences of life. Its flesh is excellent.

1865. *The horns of the deer tribe* are of the nature of bone, containing a large quantity of gelatin, which may be extracted by boiling, as is done in making hartshorn jelly; and they differ in this respect from the horns of the ox and sheep, which consist mostly of albumen, and can only be softened, but not dissolved, by water. The horns of the deer are cast off annually; a natural joint forming at their base, between them and the bones of the scull, with which they are connected. They are afterward reproduced, and, while young, are covered with a skin, serving as a periosteum, which the animal rubs off when the new horns have attained their proper size.

SECTION VI.—GOAT (*Capra Hircus*, Linn.).

1866. *The wild goat—the supposed original of our domestic species*—inhabits the mountains of Persia and the Caucasus. In its domestic state it is found in almost every part of the world, bearing the extremes of heat and cold, but differing in form according to circumstances. It is a hardy, active, and sprightly animal, possessed of more dexterity than the sheep. Unlike the sheep, the goat approaches man, is easily tamed and familiarized, and is capable of a considerable degree of attachment; but he prefers a wandering life, and to climb and sleep among rocky eminences. He is easily nourished, as he eats almost every plant, and is injured by few; but he does infinite harm to crops and young plantations by feeding on the shoots. The flesh, tallow, hair, skin, and milk are all valuable.

1867. *The domestic goat was anciently held in much estimation as food;* and in modern times, in districts where the animal is common, the haunches are frequently salted and dried, serving instead of bacon. The Welsh call it *hung venison*, to which it is little inferior. The meat of the wedder goat is best; and, under the name of *rock venison*, is supposed to be little inferior to the flesh of deer. It is reckoned peculiarly nutritious in soup. In the West Indies the flesh of both of the ewe and the wedder goat is accounted as good as mutton; and Sir John Sinclair remarks that, both on account of the milk it produces, and its flesh and skin, it is a pity that the West Indian goat is not more attended to in this country. The flesh of the kid is a delicacy everywhere, though not very sapid; in the East Indies it is preferred to lamb. *The suet* is whiter than that of the ox, and is preferable for candles. *The skin* is employed for various kinds of leather; and that of the kid is well known in gloves. *The milk* is abundant, and considered as more wholesome than that of any other animal; when mixed with cows' milk it makes excellent cheese. The goat is very prolific, bringing forth frequently two kids at a time, and often twice in a year. Formerly they were very plentiful in Wales, but they have given place to a small breed of sheep which are more profitable; at present very few goats are to be seen there. As an article of food, of course, the flesh of this animal is now rare in Britain.

1868. *The chamois* very much resembles the goat, and is one of the wildest and most timid of animals. Hunting it in the mountains of Switzerland is often a toilsome and dangerous employment; but its flesh is considered as good food, and a large one will weigh from fifty to seventy pounds. The Swiss salt and smoke the flesh; and the use of the skin is well known.

SECTION VII.—RABBIT (*Lepus Cuniculus*, Linn.).

1869. *The rabbit* is an inhabitant of most temperate climates, but does not reach quite so far north as the hare.

1870. *The wild rabbit* is a native of this island, and is found in great numbers, burrowing in dry, sandy soils, particularly if the situations be hilly or the ground irregular, such as the sandy districts of Norfolk and Cambridgeshire. Enclosures, called *warrens*, are frequently made in favourable spots of this kind, some of which extend to 2000 acres. Rabbits, not being swift-footed animals, are taken by nets, traps, ferrets, and dogs. The common wild rabbit is of a *gray* colour, and is the best for the purpose of food; its skin is valuable, as the pelt is a material for hats; but another variety has been lately introduced, the *silver gray*, the skin of which is more valuable, and is dressed as *fur*; the colour of this is a black ground thickly interspersed with single gray hairs: a great number of them are exported to China.

1871. *Tame rabbits are also reared* in hutches or boxes placed in apartments or sheds. They are easily fattened upon the same food as is given to cattle and sheep—roots, good green vegetables, hay, corn, and peas.

1872. *The flesh of the rabbit* differs somewhat according to its wild or domesticated state. There is some difference of opinion as to which is preferable. The wild rabbit has more flavour; but some prefer the tame one as whiter and more delicate. Wild rabbits are procurable young and in good condition only at particular seasons, as from the end of October to the beginning of January; but tame ones may be always bred in a state fit for the table. The latter are in greatest perfection when three months old; but, if well fed, will not be too old at eighteen months. The flesh of rabbits is inclined to be dry; but feeding them partly on green vegetables makes it more juicy. They become larger and fatter in the tame than in the wild state; but it is not desirable to have them as fat as they can be made. Some that have been fed in coops have been known to exceed a dozen pounds in weight. When very old they are tough, like the hare.

1873. *There are several varieties of tame rabbits.*—The large white and yellow, and white variety, have the whitest and most delicate flesh, and, when cooked in the same way, sometimes rival the turkey. There is also a large variety of the hare colour, the flesh of which is high-flavoured, and more savory than that of the common rabbit; and it makes a good dish cooked like the hare, which, at six or eight months old, it nearly equals in size. All these are to be had of the London dealers and poultry-men.

Rabbits may be easily bred in a small artificial warren where the ground is extremely dry and well drained by a ditch all round it, and having banks raised for the rabbits to burrow in. Food must be provided as when bred in hutches. They are more prolific in their domesticated than in their wild and exposed state.

1874. *The skins*, besides being saleable, are useful in a family for lining night-gowns, and other domestic purposes.

Sect. VIII.—hare (*Lepus Timidus*, Linn.).

1875. *The common hare is found* over the whole of Europe, and in almost the whole of Asia, in North America, and even in Chili. In the polar regions it becomes white in the beginning of winter. It is usually a wild animal, and is taken by hunting in various modes; hence the price of the hare is much greater than that of the rabbit. It is seldom domesticated, though it is capable of being made extremely tame, and is then a remarkably playful animal. An attempt has been made to breed hares in warrens, like rabbits; and some are of opinion that this might be practicable in certain dry situations; but confinement always injures their flavour: those which live in mountains are superior to those which are found in low grounds. They do not burrow under ground, like rabbits, but make a slight depression, called their *form*, in which they rest: its quickness of sight and hearing, and its timidity, are well known.

1876. *Its flesh* is considered in many respects superior to that of the rabbit, being much more savoury, and of a higher flavour; it is, however, a dry kind of animal food, and requires much gravy, stuffing, &c., and this natural dryness is too often unnecessarily increased by the common practice of soaking it in water for some time before it is dressed, which deprives it of its juices. It is not fit for table immediately after being killed; but requires to hang up for some days to make the flesh tender. An old hare is excessively tough, and scarcely fit for stewing. It is less digestible than the flesh of the rabbit, and should not be eaten by dyspeptics. Ude directs, in order to ascertain whether a hare is young, "to feel the first joint of the fore claw: if you find a small nut, the animal is still young; should this nut have disappeared, turn the claw sideways, and if the joint cracks, that is a sign of its being still tender." Dolby says, "if the ears feel tender and pliable, and the claws smooth and sharp, the hare is young."

1877. *Hares are reckoned game*, and the *game laws*, which formerly were the source of much incentive to vice, were the remnant of the ancient forest laws, under which the killing one of the king's deer was a capital crime.

These laws declared what birds and beasts should be called game, and prohibited every one not duly qualified by birth or estate from killing any of them. By a statute passed in 1831, the old system was considerably modified. The whole of the former provisions respecting qualification by estate or birth were removed; and any person obtaining a certificate is now enabled to kill game either upon his own land or on the land of any other person with his permission. The sale of game is, under certain restrictions, legalized; and being deemed an article of legal traffic, summary means are provided for protecting it from trespasses. Poaching in the night-time still remains punishable by imprisonment for the first two offences, and by imprisonment or transportation for the third.

The word game includes hares, pheasants, partridges, grouse, heath or moor game, black game, and bustards; and the periods during which the different species of game may not be killed are those of the breeding and rearing seasons of the different species; penalties are imposed upon persons laying poison for game, or destroying the eggs of any bird of game, or of any swan, wild duck, teal, or widgeon, or knowingly having possession thereof.

CHAPTER IV.

MILK, BUTTER, AND CHEESE.

SECT. I.—MILK, AND THE VARIETIES OF FOOD PREPARED FROM IT.

SUBSECT. 1.—*General Remarks.*

1878. The general properties of milk are well known; but it will be useful to describe its chemical composition, and the various changes it undergoes; since it is in consequence of these that we are enabled to prepare from it so many articles of diet.

1879. *Milk is obtained only from the class of animals called Mammalia*, and is intended by nature for the nourishment of their young. The milk of each animal is distinguished by some peculiarities, but as that of the cow is by far the most useful to us in this part of the world, our first observations will be confined to that variety.

1880. *When the milk of the cow is taken away periodically*, the supply is continued for some time; and hence the great value of this animal to man, who is indebted to her for three of the most useful articles of food, milk, butter, and cheese.

SUBSECT. 2.—*Properties of Cow's Milk.*

1881. *Milk, when just drawn from the cow*, is of a yellowish white colour, and is the most yellow at the beginning of the period of lactation. Its taste is agreeable, and rather saccharine. The viscidity and specific gravity of milk are somewhat greater than that of water; but these properties vary somewhat in the milk procured from different individuals. On an average, the specific gravity of milk is 1.035, water being 1. The small cows of the Alderney breed afford the richest milk.

1882. *On comparing the milk of two cows*, in order to judge of their respective qualities, particular attention should be paid to the time that has elapsed since their calving, as the milk of the same cow is always thinner soon after that time than it is afterward; and it gradually becomes thicker, though less in quantity, in proportion to the time that has elapsed since the cow has calved.

1883. *The milk that is drawn first* at one milking is also thinner and of a worse quality than that obtained afterward; and the richness of the milk continues to increase progressively to the very last drop that can be obtained from the udder. It is even said that the last milk is at least eight or ten times richer than the first.

1884. *Milk which is carried to a considerable distance*, so as to be much agitated, and cooled before it is put into pans to settle for cream, never throws up so much, nor such rich cream, as if the same milk had been put into pans directly after it was milked.

1885. *When exposed to heat*, milk boils at 199°, water boiling at 212°; and in the boiling a curd or caseous matter is partly coagulated, rising to the surface in form of a pellicle or thin skin; if this be removed it is soon succeeded by another, and the effect would go on till the residuum would have a watery appearance, and be incapable of furnishing any more such pellicle. But when milk is very slowly evaporated without boiling, it forms a kind of thick extract of milk, which is called *franchipane;* this, being mixed with sugar, almonds, and orange flowers, constitutes a sweetmeat or custard.

1886. *The quality of cow's milk varies considerably, likewise, according to the manner in which the cows are fed and managed.* In order to possess an abundant supply, it is necessary to have recourse to a constant and plentiful feeding of the animals with rich, luxuriant green food. Certain kinds of food affect the flavour and richness of the milk. Cabbages and turnips impart their peculiar flavour, and injure its quality; and the smallest quantity of wild garlic, if eaten by the cows, is discoverable by the taste. When fed on grains, which is the case frequently in large towns, cows give poor milk.

1887. *Description of the spontaneous changes which milk undergoes.*—When milk is suffered to remain at rest for a short time, it separates into two parts. The *cream* rises to the surface, a yellowish-white, unctuous fluid, with a peculiarly rich taste, containing the greatest part of the butter. After the cream has separated, and is removed, what remains is termed *skimmed milk:* this is much thinner than before, and has a bluish white colour. The milk, now deprived of the cream, if exposed for a day or two to a temperature of from 60° to 70°, becomes a thick coagulum, and during this change it is found that the milk has become sour; an acid has been formed, which has occasioned the milk to separate into two portions, *curd*, called also *caseous matter*, and *whey*. The acid which has been generated and contained in the whey is the *lactic acid*. This coagulum, curd, or caseous matter, however, when produced by *spontaneous* change, is not capable of forming cheese: for this purpose it must be made in a different manner.

SUBSECT. 3.—*Artificial Coagulation of Milk.*

1888. *To produce the kind of coagulum, or curd, necessary to make cheese, some substance* *must be added to the milk* for that purpose: the material usually employed in this country is *rennet*, a liquid procured by boiling a portion of the inner coat of the stomach of young ruminating animals, particularly that of the calf; and it is kept salted and cured for this purpose. The effect produced by the rennet is owing to some of the gastric juice of the calf's stomach, which adhered to it, and which is thought to be somewhat of an acid nature. To coagulate, or *turn* the milk, as it is called, into curds and whey, it is heated to about 90° or 100° before the rennet is added. The proper quantity of rennet, and the just degree of heat, can only be learned by a little practice. To make rennet, the inside of the stomach of pigs will also answer, and even the membrane that lines the inside of the gizzard of fowls and turkeys; this last makes the *gallino rennet* of Italy. Many other substances will coagulate or turn milk besides rennet—vinegar and acids of all kinds; and the Dutch employ muriatic acid instead of rennet, which is said to be the cause of the pungent relish for which their cheese is remarkable. Many astringent vegetables also have this effect; likewise alcohol, molasses, gelatin, and many neutral salts. The Jews employ ladies bed straw (*Galium verum*) to coagulate their milk in the making of cheese, the Mosaic law forbidding them to mingle meat with milk; and rennet they consider as meat.

1889. *There is a considerable difference between the curd formed by the spontaneous alteration of milk and that by an artificial process.* That produced by spontaneous coagulation is much less solid, and readily unites with water; what is artificially produced is much more firm, and is insoluble in water. Pure curd is *casein*, very analogous to gum and to albumen, although it differs in some respects from both; by boiling it with an alkali, or lime, it becomes a soluble substance that dries very hard and transparent, like gum, and may be employed as a cement.

1890. *Curd, casein, or caseous matter, the basis of cheese*, is, when fresh, white, insipid, inodorous, and insoluble in water. When just made, a portion of whey adheres to it, but when that is removed by pressure and drying, it becomes *cheese.* The white colour of milk is owing to the curd being intimately mixed up with it.

Subsect. 4.—*Whey.*

1891. *The whey which remains after the separation of the curd in the artificial coagulation of milk by rennet* is a thin fluid, yellowish green, and almost transparent, having an agreeable, sweetish taste, in which respect it differs from spontaneously formed whey, which is always distinctly acid. The whey of the dairy retains a little oily matter, or butter, and some unseparated curd. If it be boiled, a whitish scum rises to the surface, and the liquor becomes turbid; but, upon being set to cool, the matter which rendered it turbid falls down, leaving the liquid quite clear. The scum which rises is somewhat analogous to cream, and is capable of affording butter.

1892. *The principal ingredient of whey is water with lactic acid;* the proportion of curd or casein, butter, and sugar, is very small; hence we should not expect to find whey very nutritive; yet it seems to be well calculated as an article of diet in certain states of the constitution, and in febrile complaints; and, containing always a little acid, it is found to be cooling and refreshing. Besides the saccharine matter and lactic acid, whey contains several saline substances in solution, as a small quantity of muriate of potash, muriate of soda, phosphate of lime and of iron, and sulphate of potash. If whey, by the spontaneous coagulation, be long kept, it becomes very sour; but in this state it is a wholesome and refreshing beverage for labouring people.

1893. *Besides rennet whey*, there are several other varieties of whey used as remedies, as white wine whey, tamarind whey, alum whey, &c., for which see Book XXVI., "Domestic Management of the Sick-room."

1894. *Sugar of milk.*—The sweet taste of new milk and whey is owing to the sugar which they contain. This sugar can be produced in a solid form, and, having some medical reputation on the Continent, it is manufactured in considerable quantity, particularly in Switzerland. It much resembles common refined sugar, but is less white, and has little sweetness to the taste. It is less soluble in water than common sugar, but when dissolved in warm water, it makes a beverage like whey. This sugar is now imported into England, and is sold by many respectable chemists in London, being a good deal used by foreigners, particularly French and Swiss. To prepare it, the whey produced in making cheese is first heated, to separate the butter from it, and is then boiled down to the consistence of sirup; it is poured into earthen pots, and exposed to the sun till it becomes nearly solid. The mass is then put into water, and heated till the sugar is dissolved; and the hot liquor being poured through a linen filter, the insoluble impurities are, for the most part, separated; it is then clarified with the white of egg, and deposites, on cooling, a whitish, crystalline mass, which is the sugar of milk. It does not differ much from grape sugar.

Subsect. 5.—*Cream.*

1895. *When new milk has stood still for six or eight hours, the cream separates and forms* a layer upon the surface. That this may take place in the most expeditious manner, and that the largest quantity of cream may be procured, the milk is put into shallow vessels in which it does not stand above three or four inches deep; and the throwing up the cream proceeds with the greatest regularity when the temperature of the dairy is from 50° to 55°. It is essential that the milk should be kept cool in warm weather, to prevent acidity; but much cold is unfavourable, and when the temperature is so low as 40°, the cream forms with difficulty. The cream is usually removed with a skimming dish made of tin or wood. If butter is to be made from it, it is immediately put into a wooden barrel, in which it is collected until there is a sufficient quantity to be churned.

Cream is a yellowish-white, opaque fluid, smooth and unctuous to the touch, and of an agreeable flavour. It consists of a peculiar oil or butter, curd, and serum or whey. According to Berzelius, it contains in 100 parts, butter, 3.5; curd, or matter of cheese, 3.5; whey, 92.0.

1896. *That cream contains an oil* is evinced by its staining clothes in the manner of oil; and when boiled for some time, a little oil floats upon the surface. The thick animal oil which it contains, the well-known *butter*, is separated only by agitation, as in the common process of *churning*, and the cheesy matter remains blended with the whey in the state of *buttermilk*.

1897. *Cream yields its butter more easily* by standing some days, till it acquires a slightly acid taste: no acid is perceived in the butter, but a little is found in the buttermilk, though not so much as in the cream; hence some acid has disappeared in the churning.

1898. *The consistency of cream increases by exposure to the air.* In three or four days it becomes so thick that the vessel which contains it may be inverted without its being spilt. In eight or ten days more it becomes a soft solid, and its surface becomes tough. It has now no longer the flavour of cream, but has acquired that of cheese. This is the process for making what is termed *cream cheese.*

Subsect. 6.—*Skimmed Milk.*

1899. *This is the milk from which the cream has been removed.* When the cream has been taken off within twelve or fifteen hours from the time of milking, the milk is sweet, and forms a most useful article of food, eaten in a great variety of ways; and it is likewise employed for making cheese and butter, as some of these substances still remain in it. If allowed to remain twenty or thirty hours, it coagulates spontaneously, as above stated, separating into a soft curd and whey, the former of which is extremely wholesome, and, eaten with a little sugar, is excellent. If the whey be kept about three weeks in a warm temperature, it passes into the vinous fermentation by means of the saccharine matter which it contains, and a kind of vinous liquor is prepared from it in some countries of Asia, and from that, again, an ardent spirit is obtained.

1900. *Skimmed milk, analyzed by Berzelius,* affords, in 1000 parts, water, 928.75; gaseous matter, with a trace of butter, 28.0; sugar of milk, 35.0; chloride and phosphate of potash, 1.95; lactic acid, acetate of potash, and a trace of lactate of iron, 6.0; earthy phosphates, 0.30. Other chemists have also found a minute portion of sulphur.

Subsect. 7.—*Milk considered as an Aliment.*

1901. *Milk, considered as an aliment, is of such importance in domestic economy* as to render all the improvements in its production extremely valuable. To enlarge upon the antiquity of its use is unnecessary; it has always been a favourite food in Britain: "Lacte et carne vivunt," says Cæsar in his Commentaries; the English of which is, "the inhabitants subsist upon flesh and milk." It is stated by agricultural writers that the breed of the cow has received great improvement in modern times as regards quantity and quality of the milk which she affords, the form of milch cows, their mode of nourishment, and also in the management of the dairy.

1902. *Although milk in its natural state be a fluid, yet, considered as an aliment, it is both solid and fluid;* for no sooner does it enter the stomach, than it is coagulated by the gastric juice, and separated into curd and whey, the first of these being extremely nutritive.

1903. *Milk, being the natural food of young animals, is universally admitted to be one of the most easily assimilated kinds of nutriment,* more particularly when drank immediately after it is drawn from the udder. When it is coagulated artificially by rennet the curd is less digestible. It appears to occupy a middle rank between animal and vegetable food, and is particularly calculated, not only for young persons, but for all those who require very nourishing aliment. With some constitutions it is apt to become acid; but to counteract this tendency, it may be mixed with soda-water, or have a little magnesia, or a very little soda, put into it.

1904. *To understand the perfection of milk as an aliment,* independently of experience, which has universally declared in its favour, we must consider its chemical composition. Dr. Prout has shown that all our principal alimentary matters may be reduced to three classes: the saccharine, the oleaginous, and the albuminous, represented by sugar, butter, and white of egg. Now, milk consists of all three: the curd, or caseous part, which is chiefly albumen; the butter, chiefly oil; and a portion of sugar. Milk is the only substance prepared by nature so completely perfect as to be a compound of these three principles.

1905. *There is a considerable difference in the milk of various animals.*

1906. *Milk of the human subject* is much thinner than cow's milk, and contains more saccharine matter. It yields much cream, but no butter can be procured from it by agitation.

1907. *Asses' milk* comes the nearest to human milk of any other; it has, likewise, more saccharine matter than milk from the cow, and is thinner, with a larger proportion of curd. It is considered as the lightest and easiest to digest of any; hence it is a popular remedy in consumption, but is apt to cause diarrhœa in very delicate persons, if taken in too great a quantity. Artificial asses' milk may be prepared by dissolving two ounces of sugar of milk in a pint of skimmed cow's milk.

1908. *Goat's milk* is something thicker and richer than cow's milk. It has a peculiar aroma, contains a great deal of curd, and makes excellent cheese; also affording butter, which is whiter than that from the cow, and is said to keep longer. The milk of the goat is much used in Spain, Italy, and the south of France.

1909. *Ewe's milk* has the appearance of cow's milk. It affords a larger quantity of cream, forming a soft and very fusible butter. Its curd is very soft and unctuous, and when mixed with that of the cow, it gives it a rich appearance. It makes excellent cheese, and in greater quantity than any other milk, but contains the least sugar of any. Ewes were formerly milked generally in this country, but that custom is nearly worn out of use.

1910. *Mare's milk* contains more sugar than that of the ewe, and hence it is much used in Tartary for making a fermented liquor. It contains scarcely any butter.

1911. *Camel's milk* is used only in Africa.

1912. *Buffaloe's milk* is employed in India; it is nearly the same with that of the cow, but rather thinner.

1913. *From no other substance, solid or fluid, can so great a number of distinct kinds of aliment be prepared as from milk*, some forming food, others drink; some of them delicious, and deserving the name of luxuries; all of them wholesome, and some medicinal; indeed, the variety of aliments that seems capable of being produced from milk appears to be quite endless. In every age this must have been a subject for experiment, and every nation has added to the number by the invention of some peculiarly its own. Milk, likewise, enters as an ingredient into an infinity of dishes, for which we must refer to the receipts for cookery. We shall, in this place, enumerate a few preparations used in England that may be considered properly as varieties of prepared milk, and which, though in these times of modern refinement little thought of, formed some of the luxuries among the articles of simple rural fare of our ancestors.

1914. *Curds and whey*, merely new milk coagulated by rennet, and the curds and whey eaten together, with or without sugar.

1915. *Curds and cream.*—Here the whey is removed, and cream substituted; or, if that be too rich, half cream and half milk.

1916. *Costorphin cream*, so named from a village of that name, two miles from Edinburgh, used to be in repute there and in the environs. The milk of three or four days is put, when first drawn, into a wooden vessel, which is submitted to a certain degree of heat, generally by immersion in warm water; this accelerates the separation of the cream. The milk is then drawn off by a hole in the bottom of the vessel; what remains is put into the plunge churn, and, after having been agitated for some time, is sold as Costorphin cream.

1917. *Devonshire cream, called also clotted or clouted cream.*—This is milk brought very gradually to near boiling, but not quite, in shallow tin vessels over a charcoal fire, and kept in that state until the whole of the cream is thrown up, which will be from twelve to twenty-four hours, according to the season. It is essential, in this preparation, that the simmering should not proceed to boiling. The vessel containing it is then taken off the fire, and the cream remains on it till it is cold, when it is skimmed off, and is extremely thick, but, perhaps, not richer than the best common cream, though often thought so. Some, instead of heating the milk over a fire, put it into shallow vessels, which they set to swim upon boiling water in a copper. It is used for eating with fruit, tarts, &c., and is almost peculiar to Devonshire. It does not readily mix with tea or coffee, except beaten up with a little milk. It is now frequently sent up to London quite fresh.

1918. *Dutch clotted cream.*—In Holland they put the fresh-drawn milk into a pan, and stir it with a wooden spoon two or three times a day, to prevent the cream from separating from the milk; when the whole coagulates, the spoon will stand upright in it.

1919. *Tyre* is the name of a preparation used in India to eat with rice. It is made by adding a little buttermilk to warm fresh milk, and letting it stand all night: it is slightly acid.

1920. *Scotch sour cream.*—At night they put skimmed milk into a wooden tub or pail, having a spigot near the bottom. This vessel they put into a tub a little larger, and fill the space between the two with hot water, and let the whole remain all night. In the morning they take out the inner tub, and, gently opening the spigot, allow the thin milk, called *wigg*, to run off, and the remainder will be found converted into a kind of thick *sour cream*. This is eaten with sugar. To make it requires some practice as to the heat of the water.

1921. *The crowdie of Inverness and Ross-shire* is made (according to the celebrated Megg Dods) by "working together well two parts of fresh sweet milk curd and one of fresh butter. It is then pressed into a shape, and turned out, when it will slice well. It is eaten for breakfast. When put up in vessels it will keep for months, and become very high-flavoured, but mellow. The Arabian cheese is made in this way in vats."

1922. *The supply of such a metropolis as London with milk* is, as may be supposed, a very extensive concern. It has been stated that the number of cows kept for this purpose in the environs of London amounts to 12,000, chiefly of the short-horn breed, and great part of the land in the vicinity is devoted to this object; besides which, a great deal of milk and cream is now brought from the distance of five to twenty miles in the country in tin vessels slung in light spring carts; and, as the means of conveyance are improved, the inhabitants of London may expect a more plentiful supply of this necessary article of food, to which we may add, and of a superior quality; for it cannot be expected that milk procured from cows shut up and fed on distilled grains can equal that produced by cows whose health is supported by grass, and living much in the open air If they are not well fed in winter they often lose their milk. The most considerable London dairies are, one at Islington, belonging to Mr. Rhodes, another to Mr. Laycock, and the so-called Metropolitan Dairy in Edgeware Road. The first is the most complete establishment, containing, on an average, 400 cows. In this the cows are fed on brewers' grains, together with green food and succulent roots, and the whole place is kept extremely clean and well ventilated; but the cows are never allowed to go out. Mr. Laycock suffers his cows to be out some time every day, which, we think, is the best practice. Each cow is allowed a portion of salt. The breed in most esteem with the London cow-keepers is the old Yorkshire stock, or a cross between the Teeswater and the Holderness, as producing the greatest quantity of milk, though it is not of the richest quality. These cows are preferred also, from their great disposition to fatten, for the butcher.

It is publicly stated that it is the practice of some cow-keepers to put by the milk got from the cow at night until the morning, and, when the cream is skimmed off, it is sold as morning's milk. The next morning's milk is treated in a like manner, and sold as evening's milk. The water afterward is added by the retailers. We trust this practice is not universal. It is well known that what is sold for cream is not of first-rate quality; but the sophistications, if any, are too little understood to be easily exposed.

1923. *Adulteration of milk* is very generally complained of, and had, no doubt, been formerly practised to a greater extent than at present, since the means of detection have been pointed out by chemistry. Perhaps the most usual kind of adulteration employed at present is diluting it with water; and it is not easy to detect this fraud except it be carried too far. It is true that the addition of water renders milk of less density or specific gravity; yet, as pure milk varies considerably in this respect, according to the food given to the cattle, and other circumstances, a variation in its weight, except it be very considerable, would not prove that water had been added. M. Barruel, a chemist of Paris, has investigated the adulteration of milk with much care, milk-dealers having been as dishonest in that capital as with us; and he has shown that they increased the specific gravity of watered milk by the addition of another substance, as sugar, which also took off the flat taste given by water, and thus rendered the detection difficult even by the *lactometer*, an instrument for measuring the specific gravity of milk. Water gives to milk a bluish colour; and, to conceal this, it is said that chalk, and also wheat flour, have been added. Chalk is easily found out, because it settles to the bottom after a couple of hours, and then the bluish colour returns; and any person, even of indifferent delicacy of palate, could distinguish the altered taste of the milk. Boiling the flour in the water prevents its settling like chalk; but the existence of any kind of flour or meal may be detected by employing *iodine*, which strikes a blue colour with the starch of the flour. For this purpose, add to the milk or cream suspected some iodine in alcohol, to be had of any respectable chemist; and if there be any flour, arrow-root, starch, or rice, it will be shown by a beautiful blue making its appearance.

1924. *To prevent milk from turning sour in hot weather*, the milkmen of Paris have been in the habit of employing a little subcarbonate of soda or of potash. This, by combining with and neutralizing the acetic acid formed, has the desired effect, and keeps the milk from turning so soon as it otherwise would: the salt that is thus formed, viz., the acetate of soda or of potash, is not at all injurious; and, as pure milk does contain a small quantity of this salt, it is difficult to pronounce upon the addition of any alkali, except there should be some in a free or uncombined state, which does not exist in milk. The addition of a little carbonate of potash will break down the curd that is beginning to form in consequence of souring, or a little calcined magnesia will produce the same effect; but this addition is not unwholesome.

1925. *The possession of a cow affords the most certain method of obtaining pure milk and cream;* and it is scarcely necessary here to remark upon the numerous advantages which a family may derive from it: such as butter churned fresh for breakfast, syllabubs, milk diet, whether in the shape of porridge, arrow-root, and other preparations for children. For the management of a cow, see "Dairy," in a future part of this work.

1926. *An instrument has been employed for measuring the degree of richness of milk very different from the lactometer*, which determines its specific gravity. This instrument ascertains the proportions of cream which any milk will yield, and consists simply of a glass tube a little more than a foot long, with a funnel at the top. The upper two inches of the tube are marked in small divisions, and, when the instrument is filled with milk to the height of a foot, the depth of cream yielded is shown by the marks on the upper part: allowance must, of course, be made for the circumstances under which the cream is formed, and, in comparing two kinds of milk, they should be placed in exactly the same circumstances.

[The first volume ever published on the subject of milk has recently appeared in New-York, by Robert M. Hartley, Esq., an American gentleman, whose philanthropic labours in the service of the great temperance reformation directed his inquiries into this channel, from observing the unnatural methods of producing milk for the supply of large cities, by feeding cows on the refuse of the distillery, and confining them in foul and illy-ventilated stables. The work is fitly entitled, "An Historical, Scientific, and Practical Essay on Milk, as an Article of Human Sustenance," &c., and will be found to contain an ample and elaborate disquisition on the whole subject, meriting the public attention both in its physical and moral bearings. The editor regrets that want of space forbids even extracts from this valuable work, but to which he refers the curious reader for much original and valuable information on this topic.]

SECT. II.—BUTTER.

SUBSECT. 1.—*General Remarks.*

1927. *Butter is, as we have stated, the oil of milk separated by the agitation called churning;* and it differs from common animal fats in containing, besides olein and stearin, the latter of which is quite fluid at 70°, a peculiar matter to which Chevreul has applied the name of *butyrine* or *butyric acid*, to which the agreeable flavour of butter is owing. It is extensively used as food, and in the culinary art, in this and most northern countries of Europe; in the south of Europe it is little employed, olive and other vegetable oils taking its place. In the warm parts of tropical climates butter is always liquid, and it melts at 96°. In India it is made from the milk of the buffalo, and when clarified it is called *ghee.* Burckhardt informs us that the Arabs are extremely fond of this butter, of which they drink a cupful every morning, and use it, besides, in many other ways.

1928. *Beckman, in his "History of Inventions,"* states "that butter was not used either by the Greeks or Romans in cooking; nor was it brought upon their tables at certain meals, as is the custom at present. We do not find it mentioned by Galen and others of his time as food, though they have spoken of it as applicable to other purposes. No notice is taken of it by Apicius; nor is there anything said of it in that respect by the authors who treat of agriculture, though they have given us very particular information with respect to milk, cheese, and oil. This, as has been remarked, may be easily accounted for by the ancients having accustomed themselves to the use of good oil; and butter is very little employed at present in Italy, Spain, Portugal, and the southern parts of France." In England it has been made from time immemorial, though the art of making cheese is said not to have been known to the ancient Britons, and to have been learned from their conquerors.

SUBSECT. 2.—*General Principles of the Formation of Butter.*

1929. *There are two methods pursued in the manufactare of butter.* In one the cream is separated from the milk, and in that state it is converted into butter by churning, as is the practice about Epping; in the other the whole milk is subjected to the same process, which is the method usually followed in Cheshire. The first method is generally said to give the richest butter, and the latter the largest quantity, though some are of opinion that there is little difference either in quality of quantity.

1930. *The development of an acid appears to be almost essential in the preparation of butter.* To obtain butter readily, either from cream or milk, both these require to be kept for a few days till sourness commences, and in some cases a little warmth is employed to hasten the acidity; but the addition of cream already soured is said to be apt to induce putridity. Butter may, indeed, be made from fresh cream, but it requires much more labour to produce it; and it is said that no butter of good quality can be made from cream that is not more than one day old.

1931. Butter is therefore generally made from cream a little sour, and also from milk allowed to turn thick, or, as it is called in some places, *lapperd.* When very sour cream or milk is churned, the butter-milk, or the milk which remains after the butter has been extracted, is not nearly so sour as the cream or milk had been, and the butter in all cases is perfectly sweet; consequently, the acid which has been evolved has, in a great measure, disappeared during the churning, an effect not easily explained.

1932. *In churning, the heat must be raised* to 50° or 55°, and during the process there is an increase of temperature amounting to 3° or 4°; a little oxygen gas is absorbed, which has been supposed to be by the oil.

1933. *Very rich butter may be made* by using only the latter half of the milking, as it is well known that the first portion of milk drawn from the cow is much less rich than the latter. In the Highlands it is the custom to suffer the calves to suck the first milk, and to use the remainder only for making butter, which by this means they make extremely rich. But this separation could only be made in large dairy farms; and it has been remarked that, in districts where cheese is the principal manufacture, they have the opportunity of making the best butter, contrary to the general opinion; for there they could appropriate the last part of the milkings to the making of butter, and use the first part in making cheese. As it is, while the whole of the cream is taken to make butter, where that is the principal consideration, it cannot be expected that rich cheese can be made of the remainder of the milk.

1934. *The yellowish colour of butter in England is generally in part artificial.* In the summer season, in which the cows are fed on grass, it is seldom requisite to give any artificial colouring to butter, as what it has naturally is sufficient; but in the winter and spring months the natural colour of butter becomes whitish, and often tallowy; the farmers, therefore, to please their customers, use some colouring matter, as arnotto, a dyeing drug produced from the pulp of the seed-vessel of a shrub (*Bixa orellana*) which grows spontaneously in the West Indies; or the juice of carrots, or the flowers of the marigold; but though these substances are all harmless, the practice of colouring butter should be discouraged, as tending to conceal defects, and to destroy one of the tests of good butter.

SUBSECT. 3.—*Properties of Butter.*

1935. *The taste of butter is peculiar* and very unlike any other fatty substance. It is extremely agreeable when of the best quality, but its flavour depends much upon the food given to the cows: to be good it should not adhere to the knife.

1936. *Butter is not changed by a heat that merely melts it; but if exposed to that of boiling water for a little time*, the butter-milk will rise to the top as a scum, and the curdy matter separates in a coagulated state, and falls to the bottom of the vessel with the whey and water, leaving the butter transparent; it is then called *clarified butter*. What is called *oiling*, in the making of melted butter in cooking, depends upon this principle. If butter is required to be oiled, as it is called, it must be melted, and suffered to stand a little, to separate the sediment, and the clear butter is poured off. Butter-milk, from its bad quality, sometimes runs to oil, in spite of the most vigilant cook. When this happens, it is the practice to put a little cold water to it, and to pour it rapidly backward and forward from the saucepan into a basin, which will partially restore it. But there is an easy method of recovering it completely, by adding to it a little salt of tartar (kept in a close-stopped vial for the purpose); then shaking them together, and the creamy appearance will be reproduced.

1937. *Very much of the goodness of butter depends upon the way in which it has been managed after it is made.* It is pressed and worked to get out the whole of the butter-milk; if the whole is not removed, the butter will infallibly spoil in a short time; and if it is too much worked, it will be tough and gluey. Butter is very apt to become rancid; and it cannot be preserved fresh for many days exposed to the air without the addition of some salt; but it is observed, that the more the butter-milk is extracted, the longer the butter will keep; and, by clarifying, it will keep much longer, even weeks and months, without salt.

The tendency to rancidity in butter is increased by the economical method of warming the milk in order to increase the quantity of cream and butter, and by letting the cream remain too long a time before it is churned. The cream that rises without the aid of warmth, and that is formed into butter while perfectly fresh, will yield the most delicate kind, though with more labour, and which may be preserved for the longest time.

1938. *By the application of salt*, the tendency to rancidity is checked: a small quantity of salt is put to all butter as soon as it is made, for the sake of flavour, even when it is called fresh; and various quantities are added, according to the distance it is to be carried, and the time it is to be kept. In hot weather, fresh butter is generally too soft, even when good: to harden it, it may be kept in one of the apartments connected with the ice-house, if there is one, or it may be placed, for a short time, in a vessel with cold spring-water, into which a little saltpetre or common salt may be dissolved. It may be brought to table in water, but should not remain long in it, as this renders it white and of an unpleasant appearance. When butter cannot be obtained quite fresh every day, or every other day, a few pounds may be sprinkled with a little salt, and pressed into an earthenware pan to preserve it from becoming rancid. This small quantity of salt will not prevent it from being quite fit for the usual purposes of melting, for toast, pastry, or bread and butter.

1939. *Butter, with regard to its dietetic properties*, may be regarded nearly in the light of vegetable oils and animal fats; but it becomes sooner rancid than most other fat oils. When fresh it cannot but be considered as very wholesome; but it should be quite free from rancidity. If slightly salted when it is fresh, its wholesomeness is probably not at all impaired; but should it begin to turn rancid, salting will not correct its unwholesomeness. When salt butter is put into casks, the upper part, next the air, is very apt to become rancid; and this rancidity is also liable to affect the whole cask.

For details of the processes in making butter, see Section "Dairy;" and for the manner of salting it, &c., see "Preservation of Food."

SUBSECT. 4.—*Varieties of Butter used in England.*

1940. *Epping butter* is the kind most esteemed in London, on account of its richness, firmness, and fine colour, and is made entirely from cream. This name was originally given, and properly belongs, to butter made from the milk of cows that feed, during the summer months, in Epping Forest, where the leaves of shrubby plants and wild herbs contribute to improve the flavour: a good deal of butter is still made in that district; but much of that made in other parts of Essex goes under the name of Epping butter. It is made up for market in rolls which weigh a pound each. The fine colour is, in general, natural to it; but some manufacturers, it is said, use the juice of carrots or marigolds, which they mix with the cream before churning.

1941. *Fresh butter is sent up to London*, by wagon, from several other counties, as Suffolk, Oxfordshire, Yorkshire, Devonshire, &c. It is made up into various forms by the London dealers, and sold at different prices, according to the quality. A great deal of excellent butter is made in the rich vales of Buckingham and Oxford for the London market. The farmers there keep a large breed of cows, often in herds of fifty or sixty.

1942. *Cambridge butter* is most esteemed in London next to fresh butter; it is always a little salted, but not cured. This butter is produced from cows that feed one part of the year upon chalk uplands, and during the other part on rich meadows or fens.

1943. *Dorsetshire butter* is nearly similar in quality.

1944. *The mountains of Wales and the Highlands of Scotland*, and the moors, commons and heaths of England, produce excellent butter under proper management, which though not equal in quantity, is far superior in quality to that produced from the richest meadows.

1945. *Irish butter* sold in London is necessarily all salted. Some of it is very good, and it is said that the best is sometimes sold in London for Dorset or Cambridgeshire butter, after having been washed and repacked; but most of the Irish butter is of an inferior kind, owing chiefly to the want of attention and cleanliness in the manufacture.

1946. *Dutch butter* has acquired a deserved reputation all over Europe, America, and even India, and is imported in considerable quantities. Its superiority is owing to the fine pasturages of Holland, and in great part to the extreme care and cleanliness with which the butter is manufactured. The best is made in the vicinity of Delft and Leyden. What comes to London is, of course, a little salted: the price is considerably lower than butter of the same quality can be made for in England.

1947. *Kiel and Ostend butter* are well known in London, and, when genuine, are of excellent quality. The salt butter of Holland is said to be superior to that of any other country.

1948. *Whey butter.*—An inferior sort of butter is made from the whey that is separated from the curd in the manufacture of cheese, and is therefore chiefly produced in those counties where cheese is made in large quantities. It is said that in Derbyshire, perhaps, nearly as much butter is made from whey as from cream or from milk. The whey which is pressed out of the cheese is collected, and after twenty-four hours it has thrown up a scum or cream, which is churned for butter.

SUBSECT. 5.—*Butter-milk.*

949. This is the milk that is left after the butter has been separated by churning. In some districts it is either sold to the poor, or made use of by the farmers' servants; but in large dairies it is most frequently employed as a food for the pigs, and in moistening the bran which is given to the poultry in the farm-yard. When quite fresh, it differs from entire milk, as Parmentier has ascertained, chiefly by the absence of the butter or oily part; but it retains the casein, sugar, and salts of milk. In this state it is very nourishing; and being more easily digested than entire milk, it is sometimes recommended to invalids. As it is extremely cooling, it forms a useful beverage in warm weather, and is often drank by labourers in the fields as refreshing. It is particularly employed in this manner in Scotland. When kept a day or two, it acquires an acescency; but it is proper to notice that the acid of butter-milk does not increase the acescency of the stomach, or occasion flatulence, as vegetable acids commonly do, and it may therefore be safely used by dyspeptic persons. In this state it is refrigerant, and should not be taken when the body is very warm. The butter-milk, where cream has been churned, is particularly rich and agreeable. It can seldom be procured in London; but it is easily made in small quantities by putting some fresh milk into a closed vessel, and using the necessary agitation.

1950. *Thick butter-milk.*—In some places, they put butter-milk into a linen bag, and let the whey drop through; what remains is then much thicker, and, eaten with sugar and cream, is excellent.

SECTION III.—CHEESE.

SUBSECT. 1.—*Chemical Principles and General Properties.*

1951. *Cheese is the curd formed from milk by artificial coagulation, pressed and dried for use.* In treating of milk, we have stated that curd, called also casein and *caseous matter*, or the basis of cheese, exists in the milk, and not in the cream, and requires only to be separated by coagulation. The coagulation, however, supposes some alteration of the curd. By means of the substance employed to coagulate it, it is rendered insoluble in water. When the curd is freed from the whey, kneaded, and pressed, to expel *it entirely*, it becomes cheese. This assumes a degree of transparency, and possesses many of the properties of coagulated albumen. If it be well dried, it does not change by exposure to the air; but if it contain moisture, it soon putrefies. It therefore requires some salt to preserve it, and this acts, likewise, as a kind of seasoning.

1952. *All our cheese is coloured more or less*, except that made from skimmed milk. The colouring substances employed are arnotto, turmeric, or marigold, all perfectly harmless, unless they are adulterated; and it is said that arnotto sometimes contains red-lead.

1953. *Cheese requires to be kept* in a dry room where there is a circulation of air, and they should be turned frequently. The room should be kept very clean by sweeping, to prevent the access of mites (*Acarus domesticus*) and other insects. The fly called *Musca putris* deposites its eggs in cheese, which afterward become the maggots called hoppers, or jumpers. Even the common bug will infest cheese if placed near where they resort. The production of mites may be checked by pouring spirits into the affected parts.

1954. *Some prefer cheese when it begins to change blue*, or begins to putrefy; and means are sometimes taken to produce this change, or render it *ripe*, as it is called. This is effected by putting the cheese into a damp place, and turning them from time to time. By this they absorb water, increase in bulk, become unctuous and soft, and begin to give out a peculiar smell, which increases until it becomes ammoniacal. Some gourmands, instead of allowing them to absorb water, saturate them with port wine or strong ale. The blue mould that appears upon the surface of cheese that has been cut and kept shut up too close is a species of fungus, or minute vegetable, and may be distinctly seen when examined by a magnifying glass; but the blue mould which appears in the interior of cheese is a substance not well understood.

1955. *Cheese, when analyzed*, is found to consist of carbon, 59·781; hydrogen, 7·429; oxygen, 11·409; nitrogen, 21·381. From its containing so large a quantity of nitrogen, it must be considered as a highly animalized substance.

1956. *As diet* for persons in sound health, and who have plenty of exercise, it appears to be salutary; but to those of weak constitutions, and valetudinarians, it is sometimes found difficult of digestion, particularly what is made of skimmed milk and much dried. Vauquelin has shown that cheese contains ammonia, particularly old cheese, and the odour of ammonia is very evident in what is decayed. It is probably the presence of this alkali that causes old cheese to prevent the injurious effects of acid fruits, as well as to render their taste milder. The fatness of cheese cannot be ascertained by its appearance: toasting shows this quality best. Some cheese, apparently fat, dry up with the heat, while some apparently dry cheese, when toasted, become fat. Cheese requires a certain time to acquire its proper flavour. When too new, it is insipid and wasteful.

1957. *Cheese varies in quality and richness* according to the materials of which it is made. It is made, 1, of entire milk, as in Cheshire; 2, of milk and cream, as at Stilton; 3, of new milk mixed with skimmed milk, as in Gloucestershire; 4, of skimmed milk only, as in Suffolk, Holland, and Italy.

When new milk or cream is employed partially, there is a good deal of fat or butter in the cheese, as in the Cheshire, Stilton, and Gloucester, whereas skimmed-milk cheese contains very little fat; but it is admitted by good judges that the quality of cheese depends as much, at least, upon the mode of manufacture as on the materials. Some of the most agreeably-tasted cheese is made of skimmed milk, as the Parmesan, and some of the Dutch cheese. Rich or fat cheese is prone to decomposition, and is apt to collect mites or maggots: hence the poor cheeses, such as the Dutch, are preferred for carrying to sea, from their keeping better. Braconnot has shown that the flavour of cheese depends upon a peculiar principle, which he has called *caseic acid*. For the process of making cheese, see Book XXV., "Dairy."

Subsect. 2.—*Varieties of Cheese.*

The principal varieties of cheese used in England are the following:

1958. *Cheshire cheese.*—This cheese is famous all over Europe for its rich quality and fine, piquant flavour. It is made of entire new milk, the cream not being taken off. The cheeses are generally of very large size, usually about sixty pounds' weight, and some have been made of one, or even two hundred weight. Each cheese is usually made of the produce of one day's milking from herds of from 100 to 200 cows, who feed in rich pastures on some of the finest land in England. Their excellence must be attributed to the goodness of the milk, their size and age, and the skill employed in the manufacture. The colour is not entirely natural; but a yellow tint is given by *arnotto*, marigolds, or carrots. It is said that some increase the richness and mellowness of the cheese by adding beef suet, or any other wholesome and sweet fat well clarified, which is poured into and mixed with the curd.

1959. *Gloucester cheese* is much milder in its taste than the Cheshire. There are two kinds of Gloucester cheese, single and double. *Single Gloucester* is made of skimmed milk, or of the milk deprived of half the cream; of course it is not very rich, but is often of good flavour. *Double Gloucester* is a cheese that pleases almost every palate: it is made of the whole milk and cream, and is a fat cheese, usually the kind employed for toasting, though the single often toasts very well. These cheeses are made of various sizes, the single generally eight to the cwt., and very thin, and the double four to the cwt., and at least twice as thick. As the two kinds sometimes resemble each other considerably, some honest farmers stamp a figure of a heart upon the single Gloucester, to distinguish it from the double. The true characteristics of Gloucester cheese consist in its great richness, together with the mildness of its flavour, and that smooth, waxy texture which makes it cut, even in thin slices, without crumbling, as Cheshire cheese is apt to do. Its oily matter is retained in toasting, by softening without being burned.

1960. *Stilton cheese.*—This, from its peculiar richness and flavour, has been called the Parmesan of England. Its name is derived from having been first made at Stilton in Leicestershire, though it is now manufactured very generally throughout the counties of Cambridge, Huntingdon, Rutland, and Northampton. It is made by adding the cream of one day to the entire milk of the next. The cheeses are all of a small size, from six to eight pounds' weight, and are of a cylindrical form, made in a deep vat, and are not considered to be sufficiently mellow until they are two years old, nor ripe until they exhibit spots of blue in the interior, marking the commencement of decay. It is said that some keep them in warm, damp cellars to accelerate the ripening. The blue part is of a peculiar nature, different, it is said, from the common blue mould of cheese. The decay should not be advanced beyond a certain point. A variety of Stilton, but not so rich, or of so fine a flavour as the last, is made in a net, and of the form of a pine cone, the net impressing lines on its surface.

1961. *Cottenham cheese,* made near a town of that name in Cambridgeshire, is a thicker kind of cream cheese than Stilton. Its superior delicacy and flavour are attributed to the fragrant herbage on the commons where the cows are pastured.

1962. *Sage cheese,* called also green cheese, is made chiefly in the vales of Gloucester and Wiltshire, by colouring some curd with bruised sage, marigold leaves, and parsley, and mixing this with some uncoloured curd; the whole is then made into a cheese, which, of course, exhibits a mottled appearance.

Among the Romans it was a practice to flavour cheese with thyme and other sweet herbs; and this custom was continued during the middle ages. We are told that the Emperor Charlemagne, arriving at a bishop's palace on a fast day, could get nothing but bread and cheese. The prelate, observing the king picking out with his knife small specks, which he mistook for impurities in the cheese, informed his guest that they were parsley seeds. The monarch tasted them, and liked them so much that he requested the prelate to send him an annual supply of cheese prepared in this manner.

1963. *Chedder cheese* is not exclusively made at the village of Chedder, in the Mendip Hills, Somersetshire. A great deal of the same kind is also made round Bridgewater, and in the marshes round Glastonbury. The cheese is peculiar, much resembling Parmesan; it has a very agreeable taste and flavour, and has a spongy appearance, the eyes being filled with a limpid and rich, but not rancid oil. The cheeses are generally large. But little of the prime Chedder cheese is made, that generally sold for it not being genuine, and is inferior.

1964. *Brickbat cheese.*—There is nothing remarkable in this except its form. It is made by turning with rennet a mixture of cream and new milk. The curd is put into a wooden vessel the shape of a brick, and is then pressed and dried in the usual way. It is best made in September, and is ready in six months.

1965. *Dunlop cheese* is famous in Scotland: it is so called from the Parish of Dunlop, in Ayrshire, where it was first or best made, and where the pastures are very rich; but it is now manufactured in other parts of Ayrshire. The best is made entirely from new milk, and it has a peculiarly mild and rich taste; but there is nothing remarkable in the manner of making it.

In some parts of England they never churn the milk, but only the cream; consequently they make little butter-milk, because the servants will not eat this, though they have no objection to skimmed milk. In Scotland and Ireland, on the contrary, they churn all the milk, and have, of course, much butter-milk, which is much relished there.

In the Highlands of Scotland they make a cheese for the table of a very high *gout*, an almost Tartarian preparation, by allowing the milk to become sour, and to coagulate of itself, which gives a flavour even more pungent than that of goat's-milk cheese.

1966. What is called in London *new cheese* is made chiefly in Lincolnshire, and is either made all of cream, or, like the Stilton, by adding the cream of one day's milking to the milk that comes immediately from the cow: they are extremely thin, and are compressed gently two or three times, turned for a few days, and then sent to be disposed of to be eaten new with radishes, salad, &c. It may be made in the following manner: Warm some cream, add rennet in the proportion of a spoonful to a pint, or more if necessary. Put the curd into a sieve, having a cloth at the bottom; when it has remained twenty-four hours, transfer it to a cheese vat, and cover it with a wet cloth and board; in about two hours it may be used.

1967. *Skimmed-milk cheese.*—Cheese made from the curd of skimmed milk, when all the cream has been separated, has in it no butyraceous matter, but is the caseous substance in a pure state, resembling very nearly white of eggs or albumen, or, perhaps, more nearly the gluten of wheat. This cheese from skimmed milk only is made in those districts of England where butter is the chief object of the dairy-man, as in Essex and Suffolk. What is made in England of this kind has scarcely any flavour, and dries almost as hard as horn, but is as digestible as the softer cheese, though not very palatable. It is, however, useful as part of ship stores, being less liable to spoil on a sea voyage than richer cheese, particularly in a warm climate. On the subjec of skimmed-milk cheese Dr. Anderson, celebrated for his writings on agriculture, observes that it is an erroneous idea to suppose that the agreeable taste of cheese depends solely upon the quantity of oily or fat matter it may contain. Parmesan cheese is made of skimmed milk; so are the Dutch cheeses, which many consider as very pleasant tasted. He has seen cheese made of skimmed milk that ate exactly like the finest cream cheese, and he considers that what is called richness in cheese depends as much upon the particular mode in which they are manufactured as upon the materials of which the cheese consists. In confirmation of this opinion, he remarks that, though the taste of double Gloucester differs so much from Cheshire cheese, yet they are both made from the same kind of milk.

1968. *Parmesan cheese.*—This most celebrated of all cheese is made in the duchy of Parma and Piacenza, and in various parts of Lombardy: at present the district of Lodi is in high repute for it. It was formerly supposed to be made from goats' milk; but it is made merely of skimmed cows' milk, and the high flavour which it has is supposed by some to be owing to the rich herbage of the meadows of the Po, where the cows are pastured, and by others solely to the process by which it is manufactured, a particular account of which may be seen in Cadell's "Journey in Italy, 1818." Half the milk has stood sixteen or seventeen hours, and the other half has stood only six. The milk is heated and coagulated in a caldron, and, without being taken out of the caldron, the curd is broken very small by an implement consisting of a stick with cross wires; it is again heated, or, rather, scalded, till the curd, now a deposition from the whey, has attained a considerable degree of firmness; it is then taken out, drained, salted, and pressed, and in forty days it is fit to put into the cheese loft. The best Parmesan is kept for three or four years, and none is carried to market till it is at least six months old. Another account of the manner of making it is to be found in the seventh volume of the Bath Society's papers, and in the second volume of Mr. Arthur Young's "Travels in France."

1969. *Dutch cheese.*—In Holland they coagulate their milk with muriatic acid instead of rennet, which occasions that pungent taste peculiar to this cheese, and preserves it from mites. The *Gonda* is most celebrated, which is made with extraordinary care. A detailed description of the mode of making it is published in the *Jour. Agri. des Pays Bas*, and is quoted in the excellent work by Margaret Dodds. The best Dutch cheese is made in the environs of Leyden, at Eidam and Friezland, where also a very large quantity is manufactured for England, of skimmed milk, chiefly for sea stores. In the Texel they make cheese from ewes' milk: a good deal of Dutch cheese of a round form comes now to London; it is of a low price, and frequently of very good quality.

1970. *Swiss cheese.*—Switzerland has been long celebrated for its cheese: several varieties of cheese are produced there, and though made of skimmed milk, or partially skimmed milk, yet are they remarkable for their fine flavour, which is partly owing to the herbage of the mountain pastures. That denominated from *Gruyère*, a bailiwick in the canton of Fribourg, is best known in England. This is flavoured by the dried herb of *Melilotos officinalis* in powder. The cheeses weigh from forty to sixty pounds each, and require to be kept in a damp place, and washed frequently with white wine to preserve it from the depredations of insects. Until of late, the manufacture of this cheese was limited to a few wealthy persons: as it is necessary for its quality that the cheese should be very large, and that the milk should be coagulated on the day it was taken from the cow, it was only by keeping a large number of cows that the manufacture could be carried on, and the owner of a few cows only was unable to succeed. At present, how ever, it appears that cheese dairies have been established by the poor peasantry joining together, and thus competing with the more wealthy. Another excellent cheese is made at *Neufchatel.* The *Schabziegar* cheese is made by the mountaineers of the canton of Glarus. It has a marbled appearance and aromatic flavour, from the bruised leaves of the melilot. The milk is exposed to the temperature of 46° for five or six days, when the cream is completely formed, and is taken off. The skimmed milk is coagulated by sour milk, and not by rennet, and the curd thus obtained is pressed strongly in bags, and when sufficiently pressed and dried, it is ground to powder, salted, and mixed with the bruised flowers or seeds of the Melilotos officinalis, and afterward again pressed into cheese. The entire separation of the cream, or unctuous part of the milk, is essential. Some Swiss cheese is also manufactured from a mixture of ewe-milk with that of the cow.

1971. *Westphalia cheese* is a skimmed-milk cheese, and is a remarkable instance of how much the quality of cheese depends upon the manufacture. It is described by some as being preferable to the Dutch, Swiss, and even Parmesan cheese. The cream is allowed to remain till the milk beneath is sub-acid; it is then removed, and the milk placed near a fire to coagulate. The whey is next expressed from the curd, which is dried and crumbled between the hands. It remains for several days until the putrid fermentation commences; but this is stopped by kneading it into balls with carroways, salt, butter, pounded pepper, and cloves. Sometimes these balls, or little cheeses, are hung up in the smoke of a wood fire.

1972. *Cheese from milk and potatoes* is manufactured in Thuringia and Saxony. The best potatoes are half dressed in steam, peeled, and reduced to a pulp. Five pounds of this are mixed with from one to ten pounds of sweet curd, and kneaded together, some salt being added; after lying for a few days, this is again kneaded, and then pressed into little baskets, where the superfluous moisture drains off; the cheese are then formed into balls and dried in the shade. These cheeses keep well in the dry, and their quality improves with age, with the advantage that they generate no vermin; their taste is said to exceed the best cheese made in Holland.

1973. *Cream cheese*, although so called, is not properly cheese, but is nothing more than cream dried sufficiently to be cut with a knife. To make it, a quantity of good sweet cream is put into a cheese vat, with green rushes sewed together on purpose, at the bottom of the vat, which must have a sufficient number of holes to let the whey which drains off pass freely away. On the top of this cheese are likewise laid rushes or long grass of the Indian corn, in the same manner as at the bottom, in order to allow it to be turned without being handled. It is usual to make these cheeses from one inch to one inch and a half in thickness. The thinner they are made, the sooner they are ready. It is kept in a warm place to sweat and ripen; but extremes of heat or cold are injurious, and some judgment must be used in managing it.

CHAPTER V.

BIRDS.

Sect. I.—INTRODUCTORY OBSERVATIONS.

1974. *The feathered tribe of animals*, or *birds*, furnish a considerable and varied supply of sustenance to man; and they possess this quality in common with quadrupeds, that none of them are absolutely deleterious when used as food, although their properties in this respect vary considerably. Like quadrupeds, also, some birds which have been found the fittest for the table have been long domesticated, while others remain always wild. Birds of prey are never eaten among us, their flesh being coarse, tough, and ill-flavoured.

1975. *Those which serve us as food may be divided into such* as are domesticated, as the common fowl, turkey, duck, and goose; wild birds, usually termed game, as the pheasant, partridge, grouse, woodcock, &c.; and some other wild birds, that are not considered as game, such as lark, pigeon, &c.

Of birds, both domestic and wild, some are white-fleshed, as the common fowl, turkey, and pheasant; others have a dark-coloured flesh, as the duck, goose, and pigeon, also grouse, blackcock, &c.

Game, in this country, is usually considered as a luxury rather than a general article of food; and it is frequently kept for some time, until it has acquired a peculiar odour, called *fumet*, and a certain slightly aromatic bitter taste.

Of aquatic birds, both swimmers and waders, many are very delicate, though in general they are disposed to become fat, and some have a rank, fishy taste.

1976. *Not only the fattening, but the flavour of birds* is very much influenced by the nature of their food. Those which feed upon grains and vegetables, as the common fowl, turkey, and pheasant, are the most delicate, and have the whitest flesh. Those which live partly on animal and partly on vegetable food, as ducks and geese, are brown-fleshed, and higher flavoured; and those which, being aquatic, live wholly on fish, have a taste savouring of the creatures they feed upon; it is remarked that the same bird may be made to acquire, in a certain degree, a peculiar flavour by managing its food accordingly. If permitted to go at large, with plenty of food, and under favourable circumstances, as in the case of common fowl in a farm-yard, they often get sufficiently fat; but domestic fowls are generally fattened for the market, and sometimes not in the way best calculated to promote their health, and, consequently, wholesomeness as food. Some wild birds are migratory, and can only be had while they remain with us; before the use of gunpowder these were caught by hawks trained for the purpose, a mode of killing calculated to render the flesh more tender; at present they are shot, hawking having gone out of use. Some small birds, as larks, are caught in nets and traps.

1977. *The fat of birds is not dispersed through the muscles or marbled, as it is in quadrupeds*; and different parts of the same bird differ very much in flavour and other properties. Every one knows how much whiter the pectoral muscles which move the wings are, when cooked, than those which move the legs; but the flesh of the latter is more juicy, and, when tender, from being young and well dressed, is by many preferred. The legs of the snipe and the woodcock are always preferred to the breast. The legs of birds are more apt to get tough and stringy when old, particularly the tendons and ligaments; hence the greater difficulty in carving them. The flesh of birds, particularly poultry, is extremely nutritious and easy of digestion; therefore very fit for valetudinarians.

1978. *The internal organs or viscera of birds* are partly eaten; of these the gizzard is digested slowly, and is not proper for dyspeptic persons. The intestines of the wood cock, called the *trail*, when dressed is considered by epicures as a delicate morsel. The liver has a peculiar flavour, from the bile contained in it: by some it is relished, and disliked by others. The livers of geese fattened and enormously enlarged, so much the fashion in some parts of the Continent, are really in a state of disease; and Dr. Prout remarks that it can scarcely be considered as free from danger to eat them.

1979. *The term poultry* is applied to all kinds of domestic fowls brought up in a farm-yard. In Britain, where much butcher's meat is consumed, these are generally esteemed a luxury, and, consequently, are not reared in such considerable quantities as in

France, Egypt, and some other countries, where it is used more as a common article of food. In France, poultry forms an important part of the live stock of the farmer, and it has been said of that country that the poultry-yards supply a much greater quantity of food to the gentleman, the wealthy tradesman, and the substantial farmer, than the shambles. It is well known that in Egypt it has been, from time immemorial, a considerable branch of rural economy to raise domestic poultry for sale, hatched in ovens, by artificial heat. The warmer climates are far more favourable than ours for the purpose of raising poultry; and the same remark necessarily holds with respect to this country, where the warmest and driest soils are best adapted to this production, more especially of chickens and turkeys.

It is conceived that the consolidations of farms, among other consequences, has diminished the quantity of poultry, and, consequently, enhanced the price. Though the gentleman, the yeoman, and the capital rack-renter may sometimes rear enough for the supply of their own table, yet it is not an object with them to produce a supply for the public, and the business of breeding poultry for the market is either left to the cottager, whose means and opportunities are too limited, or to the little tradesmen and farmers. When markets are too distant for the cottagers, their poultry is purchased by the higglers, who carry it to the large towns for sale.

1980. *Hatching chickens by artificial heat* may be mentioned as one of the modes of increasing food, perhaps deserving of attention. This method, we are informed by Diodorus and Aristotle, was practised from time immemorial by the Egyptians, and is still used in that country to a considerable extent. This art is practised very successfully by the inhabitants of a village named Bermé, and by those who live at a small distance from it. Towards the beginning of autumn, the persons who follow it as a trade spread themselves into various parts of the country, and each one offers his services in managing an oven. The ovens are of different sizes, but generally hold from 40,000 to 80,000 eggs. Each Bermean engages to deliver two thirds as many chickens as he receives eggs; and as many of the remaining third as he hatches are his own property. From a newspaper, published by the Egyptian government, it appears that upward of seventeen millions of chickens are annually hatched in this manner in Egypt; and the fowls, when grown up, are not inferior to those produced by incubation.

The members of the French Academy, in the early and middle part of the last century, in consequence of the reports of travellers, made experiments on this subject, under the direction of Reaumur; the trials succeeded, and the details of the methods employed were published in a volume, which was translated into English in 1750. These experiments were repeated by various individuals, not only in France, but at Florence, and in Poland. M. Bonnemain, a physician of Paris, succeeded, in 1777, in hatching chickens in an apparatus heated by hot water; and it is said that chickens produced in this way supplied the table of Louis XIV.

1981. *We give the method used by M. Bonnemain*, which is interesting, because it appears to have been the first example of the mode of producing a very uniform degree of temperature, by means of hot water, now extensively employed in warming buildings.

A box in a wooden building was constructed for hatching the eggs, provided with many shelves in the inside, in which the eggs were placed;* pipes proceeding from a boiler passed between all the shelves, and the heat was kept up by the circulation of hot water through them. The fire being lighted, the temperature is raised till the heat is obtained in the box which is necessary for incubation, which is about that of the human body, or 98°; and this is ascertained by a thermometer placed in the box. It is convenient not to cover, on the first day, more than the twentieth part of the superfices of the shelves, and to add every day, for twenty days, an equal quantity of eggs, so that on the twenty-first day the quantity of eggs first placed will be for the greater part hatched; and we may thus obtain every day nearly the same number of chickens; but this, nevertheless, may be occasionally regulated by the particular season of the year. During the first days of incubation, whether natural or artificial, the small portion of water contained within the substance of the egg evaporates through the pores in its shell; this is replaced by an equal portion of air, which is necessary to support the respiration of the chick; but as the atmospheric air which surrounds the eggs in the box at that degree of temperature is completely dry, or but little humid, so the chick would greatly suffer, or finally perish from this kind of desiccation, were not some remedy provided; and thus, in order that the eggs may be better hatched in the dry seasons, the hens cover them with the earth on the floor of the place where they sit. In artificial incubation, to keep the air in the stove constantly humid, they place it in flat vessels, such as plates, filled with water. When the chickens are hatched, they are removed from the stove, and carried to another box called the cage, where they are fed with millet, and nestle under a sheep's skin with wool in it suspended over them; this is called an artificial mother, and is to supply the place of the shelter afforded by the hen. They also separate, by means of partitions in the cage, the chickens as they are hatched each day, in order to modify their nourishment agreeably to their age. The heat in the water, and, consequently, in the box, is very accurately regulated by means of an apparatus very ingenious, but too complicated to describe in this place. The complete details may be seen in Gill's "Technological Repository," Feb., 1828, p. 70.

1982. *Lately, the public has been amused by the exhibition, in London, of a mode very similar of performing the same process*, which appears to be completely successful. A large box is divided by shelves in the manner of the hot closets that are heated by steam; each division, into which the eggs are laid in flannel, is surrounded on the top, bottom, and sides by steam, and kept exactly to the same temperature. By doors opening into the several divisions, the eggs are perfectly accessible, but must be turned every twenty-four hours. On the eighteenth day the audible sign of life is apparent, by the faint piping of the chick being heard; and on the twentieth or twenty-first day the young creature liberates itself from its prison by breaking the shell in a curious manner with its bill, and by the muscular exertions of its limbs emerges into a new existence. It is curious to see the little animals run about and peck their food, which is ground biscuit, and hard eggs chopped, almost immediately after their birth. These are then put into a low glass case, the floor of which is covered

* A wood-cut of Bonnemain's apparatus is inserted in the section "On Warming Buildings by Hot Water"

with gravel; and in a few days they acquire strength enough to be removed into a larger space on the floor, also covered with gravel. The food is scattered among the gravel, and they feed themselves from the time of eaving the eggs. Upon the whole, the process of hatching in this manner appears to be very simple; but whether it would be profitable, as a speculation, to breed up chickens thus for the market in this climate, where the difficulties will be found much greater than in Egypt, remains to be ascertained by an experiment, which, however, deserves to be made. In New-York, where the climate is severe, they contrive, by means of artificial heat, to make the hens lay all the winter, and likewise breed up chickens.

1983. *Artificial incubation is practised among the Chinese.* Whole swarms of ducks are bred in barges surrounded with projecting stages, covered with coops for the reception of these birds, which are taught by the sound of the whistle to jump into the rivers and canals in search of food, and by another call to return to their lodgings. They are usually hatched by placing their eggs, as the ancient Egyptians were wont to do, in small ovens or sand-baths, in order that the same female may continue to lay eggs throughout the year; which would not be the case if she had a young brood to attend. The ducks, when killed, are usually split open, salted, and dried in the sun, in which state they afford an excellent relish to rice or other vegetables.

1984. *In the following description of birds employed as food*, we have not considered it as essential to arrange them according to the classification usually adopted in treating of their natural history, but rather according to their relative importance as food. They are, however, also grouped according to their natural classes, as nearly as is consistent with our view.

Sect. II.—common or domestic fowl (*Gallus Domesticus*, Linn.).

1985. The tame or domestic fowl, so common with us, is supposed to be derived from some of the wild species which are found in great plenty in the forests of India; but they have been domesticated from time immemorial.

1986. Like other domesticated animals, they have been divided into different breeds, of which those most esteemed here are, the common dunghill or barn-door fowl, often white, but also of every variety of colour; the Dorking; the black or Poland; the Bantam; the game fowl; and the Chittagong or Malay. Besides these, there are several others more rare.

1987. *The common dunghill fowl*, known also by the name of the barn-door, white, or English breed, is of a middle size, and will become fat upon the usual run of the farm-yard, where they thrive upon the offals of the stable and other refuse, with perhaps some small regular daily feeds. At threshing-time they become particularly fat, and both from the full allowance of corn and the constant health in which they are kept, by living in a natural state, and having the full enjoyment of air and exercise, they become the most delicate and high-flavoured of all the varieties.

1988. *Dorking fowls* take their name from Dorking in Surrey, celebrated for breeding them in great plenty and perfection. They are a large and handsome variety, and the flesh is fine, but inclined to a yellowish shade. The lay large eggs, and the capons are generally made from this breed, which has frequently five toes.

1989. *The Poland breed* is black with white tops. Their form is plump; they fatten well, and in quality they are similar to the Dorking, or, rather, superior. They lay abundance of large eggs.

1990. *The every-day, or Dutch fowls*, are smaller than the above, but have still longer plumes, so large, indeed, that their feathers should be cropped occasionally, or they will get into their eyes and blind them. They are called "everlasting layers" from the abundance of their eggs.

1991. *The bantam* is an extremely small variety, originally from India, remarkable on account of its grotesque figure, being generally feathered to the toes. From its size and delicacy, they are very convenient, as they may sometimes stand in the place of chickens, when these are not to be had; and they are particularly useful for sitting upon the eggs of partridges and pheasants, being good nurses as well as layers.

1992. *The game fowls* are rather small; but the flesh is beautifully white, and superior to that of any other variety in richness and flavour. The eggs are small and very delicate; but the chickens are difficult to rear, from their pugnacity of disposition, for which this breed is so remarkable. Great cruelty has been exercised with this animal in making them fight; but it is to be hoped that such unmanly sports will disappear.

1993. *The Chittagong* is an Indian breed, and the largest variety of the species; colour, striped. Their flesh is coarse, dark, and best calculated for soup. They are good layers, but not steady sitters.

1994. *The term chicken* is applied to the young female till they are four months old; after which they are *pullets* till they begin to lay, when they are *hens*. The male is a *chicken* till he is three months old: he is then a *cock-bird* till twelve months old, when he is a *cock*. When deprived of the faculty of procreation, he becomes a *capon;* and a female in the same condition is a *hen-capon*.

1995. *Though in general fowls, when in health, will become sufficiently fat by having plenty of food, with air and exercise*, yet they are commonly fattened for the London market. The means usually employed are, to keep them in confinement, with abundance of food, and little light; so that, in fact, they have nothing to do but to eat. It is a common practice with some housewives to coop their barn-door fowls for a week or two, under the notion of improving them for the table, and increasing their fat: a practice which, however, seldom succeeds, since the fowls generally pine for their loss of liberty; and, slighting their food, lose instead of gaining additional flesh. Such a period is, in fact, too short for them to become accustomed to confinement.

1996. *Fowls are generally fattened by being confined in coops for several weeks.* The privation of light, by inclining fowls to a constant state of repose, except when moved by the appetite for food, promotes and accelerates obesity; but such a state, observes Mr. Mowbray, obtained in this way, cannot be a state of health, nor can the flesh of animals so fed equal, in flavour, nutriment, and salubrity, that of the same species fed in a more natural way. Economy and market interest may, perhaps, be best answered by the place of darkness and close confinement; but a feeder for his own table, of delicate taste, and ambitious of furnishing his board with the choicest and most salubrious viands, will declare for the natural mode of feeding; and in that view, a feeding-yard, gravelled and turfed, a room being open all day for the fowls to retire in at pleasure, will have a decided preference, as the nearest approach to the barn-door system.

1997. *Some places are remarkable for the feeding of poultry:* North Chapel and Kinsford, in Sussex, are mentioned by Rev. Arthur Young. Barley and wheat meal are the bases or chief ingredients in all fattening mixtures for chickens and fowls; but in Sussex the food given them is ground oats made into gruel, mixed with hog's grease, sugar, pot-liquor, and milk; or ground oats, treacle and suet, sheeps' plucks, &c. With these mixtures they are *crammed*, and kept in a coop for a fortnight, when they become fat, and are sold to the higglers. Some of these fowls, when full grown, have been known to weigh seven pounds and more. Oakingham in Berks is another place famous for fattening fowls. The method employed is nearly the same as has been just mentioned. If kept too long upon this food, fever is induced by a constant state of repletion, which renders the flesh red, and frequently kills them. It appears utterly contrary to reason, that fowls fed upon such greasy and impure mixtures can produce flesh and fat so firm, delicate, and wholesome as those which are fattened upon more simple and substantial food. In the system of cramming there are sometimes cruel practices, with the mention of which we do not wish to stain our pages. It is remarked by the best judges that, where artificial feeding is required, the best method is to have feeding-houses constructed, warm and airy, with dry floors covered with sand and gravel, and kept very clean; food should be given in abundance, but of a natural and simple kind, made of grain, oatmeal, milk, boiled potatoes, bread, and sometimes mixed with a little dripping, not more than twice a day, so as to preserve perfect health. The counties of England most productive of poultry are Norfolk, Surrey, Sussex, Herts, Devon, and Somerset. Spring is the best season for breeding chickens; but the attempt to rear winter chickens in this climate seldom succeeds. The spring pullets, properly fed, are particularly fine.

1998. *In the opinion of physicians, both ancient and modern, the flesh of the chicken*, at three months old, is the most delicate and easy to digest of all other animal food; thence it is the best adapted for the stomach of invalids, or the constitutionally weak. Age makes a striking difference in the flesh of fowls; after twelve months it becomes tougher and more insoluble; the male, indeed, at that age, is only fit for making soup, while the pullet is still excellent, although a more substantial viand than the chicken. While young the cock and hen are equally delicate. The capon, when not made excessively fat, has been esteemed one of the greatest delicacies, preserving the flavour and delicacy of the chicken with the juicy maturity of age.

The mode of killing, by drawing or stretching the neck, when unskilfully performed, it may be proper to mention, is productive of great and unnecessary suffering to the animal: sufficient force should be used to break the spinal cord, otherwise death does not ensue immediately.

The common fowl belongs to the order Gallinæ, or gallinaceous birds, which also comprehends the turkey, pheasant, partridge, bustard, peacock, and quail.

Section III.—Guinea Fowl (*Meleagris Numidia*, Linn.).

1999. This bird is so named because first brought from Africa, where only it is wild in great abundance. In a state of nature these birds are gregarious, and are seen in flocks of two or three hundred: they delight in marshy places, but always perch at night upon high trees, or in dry situations. They are about the size of the common hen, but stand higher on the legs. Though domesticated, they retain much of their wild nature, and are apt to wander. They lay very abundantly, and their eggs are excellent. They are not so white in the flesh as the common fowl, but more inclined to the colour of the pheasant; and, like it, the taste is savoury, and it is easy of digestion; by many they are considered as a good sustitute for the pheasant. They are excellent for the table, having somewhat of the same flavour, and they are in season when game is going out.

Section IV.—Turkey (*Meleagris Gallipavo*, Linn.).

2000. This excellent bird is a native of America only. It was introduced into Europe from Mexico, and imported into England from Spain about 1524, in the reign of Henry VIII., since which time they have been successfully bred here, but were so rare in France, that the first which was eaten in that kingdom appeared at the nuptial feast of Charles IX., in 1570.

2001. *The wild turkey* abounds at present in some parts of America, but has become more scarce since the country has been cleared of wood. In March they get so fat that they cannot fly more than three or four hundred yards, and are soon run down by a horseman. In the unfrequented parts bordering on the Mississippi, they may be shot with a pistol. In this state they are black, or a beautiful bronze and green; but domestication produces considerable variety in their colour. The usual weight of the wild turkey is about thirty pounds: it frequents swamps, but repairs to the woods to roost, and feeds upon berries, acorns, and other wild fruit, as well as herbs. Their flesh is excellent.

2002. *There are three varieties in this country:* the black, the copper or speckled, and the white. The black is the nearest to the natural stock, and is larger and more hardy. These abound in Norfolk, and are esteemed superior to others; they often weigh fifteen pounds, particularly when crossed by the large Virginian. It is said that their superiority is chiefly owing to the dryness of the soil in that district; they are brought up by every little farmer in the county, which furnishes the largest supply to the London market; but they do much mischief to the field crops, which prevents many farmers in other parts from keeping them. The white variety is rare here, though common in France.

2003. *The flesh of the turkey* is white, tender, delicate, nutritive, and restorative, of excellent flavour, and more dense and substantial than that of the chicken. Age produces a similar effect as in the chicken: when old, it is good for little except stewing.

The usual mode of killing this bird is tedious: it is bled to death by dividing the blood-vessels under the tongue, the object of which is said to be to make the flesh whiter by extracting the blood. The method may appear cruel, but it does not appear that bleeding to death is attended with much pain to any animal.

Sect. V.—pheasant (*Phasianus colchicus*, Linn.).

2004. This beautiful bird, adorned with rich and splendid plumage, is of the same genus with the common fowl, and crows not unlike the cock. It is said to have been discovered by the Argonauts on the banks of the Phasis, near Mount Ararat, in their expedition to Cholchis, whence the name; and so highly was it thought of by the Greeks, that when Crœsus, king of Lydia, seated on his throne in all the pomp of eastern splendour, asked Solon, then his guest, whether he had ever seen such magnificence before, the philosopher replied that he had seen the beautiful plumage of the pheasant, which he thought superior. The common European or English pheasant has been long naturalized in the warmest and most woody counties of England, and is brown, with less brilliancy of colouring than some foreign varieties which have lately been introduced as fancy breeds, such as the gold and silver pheasants, natives of China, the ring-necks, natives of Tartary, the Bohemian, &c. The golden pheasant is the largest and most hardy.

2005. *The common pheasants are much prized in parks for their beautiful plumage, and are carefully protected as game on account of the delicacy and fine flavour of their flesh.* They feed upon all sorts of insects, like the peacock, as also upon small fruits and seeds, and require woods to shelter them. The cock is voracious and cruel.

2006. *They may be domesticated, though not easily;* but the flesh of those brought up in the house is not comparable to that of the wild pheasant. Upon this bird M. Ude observes: "It is not often that pheasants are met with possessing that exquisite taste which is acquired only by long keeping, as the damp of this climate prevents their being kept so long as they are in other countries. The hens, in general, are the most delicate. The cocks show their age by their spurs. They are only fit to be eaten when the blood begins to run from the bill, which is commonly six days or a week after they have been killed. The flesh of the pheasant is white, tender, and has a good flavour, if you keep it long enough; if not, it has no more than a common fowl or hen." It is in season from October to February, is best a year old, and fat. This bird is very common in France, and, before the Revolution, used to be a great nuisance to the farmers, even near to Paris.

Sect. VI.—partridge (*Tetrao Perdrix*).

2007. *Partridges are to be found in all the temperate countries in Europe,* but are unable to sustain rigorous cold or intense heat: they are most abundant in the Ukraine. They were formerly so common in France that the cultivators were obliged to sow three or four times the corn that was necessary to raise a crop, so destructive are they to the grain. They delight in the concealment of corn-fields, feeding, like the pheasant, upon insects and seeds, and are particularly fond of wild mustard. When the winter comes on, they retire to the upland meadows, and hide themselves among the grass. The partridge is a timorous and simple bird, and is easily taken: it has not been domesticated, though it might be reared like the pheasant.

2008. *It is not equal in point of flavour to grouse, but is considered as a table luxury* in England. Partridges should be chosen young; old birds are good for nothing: when young, they are generally distinguished by a dark-coloured bill and yellow legs; as they get older, the legs turn gray. There is a red-legged partridge, but it is rare in England. The season for the common partridge is from September to February. Partridges, when young, covey together, and thus the sportsman often shoots several at once.

SECT. VII.—BUSTARD (*Otis Tarda*, Linn.).

2009. *This is the largest land bird of Europe*, the male weighing from twenty-five to thirty pounds, and is a native of England. There were formerly flocks of bustards in forty or fifty, in this country, upon the wastes and in the woods, particularly in Norfolk, Cambridgeshire, and Dorset, as well as in various parts of Scotland; but they are now very rarely seen wild here, though still common on the coasts of the Mediterranean. The bustard runs with great rapidity, so as to elude the pursuit of common dogs, but falls a victim to the greyhound, which often overtakes it before it can commence its flight, the preparation for which, in this bird, is slow and laborious, and it flies with great difficulty. The hunting of the bustard was an ancient diversion. The head and neck of the male are ash-coloured; the back barred transversely with black; the belly is white. Their flesh has been ever held most delicious, and they feed principally upon grapes, grain, and worms. The male is distinguished by a circumstance wanting in the female, which is the possession of a large pouch from the throat to the breast, capable of holding several pints of water. They are bred occasionally, feeding like the turkey; and it would appear that they are an object peculiarly deserving of attention with regard to propagation and increase, as it is probable that its flesh will well repay the expense of its food. Bustards are sometimes to be had in Paris, but they are expensive fare, costing generally 4*l.* or 5*l.* each. Captain Cook discovered a prodigious number of them in a bay of Australia, which is, in consequence, named Bustard Bay. Besides this large species, a smaller species sometimes appears in England (*O. tretrax*) not larger than a pheasant.

SECT. VIII.—QUAIL (*Tetrao Coturnix*, Linn.).

2010. *This bird is a native of the East*, and abounds in the Greek islands of the Archipelago, and in Italy. It also inhabits Egypt, and formed one of the supplies which the Israelites obtained while in the wilderness. Quails are birds of passage, and migrate from warmer regions in the spring to colder in autumn. It may be said, indeed, to be a universal inhabitant of the old Continent, but not of the new.

2011. *Quails are found, though rarely, in England;* some entirely quitting it, others shifting their quarters from one country to another, and sheltering themselves, on the approach of winter, among the woods near the sea-coast. They are not domesticated here, and may be reared and preserved in the same manner as the pheasant and partridge; their food is nearly the same as that of the latter bird: when wild, they frequent corn-fields and meadows, and are ensnared by sounding a quail-pipe, an instrument made to imitate the voice of the hen. They are very abundant in France, and are caught in snares, and sent both to Paris and to the London market. The island of Capri, near Naples, produces such vast numbers of them, in consequence of its bishop's income having been formerly paid from the profits arising from them, that the island is sometimes called the Bishopric of Quails. So many as 800,000 have been taken near to Naples in one day; and Buffon states that sometimes clouds of them are seen on the French coast. They are sometimes imported from Turkey and the Greek islands, preserved in fat or clarified butter. With us, they are occasionally seen alive, fattening in cages; and at the poulterers' they sell for three shillings each. Some persons esteem them; but M. Ude says, "Quails, in my opinion, have no flavour; it is only their rarity that makes them fashionable." They are good only when fat. This bird was proverbial among the ancient Greeks as captious and quarrelsome; and quail fighting was one of the sports of the Athenians, as it is among the Chinese in the present day.

SECT. IX.—PEACOCK (*Pavo Cristatus*, Linn.).

2012. *This beautiful and majestic bird is a native of India*, and is found in a wild state in Java and Ceylon, where they perch upon trees like the turkey in America. When the conquering Alexander led his armies into the peaceful plains of India, he is said to have been so struck by the sight of the peacock in the full magnificence of its plumage that he forbade any one to destroy them under pain of death: but its antiquity we learn from the history of King Solomon, and the choice of the goddess Juno, who regarded it as her favourite bird. The peacock has been introduced on the table by the ancients as well as by the moderns, but rather as a showy and ornamental dish, being preserved in some of its fine plumage.

2013. *The flesh is coarse and ill-coloured*, and is scarcely ever eaten in these times. At three years old the splendid tail is complete; and it lives to the age of twenty years. Its chief value is as an ornament to pleasure-grounds, where it is useful in destroying reptiles.

SECT. X.—SWAN (*Cygnus Mansuetus*, Linn.).

2014. *It is now known that the wild swan (Cygnus ferus) is a distinct species from the* *tame bird of the same name.* The trachea or windpipe in the latter is simple and straight; but in the wild swan, after entering the chest a little way, it is reflected from thence in the form of a trumpet, and, again returning, divides into two branches. This structure enables the bird to make the powerful note which it utters in its flight, and which can be often heard when the bird itself is so high as to be invisible.

2015. *The wild swan is gregarious and migratory.* It visits Britain occasionally, and may be seen resting in flocks of five or six, but does not remain here long. It is rather smaller and more slender in its form than the tame species. The flesh of the wild swan is not only eatable, but is held in much consideration in the North of Europe and in America.

2016. *The tame swan* is chiefly esteemed with us as a favourite ornament in sheets of water in parks; for its flesh is ill-flavoured except when they are young, or cygnets, when it resembles the pigeon in taste. It is remarkable, however, that the Romans considered the swan as a great delicacy, while the flesh of the goose was reckoned by them impure and indigestible.

2017. *In former times the swan was served up at every great feast in England* as a dish of state, when the elegance of the table was measured by the size and quantity of the cheer: cygnets were fattened at Norwich for Christmas fare.

Sect. XI.—goose (*Anser Domesticus*).

2018. *The goose is pretty generally spread over the globe,* being met with in Arabia, Persia, North America, Lapland, and Iceland. The colour of the wild goose is uniformly gray, and the taste of the flesh strong and fishy. It frequents the fens of Lincolnshire and other places, and breeds there in the summer; they appear there in large flocks, and are migratory. They are easily tamed and domesticated, which produces a change in the colour of their plumage, no two being then exactly alike, though the predominating colour is white.

2019. *The varieties of the goose are very great* in different parts of the world; but we have only one species in England in common use, which appears to be an English breed. The Chinese and the Canadian goose are kept sometimes, but only for ornament, in pleasure grounds.

2020. *The best geese in England* are probably to be found on the borders of Suffolk and Norfolk, and in Berkshire; but the largest flocks are kept in the fens of Lincolnshire and Cambridge, many persons there having 1000 breeders. Geese, being aquatic birds, thrive best when they have access to water, as in fens, marshes, and grassy-margined pools. Vast droves are sent from the fens every year, to be fattened by the London poulterers. Besides these, prodigious numbers are kept all over the kingdom, on commons, in farmyards, and by cottagers. Part of these provide themselves with food in the summer and harvest, when they are turned in among the stubble to fatten upon the scattered grain.

2021. *The natural food of wild geese* is chiefly of an animal nature; but the tame goose feeds upon vegetables, as grass, corn of all kinds, with garden vegetables, raw or boiled. They are easily fattened by allowing them plenty of food and liberty. In some places it is the custom to cram them; and cruel methods are employed in France and Germany to produce large and fat livers, from which are prepared the celebrated *pâtés*. We are informed by Mrs. Trollope, that "There is one much-prized delicacy that never fails at Vienna; the *pâté de foie gras* seems to be considered as indispensable. Out of twenty-one dinner tables, I have missed it but at two; and as, moreover, no ball-supper is considered as perfect without it, the number of invalided geese must be greater than it is agreeable to think of." Some prefer a goose entirely fattened on the stubble, granting it to have been previously in good case; an over-fattened goose is too oily for delicate flavour. When required to be fattened, feeding-houses are best, where they may be given oats, pease, and bean meal, pollard mixed with the skimmed milk with plenty of water, and clean beds of straw.

2022. *The goose, though apparently a stupid bird, is roused by the least noise in the night,* and the immediate cackling converse which they begin to hold in the approach of apprehended danger is considered as a valuable safeguard, a memorable example of which was their saving the Capitol of Rome from an attack by the Gauls.

2023. *Though greatly relished by some persons as food,* it is not a universal favourite. The flesh abounds in flavour, and is considered to be highly stimulant. When young it is tender, but, in general, it is only adapted for good stomachs and powerful digestion, and should be sparingly used by the sedentary and weak, and by persons subject to cutaneous diseases. Its strong flavour is by some thought to require modification by stuffing with sage and onions, though others relish it only when this is not demanded. From the various parts, however, many savoury dishes are prepared, for which we refer to the receipts on that subject. The fat is reckoned peculiarly subtle, penetrating, and resolvent, and is usually preserved for domestic applications.

2024. *The average weight* of the large kind of geese is from nine to fifteen pounds, and instances have been known of their weighing thirty pounds when fully fattened; but the smaller breeds are preferable for the table.

2025. *It is generally considered that geese are in the greatest perfection about Michaelmas,* because then they have had the feeding upon the stubble after harvest; but, says Dr. Kitchener, though "a Michaelmas goose is as famous in the mouths of the million as the minced pie at Christmas, yet for those who eat with delicacy it is at that time too full-grown. The true period when the goose is in the highest perfection is when it has just acquired its full growth, and not begun to harden. If the March goose is insipid, the Michaelmas goose is rank; the fine time is between both—from the second week in June to the first in September."—*Cook's Oracle.*

In England the goose is sacred to St. Michael: in France to St. Martin. The Michaelmas goose is said to owe its origin to Queen Elizabeth's dining on one at the table of an English baronet on that day when she received tidings of the dispersion of the Spanish Armada, in commemoration of which she ordered the goose to make its appearance every Michaelmas.

2026. *Geese are called green* till they are four months old. They are roasted with pepper and salt only, instead of being stuffed with sage and onion like full-grown geese. These are, of course, early in the season, when the price is high.

2027. *Geese are in some places dried and smoked:* the smoked geese of the Orkneys used to be famous; at present they are little used.

2028. *It is not altogether on account of their use as food that this bird is valuable;* their feathers, their down, and their quills have long been considered as articles of more importance, and from which their owners reap more advantages. In this respect, the poor creatures have not been spared: urged by avarice, their inhuman masters, in some places, appear to have ascertained the exact quantity of plumage of which they can bear to be robbed, without being deprived of life. Mr. Pennant, in describing the methods used in Lincolnshire, in breeding, rearing, and plucking geese, says they are plucked five times in the year; first, at Lady Day for the feathers and quills; and this business is renewed, for the feathers only, four times more between that and Michaelmas: he adds, that he saw the operation performed upon goslings of six weeks old, from which the feathers of the tails were plucked; and that numbers of them die when the season afterward proves cold. We will not vouch that this is the present practice.

2029. *The Canada goose* is so numerous in Hudson's Bay as to form a principal part of the food of the English there, who, in favourable years, salt and barrel vast quantities of them. They are chiefly taken by the Indians, who have the talent to imitate their cackling, and thus decoy them within reach of their shot. Captain Ross describes them as of exquisite flavour. Their feathers are sent to England.

2030. *The so-called Solan goose* is frequently eaten in the Hebrides of Scotland; but their flavour partakes of that of their fishy food; this, however, they loose when they are salted and smoked for winter's store; in that state they are much relished by the inhabitants. We may just observe that this bird is not arranged by naturalists in the genus *anas;* it is, in fact, not a goose, but a pelican (*Pelicanus Bassanus*).

Sect. XII.—duck (*Anas Buschus*, Linn.).

2031. *The duck is a native of Britain,* and frequents the edges and banks of lakes in most parts of Europe. The tribe called *anas* of Linnæus is very extensive, and comprehends several families of aquatic birds, as the swan, goose, duck, teal, and widgeon, distinguished by being web-footed, and having a flat bill with the edges divided into teeth.

2032. *The wild duck* makes its summer abode in the desolate, fenny parts of our island; and when the severity of winter deprives them of food, necessity forces them to retire towards the sea in numerous flights, where they find water unfrozen, and where they remain till the return of summer. The flesh of the wild duck is not so general a favourite as that of the tame bird; when they are taken on the seacoast they have usually more or less of a fishy flavour; but those from the fens of Lincolnshire are free from that rankness, and have a fine, rich, gamy taste: these are much esteemed as being very savoury, and are sold by the poulterers in London, at a reasonable price, in the season. There are many varieties of the wild duck in foreign countries.

2033. *Great numbers of wild ducks are taken by a singular contrivance called decoys,* which are places into which they are allured by ducks bred up for the purpose. These decoys consist of a pond surrounded by wood in a marshy country. From the pond several canals lead in different directions, and terminate in a narrow ditch that is closed at last with a funnel net. Over these canals are arched hoops, and upon them a continued netting. The wild ducks settle on the pond to feed, and the decoy man is concealed behind a screen of reeds. The decoy ducks are trained so as to lead the way in search of food into the canals, and the wild birds follow; the decoy man then appears, and drives them farther up, where ultimately they are taken in the nets in great numbers. There are many of these decoys in the fens of Lincolnshire, from which the London market is supplied.

Among other methods of catching wild ducks, the ingenious mode so characteristic of the Chinese may be mentioned. Large hollow gourds are purposely thrown into the water in great numbers, and allowed to float about. The birds being at length accustomed to approach them with impunity, their captors disguise themselves by placing similar gourds over their heads, with holes to see and breathe through, very much in the manner of a helmet. Then, wading quietly along the shallow waters, they have only to approach the birds gently, and pull them under water by their legs in succession. The same method is practised by the American Indians.

2034. *Tame ducks* are well known to be greedy, and not nice feeders. They require a mixture of animal with vegetable food, being accustomed, in the natural state, to live on worms, which they are always seeking for in the water. They will eat flesh and garbage of any kind; but water insects, vegetables, corn, and pulse, are their proper nutriment. If fed much upon grain they fatten rapidly, and the flesh becomes delicate, but is apt to be insipid; and if fed too much upon animal food, their taste is strong, and more like wild fowl. They require water, and that which is stagnant is best, as affording more nourishment from weeds and insects. They are sometimes fattened in coops; but they become of a more delicate flavour, fatten equally well, and are more wholesome by having access to a pond with plenty of food. Their flesh is savoury and stimulant, and is considered to be less gross than that of the goose, as well as more easily digested.

2035. *The character of the duck* is particularly inoffensive and harmless, and is even distinguished by its social disposition. It is also valuable for its great fecundity, and the cheapness and ease with which it may be provided for.

2036. *Though ducks are well known on the table in the time of green pease*, yet Ude says that "November is their proper season, when they are plump and fat." By artificial means they may be had in their prime about Christmas, and this object is effected in some parts of England by preventing the laying of the eggs until the end of autumn; they are then hatched, and the birds fattened.

2037. *Ducks' eggs* are, in general, easily distinguished from those of the fowl, being more of a bluish colour, though some are nearly as white. When boiled, the white is never so curdy as that of the hen, but a little translucent, even when set, and the yolk is darker in colour. They have a peculiar flavour, which some dislike and others prefer; but they have a more binding quality, and are therefore preferable to hens' eggs for making puddings and pastry: a property which, in France, occasions them to be much sought after for omelets and cakes.

Sect. XIII.—widgeon.

2038. The widgeon is a smaller bird of the duck genus, but not so good as the wild duck. It is often fishy and rank, and the flesh is dark and dry; some, however, consider it as well flavoured, and a good wild fowl. It is in season from October to December.

Sect. XIV.—teal.

2039. This is the smallest of the duck tribe, and much superior to the widgeon. It is, indeed, favourite game.

Sect. XV.—pigeon (*Columbus*, Linn.).

2040. This genus is found in all the warm and temperate regions of the globe, particularly in the former; and so numerous are the species, that above a hundred have been enumerated; most of these are wild, but several have been domesticated.

2041. *We have in England two species of wild pigeons* distinct from the domesticated species. The *wood pigeons* or *ring-doves* (*Columba Palumbus*, Linn.) build their nests on lofty trees, as the beech, elm, and oak, and are thought to migrate from the northern to the southern parts of the island, according to the season of the year: they appear sometimes in considerable flocks, and afford much amusement to the sportsman, while their flesh is highly prized. They are of a bluish ash-colour, the neck green and copper-colour, with patches of white. In Carolina they appear in such numbers that they darken the air in their flight, and are found to be so fat that oil is extracted from them. The *turtle dove* is another wild species, of an elegant form but diminutive size, that visits us in spring and disappears in September. It builds its nest in deep recesses of the woods, but is not plentiful.

2042. *The stock dove is the original of our domesticated pigeons*, and is sometimes in a wild state. In its natural state it is of a deep-blue and ash-colour, the breast of a changeable green and purple; on its wings are two bars of black; on the quill feathers another, and also black on the end of the tail; the back white. It inhabits the hollows of rocks and other similar situations. In its domestic or cultivated state the pigeon runs into a number of beautiful varieties, the culture of which forms a particular kind of business: thus we have the carriers, croppers, pouters, horsemen, runts, and a number of others, known to the fancy breeders.

2043. *The blue dove house pigeon* is rather larger than the wild, and is the only variety that is bred up for the table in this country in great numbers in farmyards. Tame pigeons live entirely on grain, pease, small beans, and seeds; they are very ravenous, particularly when young, consuming a great deal of food, and, consequently, are costly When young, and still fed by their parents, they are called *squabs*, and are then prefer able for the table; under six months old they are termed *squeakers;* and at six months they begin to breed: the old bird is tough, dry, and insipid. The flesh of pigeons is highly savoury, delicate, and stimulating, and is dressed in a great variety of ways, of which the most common with us is making it into pies. The dark-coloured pigeons are considered to have the highest flavour, but the light-coloured to have the most delicate flesh. They breed fast, and, when well supplied with food, will furnish squabs every month in the year. But they are kept less than formerly, being found extremely destructive to the crops, particularly of pease, the loss of which to the farmer is very considerable.

Sect. XVI.—lark (*Alauda Arvensis*, Linn.).

2044. The lively notes of this little songster cannot save it from the gormandizing powers of man.

2045. *Though so small, larks have, it seems, always been sought after as an exquisite morsel.* They were not only caught, but reared and fattened for the Roman epicures; and our markets are abundantly supplied with them, being captured in the winter season, from September till February, in immense numbers, particularly about Dunstable, Cambridge, &c. It is remarkable that the propensity which they have to fly towards a light is converted into a method of decoying them. Mirrors reflecting the sun's rays are placed so as to revolve and attract them into nets placed to ensnare them. They are generally roasted, many together, on a lark spit, and are among our greatest delicacies. It is reckoned that 4000 dozen are annually sold in London.

Sect. XVII.—crane.

2046. *The crane belongs to a class of birds called Grallæ*, or waders, distinguished by the length of their naked legs, walking, as it were, upon stilts, the signification of the Latin word grallæ. The birds in this class are the crane, heron, stork, bittern, plover, snipe, coot, rail, and a few others. All of them seek their food, consisting of small fish, worms, and insects, in shallow water and marshes, but they likewise eat grain. The crane is migratory, and now a rare visitant to us, though it was once a constant inhabitant of Britain, and was formerly so great a favourite that there was a penalty for destroying its eggs. Its flesh is coarse, except when young.

2047. *The heron and stork* are never eaten with us at present, although, like the crane, they were once common at feasts: in France the heron was formerly considered as royal game, and the young highly prized.

2048. *The bittern* is a good deal like the heron, but shorter and rounder in its body. It is considered as an excellent bird, though less esteemed than it used to be.

Sect. XVIII.—snipe.

2049. This is a migratory bird, and one of those whicn are the most generally distributed over Europe. It prefers a cold climate to breed in, but is met with even in India. It is one of the waders, and frequents morasses and places where there is much water, and where worms are abundant; it feeds upon these, but likewise occasionally upon corn and rice. Sir H. Davy informs us that they are extremely fat and delicious during their migration from the north to the south in the marshes of Italy and Carniola, and then resemble the ortolan of Italy. With us they are fattest in frosty weather, when they haunt only warm springs, where they find plenty of worms or larvæ. A few breed in the marshes of England, but more in the Hebrides and Orkneys.

Sect. XIX.—plover.

2050. The plover is a wild water fowl, but often seeks its food on the arable land in the vicinity of the sea. It has a peculiar cry, which is easily imitated by the sportsman, and is thus lured to its destruction. They roost on the ground, and are sometimes taken with nets by hundreds. There are two species of this bird, the gray and the green; the former being somewhat less than the woodcock, though larger than the green. The green plover is generally preferred for its flavour, but both are inferior to the woodcock. Prodigious flights of these birds, consisting of many thousands, are to be seen in the Hebrides and other parts of Scotland; and in the winter such numbers are sent to London that the market is sometimes quite glutted with them, and they are sold very cheap. They are kept till they have a game flavour, previous to dressing; but though a great favourite with many, they have a peculiar taste not universally relished. Plovers' eggs are considered to be a great delicacy, and are easily to be had from the poulterers; they are generally brought to table boiled hard, but are occasionally eaten raw.

Sect. XX.—lapwing (*Tringa Vanellus*, Linn.).

2051. This is commonly known in England by the name of the *bastard plover.* It is frequent in our fenny counties, and in wet places in most parts of England. In winter they are seen in large flocks. Their flesh is very good, their food being insects and worms. The eggs are of an olive cast, spotted with black, and are much esteemed for their delicacy. Lapwings are taken with nets during October and November, and are sold by London poulterers at three shillings the dozen.

SECT. XXI.—RED GROUSE (*Tetrao Scoticus*, Linn.).

2052. *The beautiful plumage and exquisite flavour of this bird* render it an object of considerable interest. It appears to be a native of Scotland and the north of England, in the mountainous districts of which it is found by sportsmen in great plenty, feeding on various berries that grow among the heather, and also on the tops of this plant; hence it is often called *moor game*, or *moor fowl*. It does not undergo any change of colour in winter, but acquires a greater mass of clothing, and its legs become covered with a sort of hair-like feathers. The breeding season is early in the spring, and the brood continue in company for some months, sometimes joining others which range the high moorlands, where they are shy, and difficult to be approached. Their colour is a rich chestnut, barred with black.

SECT XXII.—BLACK GROUSE (*Tetrao Tetrix*, Linn.).

2053. This bird, called also the *black cock*, or *moor fowl*, is larger than the red grouse, the male weighing sometimes four pounds, and the female two pounds. It is also less common, and therefore more highly prized. It is met with nowhere in Britain but in the Highlands of Scotland and the mountainous heaths of the north of England. Its plumage is a rich mixture of black and blue relieved by markings of white, and its legs are covered with very minute feathers. The form of its tail is remarkable, branching into two crooked expansions. Its food is similar to that of the last described bird. Vast numbers of these birds are found in Norway of large size, being nearly equal to turkeys; and of late many have been imported into London and sold in the shops; but these are not equal in flavour to the Scotch smaller kind.

SECT. XXIII.—WOODLAND GROUSE (*Tetrao Urogallus*, Linn.).

2054. This is likewise called the "cock of the wood," and is the largest among the birds which we denominate game, it being little less than the turkey. It was originally common in the mountains of Britain, but is now nearly extinct with us, occurring only in the Highlands of Scotland, though still abounding in the north of Europe, Germany, and the Alps, where it lives in pine forests, on the cones of which it is supposed to subsist, and which, at some seasons, gives its flesh a terebinthinated taste. It is in general delicious eating, and is sometimes sent to England preserved in ice. From the great delicacy of its flesh, it is to be lamented that sufficient means have not been taken to domesticate it, which, it is supposed by some sportsmen, would be very practicable. Its plumage is extremely beautiful.

SECT. XXIV.—WHITE GROUSE.

2055. The *white grouse*, or *ptarmigan*, is found in the British isles, though not plentifully; the London market is supplied from Scotland and Norway, those from the latter country being preferred. When young it is excellent, and little different from common grouse. At Hudson's Bay they are in such flocks, that sixty or seventy are often taken in a net at once; and, as they are as tame as chickens, they are driven into the nets without difficulty.' A ptarmigan will weigh a pound and a half.

SECT. XXV.—WOODCOCK (*Scolopax Rusticola*, Linn.).

2056. This bird is somewhat less than the partridge, which it much resembles, and is a bird of passage. It breeds in high northern latitudes, as in the marshy and extensive pine forests of Norway, Sweden, Russia, and Siberia, feeding upon worms and insects, which it searches for with its long bill. When winter sets in, woodcocks emigrate and seek a milder climate, the time of their leaving Sweden agreeing with that of their arrival in Britain, where they frequent our woods, particularly in the west and north. In emigrating, they travel slowly, flying low from wood to wood, choosing the night, and concealing themselves during the day. They are with us during the winter, and leave England about the latter end of February, a few only remaining in this country, where they breed. There are woods in England, particularly one in Sussex, near the borders of Hampshire, in which one or two couple of these birds, it is said, may always be found in summer. They have been observed as far south as Asia Minor, Barbary, and Egypt, and they are common in Japan; these probably migrate from the north of Asia. They are taken in great numbers in nets, springes, and with bird-lime, and are served up at the best tables as delicacies, being much esteemed by gourmands as a highly-flavoured viand, resembling the barn-yard fowl in point of delicacy; but they are good only when fat. It is best to keep them before dressing till they are very tender, without suffering them to proceed too far in the progress of decay: they are remarkable for the tenderness of their skin. We are informed, in a contemporary publication, of some curious deceptions practised by the inferior poulterers of London upon genuine cockneys who are ambitious of having game at their tables. "The gray plover is sometimes trussed like a woodcock, its bill cut off, and the bill of a real woodcock inserted instead: the bills of these latter birds being purchased from the cooks of wealthy families." The detection of this fraud, which, it is hoped, is unusual, is obviously to give the bill a "good tug;" and this suggests the necessity of those who wish to purchase wild fowl being themselves acquainted with the characters of the birds, and not trusting implicitly to the sellers.

The woodcock is not considered game by law, since, being a migratory bird, having no settled habitation, and not being reared or preserved, it cannot be considered as the property of any individual.

Sect. XXVI.—Puffin, Kittiwake, and Auk.

2057. These birds live almost entirely in the sea, building their nests in the sea cliffs, and feeding altogether on fish. Though relished by some persons when young, yet their strong and peculiar flavour, derived from their food, prevents their being generally dressed, except in cases of necessity. Pickling and spicing takes off much of the fishy taste. *The sea-gull* is never eaten, the flesh being coarse and strong.

Sect. XXVII.—Swallow.

2058. *The swallow is never among the trifles seen at our tables;* but the *edible birds' nests,* which occupy the first rank among the dainties prized by Chinese gourmands, are the production of a species of swallow (*Hirundo esculenta*). These nests are formed of a transparent gelatinous substance that dissolves in water; they are employed for sauces, or in soups, or chicken broth for valetudinarians, and are reckoned an excellent restorative. This rare material is sometimes seen even at the tables of the wealthy and luxurious in Britain. The nests are about three or four inches in circumference, and one in depth, and are met with in clefts of the rocks on the shores of Cochin China, Java, Malacca, and various parts of the Indian Archipelago. They are found in great quantities in the islands on the Tavoy coast and in the Mergui Islands in Siam. Malay, Chinese, and Siamese boats come every year for six weeks in January to collect them. Taking them is a work of considerable danger, as it is necessary to climb precipices by the help of ropes and flying ladders made of ratans, and many are found in intricate caves. The Chinese, among whom the extremes of luxury and misery are frequent, pay five or six dollars a pound for them; when first brought in their raw state, they are covered with dirt and feathers, from which they are cleared before they are offered for sale. It is said that Batavia alone exports annually 4,000,000 of these nests to supply the tables of the Chinese mandarins. The substance which the bird collects to compose these edible nests does not appear to be yet clearly ascertained. Dr. Mayen, in his voyage round the world, states that the swallow eats a species of marine fucus (Sparococcus *cartalagineus*, var. cetaceus), which grows in great abundance in the Indian seas; and, after permitting it to soften for some time in its gullet, it disgorges the substance, now converted into a kind of jelly, and uses it as a cement for its nest; and it has been said that the Japanese, who have long ago discovered this fact, prepare the substance in an artist-like manner. The vegetable origin of the substance in question has, however, lately been opposed in the "Journal de Pharmacie," August, 1836, by M. Virey, who maintains, with Rumphius, that the swallow collects from the surface of the sea the gelatinous material of some species of marine mollusca, from which it would appear that the edible nests consist of animal substances.

Sect. XXVIII.—Wheat-ear.

2059. *This is a delicate little bird of passage about the size of a lark,* but difficult to be procured at the poulterers' in London, unless ordered. They visit us, and are in season from July to October; they are obtained chiefly on the South Downs in the neighbourhood of Brighton, Eastbourn, and other parts of Sussex, and may be had at Tunbridge Wells. They are caught in nets and snares like larks, and are occasionally captured in immense numbers. They are usually sold at a high price; the larger are sent to London and potted, when they are by many as much esteemed as the ortolan of the Continent; but, from their fatness, they will not keep long without spoiling, and can be had in perfection only in the districts where they are caught.

Sect. XXIX.—Landrail, or Corncrake.

2060. The landrail is known by its peculiar voice, like the sound of a watchman's rattle; and it trusts more to its swift foot among the corn or long grass than to its wings, which it rarely uses. It is seldom caught; but when in good condition, it is reckoned a first-rate delicacy. When fully grown, they weigh about half a pound.

Sect. XXX.—Ortolan.

2061. This small singing bird is considered one of the greatest luxuries of the table. It is migratory, but is never found wild in Britain, though common in France, Italy, and the warmer parts of Europe; consequently, in this country it is rarely procurable, and in its cost may rank with the turtle among the list of expensive delicacies. They are sometimes bred in cages, and are kept in a dark room, where they can have no employment but eating; in consequence, they get inordinately fat, and would die of this disease if the knife did not interpose when they have arrived at the desired point of obesity. When well fed, they weigh about three ounces each, and are roasted with the intestines in them. They are sometimes imported, potted, from the south of France and Italy.

Sect. XXXI.—Eggs.

2062. *Eggs form an important article of food,* and they have been chemically examined by several analysts, particularly Dr. Prout and Dr. Bostock. The eggs of birds are composed of several distinct substances; as the shell, the white, and the yolk.

2063. *The shell,* or external coating, is formed chiefly of carbonate of lime. It consists in 100 parts, of carbonate of lime, 72; phosphate of lime and magnesia, 2; gelatin, 3; the remainder, perhaps, water. It is supposed that birds pick up carbonate of lime with their food to supply materials for the shells of their eggs; for it is remarked, if care be taken that their food shall contain none of this earth, they will lay eggs without shells.

Egg-shells, on account of their calcareous nature, are often employed for the same purposes as chalk or lime, in correcting acidities, &c. They are observed to be filled with numerous minute pores, which should be closed by rubbing some substance over them when the eggs are to be preserved. The *thin membrane* immediately beneath the shell is, in some eggs, much stronger than in others, and is considered to be coagulated albumen.

2064. *The white of egg* is generally mentioned as being composed only of albumen, and, indeed, is referred to often as an example of pure albumen; but Dr. Bostock has given the most complete analysis of it, from which it is shown to consist of 80 parts water, 15 albumen, and 4·5 mucus. It is a glairy, insipid fluid that mixes readily with water when raw, and is often used as a varnish, like gum; it is also employed to clarify liquors. It much resembles serum of blood in its composition and properties. The white of the egg has been found, by accurate observation, to consist of two parts: the external part, or that immediately under the membrane that lines the shell, is always most abundant in newly-laid eggs. When the egg is raw, this part is almost as liquid as water, and evaporates by keeping. In eggs that have been long kept, it is scarcely observed; the inner white is by much the most considerable, and this sets, or acquires a firmer consistence, in boiling. Newly-laid eggs are heavier than water, and sink in it; but, in consequence of the evaporation of the internal white through the pores of the shell, they become lighter; hence old and bad eggs swim in water. Hens' eggs have the albumen, when coagulated by boiling, of a beautiful, opaque, milk-white substance, if they are quite fresh; but if not, it is a dirty or yellowish white, and not firm.

2065. *The yolk* has a mild and peculiar taste, and appears to consist of a deep yellow-coloured oil of the nature of fat oils, united to a portion of albumen sufficient to render it diffusible in cold water, in the form of an emulsion. It contains also a little sulphur and phosphorus, the former being evident from its blackening a silver spoon, the black stain arising from some of the silver uniting to the sulphur, and forming a sulphuret of silver, which is naturally of a black colour; consequently, this stain cannot be removed without rubbing off this part of the silver that has been altered. The use of the phosphorus is supposed to be in order to supply that principle to the bones of the young chick. The yolk is concrescible by heat, and becomes solid by boiling. It is employed as a medium for uniting resins and oils with water. The yolk is itself surrounded by an extremely thin membrane which separates it from the white.

2066. *The eggs of different birds vary much in size and colour.* Those of the ostrich are largest. One laid in the menagerie in Paris weighed two pounds fourteen ounces, held a pint, and was six inches deep: this is about the usual size of those brought from Africa. Travellers describe ostrich eggs as of an agreeable taste: they keep longer than hens' eggs. Drinking-cups are often made of the shell, which is very strong. The eggs of the turkey are almost as mild as those of the hen; that of the goose is large, but well-tasted. Ducks' eggs have a peculiar taste; the albumen is slightly transparent, or bluish, when set or coagulated by boiling, which requires less time than hens' eggs. Guinea-fowl eggs are smaller and more delicate than those of the hen.

2067. *The eggs of wild fowl* are generally coloured, often spotted, and the taste generally partakes somewhat of the flavour of the bird they belong to. Those of land birds that are eaten, as the plover, lapwing, ruff, &c., are in general much esteemed, but those of sea fowl have more or less of a strong fishy taste. The eggs of the turtle are very numerous; they consist of yolk only without shell, and are delicious.

2068. *As food, eggs are extremely nutritious.* The qualities of those belonging to different birds vary somewhat. Those of the common hen are most esteemed as delicate food, particularly when newly laid; the quality of the eggs depends much upon the food given to the hen. Eggs, in general, are considered as most easily digestible when little subjected to the art of cookery. The lightest way of dressing them is by poaching, which is effected by putting them for a minute into brisk boiling water; this coagulates the external white, without doing the inner part too much. Every one knows how much better they are when *newly laid* than for a day or two after they are laid. The usual time allotted for boiling eggs in the shell is three minutes, which should always be measured by a sand-glass. Less time than that in boiling water will not be sufficient to solidify the white; and more will make the yolk hard and less digestible; it is very difficult to guess accurately as to the time. Great care should be employed in putting them into the water, to prevent cracking the shell, which inevitably causes a portion of the white to exude, and lets water into the egg. They are often beaten up raw in nutritive beverages.

Eggs are employed in a very great many articles of cookery, entrées, entremets, and sucrés, and they form an essential ingredient in pastry, creams, flip, &c. It is particularly necessary that they should be quite fresh, as nothing is worse than stale eggs.

2069. *The metropolis is supplied with eggs* from all parts of the kingdom, and they are likewise largely imported from various places on the Continent, as France, Holland, Belgium, Guernsey, and Jersey. It appears from official statements mentioned in M'Culloch's "Commercial Dictionary," that the number imported from France alone amounts to about sixty millions a year; and supposing them, on an average, to cost four pence per dozen, it follows that we pay our continental neighbours above 83,000*l.* a year for eggs.

2070. *For the method of preserving eggs*, see Chap. III., Book X., "On the Preservation of Food."

CHAPTER VI.

FISH.

Sect. I.—general observations on fish.

2071. *In the ocean there appears to be an inexhaustible store of food in the finny tribes of animals.* Although in London fish is highly esteemed and considered rather as a luxury, yet in all countries where it is plentiful and cheap it is reckoned somewhat inferior in its nutritive powers to what is called butchers' meat. This is so well known, that the jockeys who ride at Newmarket, and who wish to weigh as little as possible, are never allowed to eat meat if fish can be obtained. The ancient Greeks seem to have looked upon fish in the same light, for we find in the Odyssey, Menelaus complaining that they had been obliged to live upon fish. Nevertheless, as the inhabitants of the seacoast in many parts of the world subsist almost entirely upon this kind of food, and enjoy perfect health, it is evidently, in general, sufficiently substantial. In Siberia, parts of Norway and Iceland, dried fish composes the principal part of the food of the inhabitants; and in Greenland and the Polar Seas the Esquimaux have no other. Being, however, less nutritive than meat, a larger quantity is necessary for sustenance. But though not so strengthening, it has some qualities which render it particularly valuable. Being less stimulating than butchers' meat, it occasions less febrile excitement, and being extremely tender and soluble, it is more easy of digestion; and though not sufficient, in all cases, to restore power to habits debilitated by disease, it is well suited for invalids, for inhabitants of towns, and for sedentary or studious persons.

2072. *Fish, however, like other animals, differ in some degree in their nutritive and other properties;* much, likewise, depends upon the modes in which they are prepared before they are employed as food. Like every other kind of aliment, it is preferable in its fresh state, but vast quantities are also salted, pickled, or dried, by which operations it is considerably altered in its properties.

2073. *Fishes may be separated into three great divisions* relatively to their habits, and the waters where they live. 1. Those which live entirely in the sea, hence called *salt-water fish*, as the cod and herring. 2. Those which live always in *fresh water*, as char, trout, &c. 3. Those which *migrate from the sea to the fresh water*, living alternately in each, as the salmon and sturgeon. Their natural history is a subject of great interest, but we can only touch upon such parts of it as bear upon their fitness for food; at the same time remarking that, as the article fish forms no inconsiderable figure on the table, the study of its good and bad qualities becomes a subject very deserving attention.

2074. *Fishes present considerable variety in the structure and firmness of their muscles.* The muscles of some fish resemble flesh, as that of the whale, shark, and sturgeon: of others it is white, and disposed in flakes, as in the cod and the haddock; and in others, again, it is fibrous, as in flat fish and eels. In general, the muscular part is less firm than that of land animals; in some it is comparatively dry; in some, soft and gelatinous; and in others fat and oily. The fat or oil is sometimes disposed between the layers of the flesh, as in salmon, or it is dispersed through the flesh, as in eels, herrings, sprats, &c. In the cod a curdy matter, resembling coagulated albumen, appears between the flakes of the flesh when fish perfectly fresh is cooked; this disappearing entirely when the fish is stale, furnishes a good test of its condition: the fat or oil of cod resides only in the liver. Flat fish and eels have none of this curdy matter, the flesh not being in flakes. All the livers of fish abound in oil. Fish having much fat or oil mingled with their muscles are less digestible than those which are leaner, but they are more nutritive, as, for instance, salmon, eels, and herring. Some of the cartilaginous fish, as skate, are also extremely nutritive.

2075. *Some fish are said to be poisonous*, but these reside chiefly in the tropical seas, and never visit our coasts.

2076. *The flavour of fish*, like that of other animals, is influenced in a certain degree by the nature of their food, and on this account the same species of fish will vary somewhat in its flavour on different coasts, and in different lakes and rivers. Some fish improve in firmness and flavour as they attain a certain age, as cod and haddock; but generally when they become old they get coarse.

2077. *The season of the year has the most decided influence upon the quality of fish*, as connected with the time of their spawning. Fish, in general, are in the best condition before they spawn, and many while they are full of roe, as the smelt, pouting, mackerel, and sole; but it is universally the case, that immediately when the spawning is over they are "out of season" and unfit for food: sometimes, indeed, at this time fish are unwholesome. This circumstance is of so much importance, that it has been considered a fit subject for the interference of the legislature, which regulates the times during which only certain fish may be caught. When fish are in season the muscles are firm, and they boil white and curdy; but when they appear transparent and bluish, though sufficiently boiled, it is a sign that the fish is not in season, or is not fresh.

Previous to the approach of the spawning season, there is a natural preparation necessary to enable the fish to undergo the fatigues and fastings by which it is accompanied. The muscles acquire size and strength, especially those connected with the tail, the principal organ of progressive motion, so that the body behind appears plump and round. A great deal of fat is deposited between the muscles, but especially on the belly, the flesh of which is, at this time, of considerable thickness. As the spawn advances to maturity, the fat is withdrawn for its nourishment, the belly becomes little else than skin, and while the epicure, upon seeing the large roe, imagines that his fish is in the best condition, it has nearly reached the maximum of its worthlessness When the business of spawning is over, the leanness of the fish then becomes apparent, and the extraordinary muscular exhaustion which it has undergone is marked by the thinness of its head and the lankness of its tail.

It appears, however, the same species of fish is occasionally subject to variations in the periods of spawning, which explains the reason why sometimes a fish is found quite good as food, while the rest of the species is poor and inedible. This is the case with cod, and also flat fish. The summer and autumn are the seasons most favourable for the procuring of fish in general, but on account of the various seasons for spawning, no month is without a supply of some particular species.

2078. *Fish surpass in fecundity all other animals used as food.* In the roe of the sturgeon above a million and a half of ova have been counted; in the mackerel, 129,000; in the perch, 69,000; in the carp, 167,000; and in the pike, 166,000.

2079. *Every part of fish may be eaten with safety,* with the exception of those that are poisonous. The hard roe, or that of the female, is particularly nutritious, often large, and forms an excellent food. Caviare is the prepared roe of the sturgeon.

2080. *Naturalists have divided fishes into two great tribes, the osseous and the cartilaginous,* according to the bones. In the first, the bones are more or less hard and firm, and contain a great deal of phosphate of lime, as in the cod and ling; in the latter the bones are soft, and consist only of cartilage, as in the skate. This distinction, however, is not precise, for osseous fishes have a great deal of cartilage, and some of the cartilaginous fishes possess a small portion of calcareous matter in their bones. Nor is the composition of the bones uniform, some having more phosphate of lime than others Some fish are very gelatinous, as eels, and make excellent soup.

2081. *The skin of most fishes is covered with scales;* but some are almost without, these being very minute, as the eel. The thickness of the skin varies according to the strength of the scales; it is, accordingly, very thick in skate, eels, &c., and thin in those species that possess larger scales, as the carp and bream; hence, in preparing these fish for the table, the former are deprived of their skin, and the latter only of their scales. The surface of the skin of fishes is more or less covered with a slimy, gelatinous, or mucous substance of a peculiar nature, secreted by an apparatus for the purpose, and shed upon the skin by a number of minute ducts or openings: this is a defensive secretion against the friction and washing of the water; but the integument that affords the chief defence to the skin are the scales. Those fish that want scales, or have them very small, have more of the slimy matter, as in eels. Dr. Paris states that the pulpy, gelatinous skin of the turbot, and the glutinous parts about the head of the cod, though highly prized by gastronomes, are very apt to disagree with invalids.

2082. *Little attention is paid to the mode of killing fish,* as the object is to keep them alive as long as possible; but many of them die as soon as they are taken out of the water. The Dutch take great care to bring them alive to market, and those that die are sold at an inferior price; but though this ensures their being fresh, yet, when they are kept long alive, the fish become exhausted, and are worse in quality than if they had been killed when caught, and kept only the proper time: when preserved in the wells of ships, they are frequently rendered poor. Fish, in general, are extremely voracious, the greater number being carnivorous, feeding upon each other, the greater on the smaller; thus the cod pursues the whiting; but some fish live upon marine plants.

2083. *White fish,* whose muscles are the firmest and least oily and viscid, possess the most valuable qualities as food, and are, in particular, the best calculated for invalids. These, comprehending the cod, ling, tusk, coalfish, haddock, and whitings; also the flat fish, as turbot, skate, soles, and flounders, swarm about the British shores, and particularly in the whole northern sea, from the Dogger Bank, in lat. 54°, to the northern extremity of Iceland, in lat. 67°; from the coast of Norway eastward to an unknown distance on the west, may be considered as one great fishery, in which Scotland, as lying in the centre, has a manifest advantage over all other nations. The number of friths and inlets of the sea, on the west coast of Scotland, render that country peculiarly favourable for the prosecution of fisheries.

The muscles of the red-coloured fish, as salmon, trout, &c., are of a peculiar tint, which has acquired the name of salmon colour, and the fish are generally esteemed in proportion to the height of this colour. They are always more or less of a fat or oily nature.

2084. *Flat fish* are called by naturalists *Pleuronectidæ.* They have no swimming bladder, and therefore keep close at the bottom. Both eyes are on one side, and that side is uppermost: when disturbed, they sometimes make a rapid shoot, changing their position from the horizontal to the vertical, but they soon settle down again into their former position.

Mr. Yarrell observes that those fishes which swim at the bottom of the sea are so constructed as to consume but a small quantity of oxygen, and have their blood only two or three degrees warmer than the temperature of the water at the surface; but they have a high degree of muscular irritability; they retain life long after they are taken out of the water, and their flesh remains good for several days. Various flat fish, and the eel, are seen gaping and writhing on the stalls of the fishmongers for hours in succession. On the contrary, those fish which usually swim near the surface of the water have a high degree of respiration, and their blood has a warmer temperature, which, in the case of the Bonito, amounts to 90° when the water is 80°. These have little irritability, and generally die as soon as they are taken out of the water, which is also the case with the mackerel, salmon, trout, and herring. In consequence of this, the latter class of fishes soon decompose or spoil after they are killed; and, to be in perfection, should be prepared for the table the day they are caught; whereas turbot is better for being kept a day or two, since they are tough while any irritability exists.

2085. *The mode of cooking fish considerably affects their properties as food.* Plain boiling, baking, and roasting appear to be the methods that prepare it in the fittest manner. There appears no reason why stewing should be objectionable, except that it is usually accompanied by numerous additions that render it extremely indigestible, for instance, port wine. The various sauces commonly eaten with fish are probably the cause of most of the faults laid to the charge of this useful aliment; these sauces are to be suspected, when purchased, as we cannot at all times be certain of their composition; and it is well known that they are sometimes deleterious. The observation which we have often made applies here in a particular manner, namely, that it is of the first importance we should *know* what we eat and drink. Few species of vegetables appear to be eaten with fish. Potatoes and parsnips are the principal of those which are found by experience to agree well.

2086. *A process called crimping is sometimes adopted for the purpose of improving cod and some other fish.* Sir Anthony Carlisle has investigated the change thus produced, and we are indebted to him for some curious observations upon the subject. Whenever the rigid contraction has not taken place, the process may be practised with success. The sea fish destined for crimping are usually struck on the head when caught, which, it is said, protracts the term of its irritability; and the muscles which retain this property longest are those about the head. Many transverse sections of the muscles being made, and the fish immersed in cold water, the contractions caused by this crimping take place in about five minutes; but if the mass be large, it often requires thirty minutes to complete the process, which is for the purpose of giving firmness to the fish. It has been found that the muscles subjected to this process have both their absolute weight and specific gravity increased; whence it appears that water is absorbed, and condensation is produced. This operation improves the flavour, as well as the digestibility of the fish.

2087. *The blowing of fish* is a fraudulent practice sometimes employed by fishmongers, of a similar nature to the blowing of flesh and poultry. It is performed especially on cod and whitings, by introducing the end of a quill or tobacco pipe at the vent, and blowing through a hole made with a pin under the fin which is next the gill; thus making the fish appear to the eye full and large, though, when dressed, it will be very different. This imposition may be easily detected, by placing the finger and thumb on each side of the vent, and squeezing it pretty hard, for the air will then be perceived to escape, and the fish will shrink into its natural dimensions.

2088. *The migration of various species of fish* in shoals, and almost infinite multitudes, to particular coasts at certain times of the year, is a circumstance of great advantage to mankind, as it gives an opportunity of taking them with ease, and in vast quantities. The causes that induce fish to make these periodical movements are stated to be the instinct they possess for seeking suitable situations to deposite their spawn, and their search after a supply of food. Several kinds of fish, as the cod, haddock, mackerel, and herring, annually leave the deeper and less accessible parts of the ocean, the region of the zoophytic tribes upon which they prey, and approach the shallow shores to deposite their spawn within that zone of marine vegetation which fringes our coasts, extending from near the high-water mark of neap tides to a short distance below the low-water mark of spring tides. Amid the shelter of this region, afforded by the groves of arborescent fuci, the young fry come to life and spend their infancy in a situation where numerous small animals reside, and which constitute their most suitable food; and it is said that since these marine plants have been cut down on many of the coasts for the manufacture of kelp, the fisheries have suffered in consequence. Even the finny tr... inhabiting lakes, as the gwinead, and other species, periodically leave the deep water, and, in obedience to a similar law, come near to the margin to deposite their spawn.

2089. Many species of fish, as the salmon, smelt, and others, in forsaking the deep water, and approaching a suitable spawning station, leave the sea altogether for a time, ascend the rivers and their tributary streams, and, having deposited their eggs, return again to their usual haunts. With respect to the migration of herrings, see "Herring," Subsection 21.

2090. *Though it is generally supposed that fish which do not migrate from salt water to fresh,* and which are properly fish of the sea, will not live in fresh water, yet, from some interesting and successful experiments which have been made, it appears that several species of fish decidedly marine may be preserved alive a long time in fresh-water ponds, and that they even thrive and get fat in them. Some very curious observations on this subject have been published by Dr. Macculloch in the *Journal of the Royal Institution*, Nos. 32 and 34, and in the *Edinburgh Review*, 1822.

This capability of some salt-water fish to live in fresh water has long been known in Sicily, where a species of mullet, when taken from the sea, are by the fishermen thrown into the Lake Linterni, where they are kept for use, and where they increase in size and improve in flavour: this lake has no communication with the sea.

2091. *An account of the naturalization of sea fishes in a lake* was lately read at a meeting of the Zoological Society by Mr. J. B. Arnold, of Guernsey. The area of the lake is about five acres; its depth varies, and its bottom is muddy, gravelly, and rocky. The water during nine months of the year is drinkable for cattle, but, in consequence of a supply which it receives through a tunnel communicating with the sea, is rather salt in summer, at which season the freshets do not come down so plentifully as at other times. Several salt-water fish were introduced into it, as turbot, sole, plaice, brill, smelt, gray mullet, whiting, pilchard, bass, and gray roach. All these thrive well, and are believed to have increased in numbers. The gray mullet, in particular, has bred as freely as in the sea. A single whiting, that had been caught three successive years, was found to have grown considerably. Pilchards also throve remarkably well. It is even suspected that hybrid fishes have been produced, as several have been caught which were unknown to persons well acquainted with the species annually met with on the coast of Guernsey. Some of these sea fishes, after having been naturalized in this lake, have been transferred to ponds of spring water, where they have not only lived, but done well; and such naturalized fish have been carried to a long distance, being much more tenacious of life than those caught in the sea.

2092. *The preservation of sea fish in salt-water ponds* is so obvious an idea, that it is surprising to find it so little practised in England; nor is it much known on the Continent. In Scotland, however, this has been tried with success in several places. One of the largest and best of these belongs to Macdonnel, of Leggan, in Wigtonshire, which has been in existence upward of thirty years. This pond is stocked with turbot, cod, haddock, whiting, thornback, coalfish, and salmon. It is stated, also, that the same mode is practised in Todness Island, in Essex, where it answers perfectly well. From these and similar facts, it would appear to be extremely possible to preserve fish for the market in enclosures or ponds made in the mouths of rivers, estuaries, or in the sea, so that a uniform and regular supply of fish might be obtained in all weathers.

2093. *Fresh-water fish are frequently preserved and bred in ponds*; but the abundance of salt-water fish in this country renders those of lakes and ponds comparatively of small importance. Char and trout abound in some lakes, as at Keswick and Loch Lomond; but these fisheries are little attended to. Fish-ponds are most plentiful in the counties of Surrey and Berkshire, and are sometimes let to dealers in carp and other pond fish; but the breeding and fattening fish for the market is much less studied here than on the Continent, where the Roman Catholic religion causes this kind of diet to be more in demand at all seasons. In China this practice is carried to a great extent. The fish most usually kept in ponds are carp, tench, perch, gudgeon, eel, and pike.

All the fresh-water fish are taken occasionally, and most of them solely by the rod and line. The art of angling is more generally practised for amusement than profit; but it is a sport of great antiquity, and is followed with the greatest avidity by persons of every rank in life. It has some advantages over other rural sports; it is but little dangerous, and incurs small expense, and is peculiarly fitted for the placid and thoughtful; accordingly, we find that some men of great eminence have been much attached to it, as affording a relaxation from deep study, and the opportunity of contemplating nature. We may refer, on this subject, to the well-known "Salmonia, or Days of Fly Fishing," written by one of the greatest philosophers of modern times, Sir Humphrey Davy. The laws have ever been favourable to this pursuit, protecting the fish, and the authorized fisher, and punishing the depredations of the poacher. Proprietors of grounds through which rivers or streams pass have the exclusive right of fishing in them, and trespass is punished by fine. The proper season for angling is from the spring to the autumn. The different fish frequent different places, and require various kinds of bait or artificial flies, the study of which, with the numerous circumstances connected with it, will be found in works written "on angling."

2094. *A method of increasing the quantity of trout in rivers or lakes to almost any extent* is mentioned by Sir H. Davy in his "Salmonia," and which he states has been practised by M. Jacobi, a German gentleman.

"His plan of raising trout from the egg was a very simple one. He had a box made with a small wire grating at one end in the cover, for admitting water from a fresh source or stream, and at the other end of the box there were a number of holes to permit the exit of the water; the bottom of the box was filled with pebbles and gravel of different sizes, which were kept in water that was always in motion. In November, or the beginning of December, when the trout were in full maturity for spawning, and collected in the rivers for this purpose upon beds of gravel, he caught males and females in a net, and, by the pressure of his hands, received the ova in a basin of water, and suffered the melt to pass into the basin; in a few minutes he introduced them upon the gravel in the box, which was placed under a source of fresh, cool, and pure water. In a few weeks the eggs burst, and the box was filled with an immense number of young trout, which had a small bag attached to the lower part of their body, containing a part of the yolk of the egg, which was still their nourishment. In this state they were easily carried from place to place in confined portions of fresh water for some days, requiring, apparently, no food; but after about a week, the nourishment in their bag being exhausted, they began to seek their food in the water, and rapidly increased in size. It is said that the experiment succeeds also with the melts of mature fish that had been just killed, if they are mixed together in cold water immediately after they are taken out of the body. One great advantage of this method is, that by this means the young ones are preserved from the attacks of fishes, and other voracious animals and insects, at the time when they are perfectly helpless and most easily destroyed. The same plan would no doubt answer equally well with grayling, or other varieties of the salmo genus. But, in all experiments of this kind, the great principle is to have a constant current of fresh and aërated water running over the eggs. The uniform supply of air to the fœtus in the egg is essential for its life and growth, and such eggs as are not supplied with water saturated with air are unproductive. The experimenter must be guided exactly by the instinct of the parent fishes, who take care to deposite the impregnated eggs that are to produce their offspring only in sources continually abounding in fresh and aërated water. It appears that the leaves of plants that grow in water afford a continual supply of oxygen to the water, and that many fish possess the instinct to deposite their eggs upon these leaves, a circumstance that affords an easy opportunity of making observations upon the growth of young fish, as the leaves with the ova may be kept in a vessel of water. The same observations will apply to fishes of the sea."

2095. *The art of carrying and keeping fish*, as we are informed by Sir H. Davy, is better understood on the Continent than in England. "In Austria every inn has a box containing grayling, trout, carp, or char, into which water from a spring runs, and no one thinks of carrying or sending *dead* fish for a dinner. A fish barrel full of cool water, which is replenished at every fresh source among these mountains, is carried on the shoulders of the fisherman: and the fish, when confined in wells, are fed with bullocks' liver cut into fine pieces, so that they are often in better season in the tank or stew than when they are taken." Sir Humphrey has "seen trout, grayling, and char even, feed voraciously, and take their food almost from the hand. These methods of carrying and preserving fish have been adopted from the monastic establishments. At Admont, in Styria, attached to the magnificent monastery of that name, are abundant ponds and reservoirs for every species of fresh-water fish; and the char, grayling, and trout are preserved in different waters, covered, enclosed, and under lock and key." Some remnants of the same practice may be seen in the colleges of Cambridge.

Since England became a Protestant country, the cultivation of fresh-water fish has been neglected; but the formation of fish-ponds in hilly or mountainous districts would be a matter of little difficulty, and by this means a considerable addition might be made to the food of these places.

2096. *In China, the art of preserving and fattening fish* is carried to a high degree of perfection. An account of the method used in that country, quoted in the *Quart. Journ. of Science*, is deserving of notice. In the district round Canton numerous fish-tanks are dug in the ground. When the pond is finished, and filled with water, the owner goes to market, and buys as many young store-fish as his pond can conveniently hold; this he can easily do, as almost all their fish are brought to market alive. Placed in the pond, they are regularly fed morning and evening, or as often as the feeder finds necessary. Their food is chiefly boiled rice, to which is added the blood of any animals they may kill, wash from their stew-pots and dishes, &c.; indeed, any animal offal or vegetable matter which the fish will eat. Fish so fed and treated advance in size rapidly, though not to any great weight, as the kind (a species of perch) which came under our observation never arrive at much more than a pound avoirdupois; but from the length of three or four inches, when first put in, they grow to from eight to nine in a few months, and are then marketable. Draughts from the pond are then occasionally made; the largest are first taken off, and conveyed in large, shallow tubs of water to market; if sold, well; if not, they are brought back, and replaced in the pond until they can be disposed of. The business of fish-feeding is so managed that the stock are all fattened off about the time that the water is most wanted for the garden crops. The pond is then cleaned out, and the mud carefully saved, or spread out as manure, again filled with water, stocked with young fry, and fed as before. This mode of employing the ground was considered in that country as more profitable than any other.

2097. *The Chinese, likewise, propagate fish* by collecting the spawn in the rivers and lakes where it is deposited, and conveying it in vessels of water to their fish-ponds; this water with spawn is regularly sold by merchants, who make a trade of transporting it from one province to another. It is even said that these ingenious people have a method of hatching the spawn of fish. They fill the shell of a new-laid egg with the gelatinous matter that contains the spawn, wax up the hole through which it was introduced, and put the egg under a sitting hen. At the expiration of a certain number of days they break the shell in water warmed by the sun. The fry are then found hatched, and are kept in pure fresh water till they are large enough to be thrown into the pond with the old fish.

Lately, an account has been published of successful experiments of the same kind having been made by Sir Francis Mackenzie, of Coram-house, Scotland, and others who have reared salmon and trout from spawn taken from the fish, and deposited in beds of gravel laid in ponds; and it is stated by Professor Agassiz that the *ova* of fish, when properly impregnated, may be conveyed in water of a proper temperature, even across the Atlantic, as safely as if it were naturally deposited by the parent fish.

2098. *The term shell-fish*, though still retained in popular language, is not at present employed by naturalists. It includes the *Crustaceæ*, or crustaceous animals, as lobsters, crabs, shrimps, &c., and the *Molluscæ*, or soft animals. Of the Molluscæ, some are covered with a hard outer shell, in one or two pieces, and are named univalves, as the periwinkle, or bivalves, as the oyster; or they are entirely naked, having no shell, as the Medusæ, Sepia, &c. The Crustaceæ contain numerous species and varieties in different parts of the world; but we have only a few in our seas. Animals with shells abound with us, but only a few are large enough to be worth eating. Of the naked Molluscæ none are used in this country as food, though the Sepia or cuttle-fish is eaten in the south of France.

Most shells consist entirely of carbonate of lime (the same as chalk), connected together in layers with a little animal matter resembling albumen; hence shells will burn to a very pure lime. The interiors of many shells are lined with a pearly matter called *nacre*, which is sometimes extremely beautiful, particularly in mother-of-pearl. Pearls, which are found in certain shells, are nothing more than concretions of this substance, which is also carbonate of lime.

2099. *It is said that living too much upon fish* is apt to give rise to cutaneous eruptions; and this Dr. Paris considers as not improbable, particularly in hot climates. The oily principle upon which the odour of fish depends is absorbed into the blood, when this kind of food is taken, as is evident from the peculiar flavour of sea-fowl that live upon fish. Even the hogs that, in Cornwall, have access to pilchard have often a fishy flavour: and from the sympathy between the stomach and the skin, it is not unlikely that the oily fat fish may have a tendency to produce cutaneous derangement. Thus many facts appear to point out the propriety of changing our food occasionally. It has been conjectured that the priests of Egypt were prohibited from eating fish to avert the leprosy, which was supposed to be induced by living too much upon it; in the same manner that it is thought the Jewish legislator interdicted the use of pork from his belief in its unwholesomeness.

2100. *The supply of fish in the seas round Britain* is not only abundant, but inexhaustible; and yet, notwithstanding this, and the encouragement given by government, the fisheries have not proved so profitable as might have been expected. There is little fish consumed in the interior of the kingdom; and though in London immense quantities are annually made use of, "there can be no doubt," observes Mr. M'Culloch, in his valuable Dictionary of Commerce, "that the consumption would be much greater were it not for the abuses in the trade, which render the supply comparatively scarce, and, in most instances, exceedingly dear." "That this harvest," says Mr. Barrow, "ripe for gathering at all seasons of the year, without the difficulty of tillage, without expense of seed or manure, without the payment of rent and taxes, is inexhaustible, the extraordinary fecundity of the most valuable kinds of fish would alone afford abundant proof. To enumerate the thousands, and even millions, of eggs which are impregnated in the herring, the cod, the ling, and, indeed, in almost the whole of the esculent fish, would give but an inadequate idea of the prodigious multitudes in which they flock to our shores; the shoals themselves must be seen in order to convey to the mind any just notion of their aggregate mass." As the fisheries, and the various circumstances connected with them, are managed at present, the supply of fish is extremely uncertain, which causes a glut at one time, while at another there is scarcely any to be had. The cause of this is obvious. Fish are extremely changeable in their places of resort, and they will leave their accustomed haunts for long periods without our being able to ascertain the reason; nor do we know all the causes of their migration. Fish also require great care in packing and transportation, as they soon spoil. So far it is easy to perceive some of the physical difficulties over which we have no control. But still a question remains, whether all the means are employed which might enable us to enjoy all the advantages of our insular situation, and the abundance with which we are surrounded. But already we see reason to hope that the time is not far distant when the modern improvements will extend to this subject. Before steam navigation, a large proportion of the salmon sold in the London market could not have been brought fresh, and a contrary wind frequently rendered a cargo unfit for sale. By the railways fresh fish will be conveyed daily to inland towns which now receive a supply only two or three times a week, or less frequently. Already the inhabitants of Birmingham have benefited in this respect by the Grand Junction Railway, which gives them access to the Liverpool fish market, and salmon brought to London from Scotland by the steam vessels have reached that place by the same railway. The want of inland conveyances has hitherto deprived the country of the advantage of the extraordinary quantities of fish that have been occasionally caught. Even of cod-fish one ton and a quarter have been taken at a time in one boat. Of mackerel the haul has been sometimes so great that it could scarcely be disposed of, and pilchards and sprats are often obliged to be used as manure for want of sale. The means of conveying these to inland districts must produce, at times, a seasonable supply of food in future.

Sect. II.—salt-water fish.

Subsect. 1.—*The Turbot* (*Pleuronectes Maximus*, Linn.).

2101. This is the most highly prized of our flat fish. It inhabits the northern and Mediterranean seas, and is taken on the south coast of England in great plenty. It grows to a large size, sometimes even to weigh thirty pounds. The flesh is white, firm, rich, gelatinous, and of a fine flavour; but being a ground fish, Ude, the celebrated French cook, says that it is better for keeping a day or two, since, when just caught, it is apt to be not merely firm, but a little too hard. They are often brought to London alive in well-boats, and, as they do not all spawn at the same time, some are in season in every part of the year. The London market is chiefly supplied by the Dutch fishermen, and a preference is given to those caught on the coast of Holland; but a great many are likewise taken at the Dogger Bank, and on the coasts of Cornwall and Devon. Those sent up from Scotland packed in ice are very inferior, and may be purchased for a fourth of the price given for the best turbots. From the great demand for this esteemed fish, notwithstanding its price, vast numbers are brought to London, so many as 87,958 in one year.

Subsect. 2.—*The Sole* (*Pleuronectes Solea*, Linn.).

2102. The sole is well known to be, next to the turbot, the best of our flat fish. It inhabits the sandy bottom on all our coasts, but is finer in the west and south than in the north and east. It is an inhabitant of the northern seas, the Baltic, Mediterranean, and America. Great numbers are taken on the south coast of England by the boats from Dover, Folkestone, Brighton, and Hastings, and brought to the London market alive by well-boats or by land carriage. The finest are caught off Plymouth and in Torbay; they frequently weigh eight or ten pounds per pair, and have been seen two feet in length, but the smaller are preferred. They are likewise taken off Yarmouth. They are full of roe at the latter end of February; for a few weeks after, they are soft and watery, but they soon recover. Some of them are in season all the year round; but they are in highest perfection about midsummer. As they are an excellent, firm, white, and delicate fish, they are frequently seen upon the London tables. It is essential that they should be perfectly fresh, or the flesh loses its firmness, and thickness is desirable. Those from the deep water are superior in quality. They have been kept alive in fresh-water ponds; in Mr. Arnold's pond in Guernsey, the sole becomes twice as thick as one of the same length from the sea, and they are known to breed there. They are taken also in the Arun in Sussex, five miles from the sea, where they remain all winter, burying themselves in the mud.

SUBSECT. 3.—*The Brill* (*Pleuronectes Rhombus*, Linn.).

2103. This is somewhat like the sole, but broader, and is intermediate between that and the turbot. It is a fine fish, and, when large, not much inferior to the latter, though much cheaper. It is brought in abundance to the London market.

SUBSECT. 4.—*The Flounder* (*Pleuronectes Flesis*, Linn.).

2104. The flounder is generally the least esteemed of our flat fish. It is smaller than the plaice. It inhabits both the seas and rivers, coming into the latter to breed; and they will thrive in fresh-water ponds. It is very abundant on our coasts, and they also frequent our rivers at a considerable distance from the salt water. Great quantities of them are brought to the London market, and are sold at a cheap rate. They are in season from January to March, and from July to September. It is considered as a light food, being sweet and easy of digestion. The Thames flounder is a delicate and esteemed fish.

SUBSECT. 5.—*The Dab* (*Pleuronectes Limanda*, Linn.).

2105. This is very similar to the flounder, but smaller and thinner. It is out of season in May and June.

SUBSECT. 6.—*The Plaice* (*Pleuronectes Platissa*, Linn.).

2106. This flat fish is extremely abundant on our coasts, and is also found in the Mediterranean and the Baltic. It is inferior to the sole, the flesh being less firm and white, and not so well flavoured; but when they are of a large size, and just caught, they are by no means despicable. They are sold at a low price, and are generally purchased by the poorer people. The best of those brought to the London market are called *Dowers plaice*, being chiefly caught in the Dowers, or on the flats in the sea between Folkestone and Hastings, weighing from one to five and six pounds. On the coast of Holland they are obtained considerably larger, and are known here as *Dutch* plaice; some of them have been even eighteen pounds. Like all ground fish, they are very tenacious of life, and therefore keep well.

SUBSECT. 7.—*Halibut* (*Pleuronectes Hippoglossus*, Linn.).

2107. This is the largest of our flat fish, being sometimes found of the weight of two or three hundred pounds, and in the seas of Iceland and Newfoundland much larger. Its flesh is extremely white, and, when small, they are thought by some to be nearly as fine as turbot; but when they are large, the flesh is coarse and dry, and is not much esteemed, having little flavour. In some parts of Scotland this is called the turbot, which often occasions mistakes with the English people. In the London market it appears in March and April, and its flesh is sold in slices by the pound at a low price.

SUBSECT. 8.—*The common Cod* (*Gadus Morhua*, Linn.).

2108. This is one of the most important of the finny tribe, from the excellence of the food which it supplies, and its prodigious abundance. It is an ocean fish, confined to cold climates, and found only in the northern parts of the world. It is supposed to reside chiefly between the latitudes of 66° and 45°. Those taken north and south of these latitudes are either few in number, or bad in quality. As far north as Greenland they are small and emaciated; and they do not reach so far south as the Mediterranean, where they are unknown. The great resort of this fish is on the banks of Newfoundland, and the other sand-banks that lie off the coast of Cape Breton, Nova Scotia, and New-England, where they find food in the worms produced in these sandy bottoms. They are also taken on the south and west coasts of Iceland, on the coasts of Norway, in the Balti·, and off the Orkneys and western islands of Scotland. The principal fish eries whicl. at present supply the London market with fresh cod are hollows between the Dogger Bank, the Well Bank, and Cromer on the east coast of England. The fish caught there separates, when cut, in fine large flakes; it is brought alive to London in well-boats. The fishermen seldom find any cod or other round fish on the bank itself, but upon the sloping edges and hollows contiguous to it. The shifting sand on the top of the bank affords them no subsistence; and the shallow agitated water allows them no rest. Inhabiting deep water, they are taken only with lines and hooks. A great deal is caught off Scarborough. They are also taken in great plenty on the coast of Scotland, and the northeast coast of Ireland.

Mr. Yarrell, in his "History of British Fishes," mentions the two principal varieties of cod in the market as *Dogger Bank* and *Scotch* cod. The first has a sharp nose, with the body of a dark-brown colour; the second has a round nose, and the body of a light yellowish ash-green. The first is most esteemed.

2109. *In our seas the cod-fish begins to spawn* in December, and they continue to deposite their eggs on rough, rocky ground till the end of February, when they become poor. Some continue in the roe till the beginning of April: they are, therefore, a winter fish, being in high season about Christmas. They recover from their spawning sooner than any other fish, and it is common to take some cod all the summer. They are amazingly prolific. Leewenhoek counted several millions of eggs in the roe of one cod-fish of middling size, a degree of increase that must render them inexhaustible by human means. They are in highest perfection in the winter, and they keep well; but the glutinous parts about the head, so highly prized by gastronomes, lose their delicate flavour after the fish has been twenty-four hours out of the water. The cod is sometimes found of a very large size, weighing as much as sixty pounds; thirty pounds is not uncommon, but twenty-five pounds is the usual size of a well-conditioned fish; about six or eight pounds is the best for the table; but they are taken of all sizes from that to one pound. When below a pound, they are called *codlings;* the smaller ones are apt to be soft and watery. They are selected by their plumpness and roundness, especially near the tail; by the depth of the pit behind the head; and by the regular appearance of the sides, as if they were ribbed.

2110. The cod is particularly firm and rich when in season, which is known by layers of white curdy matter between its flakes when boiled. It is likewise extremely nutritious and light. When just killed, and in season, the gills are red, the neck thick, the flesh firm, and the eyes bright. The firmness of the fish is much improved by *crimping*. The *milt* of the cod, or soft roe, is brought to table as a garnish, but, from its oily nature, is not fit for delicate stomachs.

2111. *What is called the sound in cod-fish* is the air-bladder, or swimming-bladder, by means of which the fish is enabled to rise or sink in the water. The fish has the power of compressing this bladder; and then the air within it is condensed, in consequence of which its specific gravity, and, therefore, that of the whole fish, becomes heavier than water, and the fish sinks; when it desires to rise, by relaxing the muscles connected with this bladder, it suffers the air within it to be expanded, and the fish becomes specifically lighter than the water, and ascends. The sole, flounder, and other flat fish, have no bladder, and are therefore always at the bottom.

2112. *Cod is brought from the Dogger Bank and other places, and kept alive in the well-boats, or store-boats,* some stout vessels, of eighty or a hundred tons burden, having a large tank for preserving the fish alive. These boats remain as low as Gravesend, because the water there is sufficiently salt; if they come higher up, the fresh water would kill the fish; from the store-boats a portion is sent to Billingsgate by each night tide.

2113. *Cod has been kept in salt-water ponds* in different parts of Scotland, and found to maintain their condition unimpaired. Of these ponds, there is one in Galloway, another in Fife, and a third at Orkney. In these preserves the fish is regularly fed, and sometimes take the food from the hand.

Vast quantities of cod are taken on the Banks of Newfoundland, and brought to us, salted, for an account of which, as well as the other methods of curing fish, by drying, smoking, and pickling, see Book X., "Preservation of Food." By all these methods of curing fish, the digestibility is much impaired, and they are rendered unfit for invalids.

Subsect. 9.—*The Haddock* (*Gadus Æglifinus*, Linn.).

2114. This fish is an inhabitant of the northern seas of Europe; but it is remarkable that it does not enter the Baltic, and is not known in the Mediterranean. It appears on our coasts in December, and is then full of roe. Some are in season from August to February. The haddock resembles the cod in some of its properties. The small ones, when boiled, are less firm than the cod, and rather watery, but the larger fish are firm, and of a fine flavour. In general, they do not exceed the height of ten or twelve inches, weighing two or three pounds, but they are known sometimes to grow to the size of three feet: when large, they are coarse. They are better for being hung up for a day or two, with a sprinkling of salt. They are sometimes cured with salt, and dried; and this is done particularly well at the fishing village of Findhorn, near Aberdeen, by hanging them a day or two in the smoke of peat. *Finnan haddocks* (a corruption of Findhorn), broiled, are much used at breakfast by the Scotch, and are esteemed a great delicacy. An imitation of these, it is said, may be made by laying the fish in salt for two hours, letting the water drain from them, and then washing them over with pyroligneous acid, and, lastly, hanging them in a dry place for a few days.

Haddocks have been kept in salt-water ponds, or preserves, and will become so tame as to feed from the hand. They are in season during the last three months of the year.

SUBSECT. 10.—*The Whiting* (*Gadus Merlangus*, Linn.).

2115. This fish is tender, delicate, extremely light, and easy of digestion; perhaps the most so of any of our salt-water fish. Whitings appear in large shoals in our seas in the spring, keeping at the distance of about half a mile to that of three miles from the shore, where they appear to come to deposite their spawn. They are taken by the line. Their usual length with us is ten or twelve inches, and they seldom exceed a pound and a half in weight; but on the edge of the Dogger Bank they are found to weigh from four to eight pounds. They are in highest season during the first two months of the year, though they are occasionally taken all the year round. They are not allowed to be caught when less than six inches in length. The spawning season extends from March to September, and towards the end of the year they recover and become good.

In Cornwall, whitings are salted and dried, and in winter sold in the markets under the name of "Buckhorn."

2116. *The whiting pout* (*Gadus luxus*, Linn.) is common about the mouth of the Thames, and generally all round our coasts; it is caught also in the northern seas. It much resembles our whiting, and is an excellent fish. It is most in season in November and December.

2117. *The whiting pollach* (*Gadus pollachius*, Linn.) is caught all round our coasts, and is very common; being somewhat like the whiting, it is sometimes mistaken by the inexperienced for that fish. Its flesh is delicate.

SUBSECT. 11.—*The Ling* (*Gadus Milva*, Linn.).

2118. This fish is an inhabitant of the northern seas, and but little used in Britain as food. The ling in form nearly resembles the cod, but is more slender, and grows to the length of six or seven feet. It is taken in vast quantities off the Orkney, Shetland, and Western Isles, and is found also near the Scilly Isles, and off Flamborough Head. It only inhabits deep water. It is in perfection from February to the end of May; and they spawn in June, depositing their ova in the soft bottom. When they are less than twenty-six inches in length, they are called *drizzles* on the Yorkshire coast, and are consumed at home, being an excellent fish; but when larger they are coarse: they are salted, dried, and exported to Spain and the more southern parts of Europe, where the ling does not inhabit. The sounds and roes are salted separately; and a good deal of oil is obtained from the livers, as well as from those of the cod.

SUBSECT. 12.—*The Torsk, or Tusk* (*Gadus Brosme*, Linn.).

2119. This fish is extremely abundant in the Shetland Islands, where it is called *tusk*. It is a northern fish, found also in Norway and Iceland; but it comes no farther south than the Orkneys, where it is scarce. When fresh, the flesh is hard, and the fish are generally dried, like stockfish, without salt: when soaked in water, and boiled, they constitute the food of a numerous population in the North; but in this state they form a very insipid, though, with strong constitutions, a very wholesome food. They are brought sometimes from Shetland to London with other dried and salt fish.

SUBSECT. 13.—*The Coalfish* (*Gadus Carbonarius*, Linn.).

2120. This is a northern fish, being found in Spitzbergen, Davis's Straits, and the Baltic. It swarms in the Orkneys, where it furnishes a great part of the support of the poor at a certain time of the year; they take it, when under one year old, with rod and line, sitting on the rocks. It is there called the *sillock:* in the second year of its age it comes less frequently to the shore, and is fished from a boat, being named a *cooth:* as it advances in age, it keeps farther out to sea; and, growing to the length of two or three feet or more, it is termed *sethe;* and then it is a very coarse fish. In this state it is split, salted, and dried, for exportation to the Mediterranean. In Edinburgh the young fish are called *podleys*. While under a year old, and till two years, they are a delicate, well-flavoured fish. They can be easily bred in salt-water ponds.

SUBSECT. 14.—*The Mackerel* (*Scomber Scomber*, Linn.).

2121. This is well known to be one of the most elegant in its form among our fish, and the most beautiful in its colours when just taken out of the sea. It was formerly supposed to be migratory, passing the winter in the polar seas, and travelling south every year to deposite its spawn in warmer climates; but the migration of these fish, as well as that of the herring, is now disputed; and most naturalists are of opinion that, during the winter season, it merely retires into the deeper parts of the sea, at a distance from the shores. They appear on our coasts in the spring in immense shoals; but their progress does not correspond with their supposed migration from the north, for they are first met with off the Land's End in March, pursuing a course from west to east, and are found in the bays of Devonshire about April. They are taken off Brighton about April and May, and on the coast of Suffolk about May and June. In the Orkneys, they are not seen till August. This, instead of being any proof of the supposed migration, rather militates against the opinion that they come from the north.

2122. *Mackerel are so prolific* that 540,000 ova have been counted in one roe. Young mackerel, called *shiners*, are caught in August, from four to six inches long; and they are half grown when they retire to the deep water in November. Their principal food is the fry of other fish, and they are voracious feeders. Their ordinary length is from fourteen to sixteen, and even twenty inches, and their weight a pound and a half to two pounds. The largest fish, however, are not considered the best for the table.

2123. *Mackerel is in great request as an article of food;* but it should be perfectly fresh to be in perfection, and no fish spoils more rapidly: in consequence of its being so perishable a commodity, they are allowed to be cried through the streets of London on Sundays. The common idea respecting mackerel is, that they are in best condition when fullest of roe; but at that time this fish, though not impoverished, has but little flavour. It is in the early part of the season, when the roe is not yet full grown, that they have most flavour. There is likewise an after-season, when, in October, they have had time to fatten and to recover after spawning. Full-grown mackerel are occasionally caught on the Cornish coast all through the year. They are taken with large nets; and in some years the quantity caught is enormous. Mackerel is seldom salted in this country, but it appears that in France they are preserved in that manner. The value of this fish was highly recognised by the ancients, who prepared from it a kind of sause, called *garum*, still made at Constantinople, but now superseded through the rest of Europe by the anchovy. A variety of this fish, called the *Spanish mackerel*, is occasionally taken on our coasts, but it is in no estimation.

The *Scad*, or *Horse Mackerel* (*Caranx trachurus*, Linn.) is a coarse fish, which occasionally appears in vast shoals on the British coasts, particularly the southern. It is rarely brought to market, and not esteemed. In Cornwall it is salted and consumed by poor people.

Subsect. 15.—*The Smelt* (*Salmo Eperlanus*, Linn.).

2124. The smelt is a very delicate fish, and much in request. Mr. Yarrell says that the true smelt is almost exclusively confined to the eastern and western coasts of Britain, and that he is not aware of its existence between Dover and the Land's End; what is caught there, and called smelt, being the Atherine or sand-smelt. The smelt ascends rivers and inhabits fresh water from August to May; and, after spawning in March, returns to the sea. It rarely goes far from shore, and is taken in abundance in November, December, and January. It is a very elegant fish: its form is beautifully taper, the skin thin, and the whole body semi-transparent; the scales are small, silvery, and easily rubbed off. It has a peculiar odour, which some compare to that of a cucumber, and others to that of a violet. The Thames used to swarm with this fish; but of late very few have been taken in it. It has been bred in ponds with complete success.

2125. The *Sand-smelt*, or *Atherine* (*Atherina presbyter*, Cuv.), is sometimes sold in Southampton and other parts of the Hampshire coast as the true smelt, to which it is inferior, being more dry; though if dressed with the liver and roe, and without being embowelled, it is excellent. It is plentiful on the south coast of England, where the true smelt is rare.

Subsect. 16.—*The Gurnard* (*Trigla Cuculus*, Linn.).

2126. *The Red Gurnard*, sometimes called the *Cuckoo Gurnard*, is very common on the English and Irish coasts. Its head is remarkably well defended with bony plates and spines, and as they swim near the bottom of the sea, they are extremely tenacious of life when taken in the trawl nets. They are an excellent fish as food, and are in greatest perfection in October, though they are to be had through the winter months.

2127. *The Piper* is a species of gurnard, but more rare on our coast than the last. It is chiefly obtained on the western coasts of Devon and Cornwall, and attains the length of two feet, weighing three pounds and a half. All the gurnards emit some sound when taken from the sea; and the name of this species is given from the noise it is supposed to make. Its flavour is thought by some superior to that of the common gurnard.

2128. *The Gray Gurnard* is not uncommon on our coasts. Its general colour is brownish-gray or greenish-gray, the belly silvery white.

Subsect. 17.—*Conger Eel* (*Muræna Conger*, Linn.).

2129. This large species of eel is found in the European seas, and sometimes, though rarely, in rivers. It is extremely voracious, feeding on other fish, crabs in their soft state, or dead animals of any kind. It grows to the length of from four to ten feet, and some have been taken weighing a hundred pounds. A fishery of congers, at Mount's Bay, in Cornwall, forms a considerable branch of commerce. They are taken in great quantities, and were formerly exported in a dried state to Spain and Portugal, where, being reduced to powder, they were used for enriching soup. At present they are chiefly sold to foreigners as bait for other fish.

2130. *They are not nearly so oily as the smaller eels*, and the fish being white and firm, they are cooked in a great variety of methods. They make excellent soup, are eaten boiled, broiled, fried, and made into pies.

SUBSECT. 18.—*Skate* (*Raia Batis*, Linn.).

2131. *Of all the larger fish of this country, the skate or ray is the most numerous*, and this is owing, in a great measure, to their size. Only the cachalot and shark have a swallow sufficiently large to receive them, and, perhaps, even they are deterred by their defensive armour. In England some have been taken that weighed two hundred weight, and in other seas they have been met with much larger. In deep water they are supposed to be enormous, for it is only the smaller ones that approach the shores. They are very prolific, one female containing sometimes three hundred eggs; but they produce their young alive, and only one at a time, enclosed in a black, square, horny purse, which are frequently found cast upon the shore after the young skate has come out of it. Like other flat fish, they live at the bottom of the sea.

2132. *The skate belongs to the cartilaginous fishes*, that is, those whose bones consist only of firm cartilage. The flesh is thick, white, and extremely nutritive; and, being easy of digestion, forms an excellent food, less esteemed than it deserves to be. It is much improved by crimping, in which state it is almost always sold in London.

From their great abundance, skate is extremely cheap in the fishing towns of England; and as it is the custom there often to cut out only the best part, and throw the rest away, much excellent nutritious food is lost, which in other places would be converted into use. Skate, likewise, admits of being kept fresh longer than any other fish, and, hung up in the sun, it can be dried without salt. In northern countries, great quantities are thus laid up in store. The French consider skate as a very nutritious and excellent fish, and hold it in greater estimation than it is on this side of the Channel. They send their boats to our fishing towns to purchase skate, particularly in Lent, and they preserve it fresh by keeping it covered with wet sand. Skate are taken in abundance all round the coasts of England and Scotland.

There are several species found in our seas besides *Raia batis*, or true skate, as the *long-nosed skate*, the *white skate*, and the *Homelyn ray*, which are of inferior quality, though often crimped and sold for true skate.

2133. *Skate gets in season* in July, and continues so through autumn and the beginning of winter, but is not good in spring or early summer.

2134. *The Thornback differs from the true skate* in having large spines in its back, which are wanting in the latter. It does not grow to the size of the skate, and is considered as rather inferior in quality; in other respects it is very similar. The thornback is taken in greatest abundance during spring and summer, because then they approach nearest the shore for the purpose of spawning; but their flesh is not so firm and fit for the table at this season as in November. The fishermen call the females *Maids*.

SUBSECT. 19.—*Striped Red Mullet* (*Mullus Surmuletus*, Linn.).

2135. The colour of this fish is an elegant rose-red tinged with olive, when on the back, and a silvery coat on the abdomen. They occur frequently on the Cornish coast, and are taken also on the coast of Sussex, but become rare more north. This fish was held in great esteem by the Romans, not only on account of its delicious flavour, but also from its beautiful colour. At present it is a fish in high request, the flesh being white, firm, and of a fine flavour. On our coasts it seldom exceeds fourteen inches in length. Mullets occur sometimes in profusion, and at other times are exceedingly scarce; they are mostly taken with trawl nets, which traverse the bottom of the sea. They appear in the fishmongers' shops nearly throughout the year, but most frequently in May and June, when they are in best condition. Notwithstanding that the usual habitat of this mullet is the sea, it occasionally ascends rivers.

SUBSECT. 20.—*Gray Mullet* (*Mugil Capito*, Cuv.).

2136. The gray mullet, though bearing the same name, is altogether a different fish from the red. It is very plentiful on the sandy coasts of our island, and is observed to assemble in small shoals near the shores in the spring in quest of food, burrowing into the soft mud for worms, and leaving the trace of its head in the form of a round hole. Unlike the salmon, they spawn in the sea; but, like that fish, they ascend rivers for miles. When preparing for these expeditions, they are observed in shoals near the surface of the water, at which time the fishermen endeavour to avail themselves of the opportunity of surrounding them with their nets. The mullet is particularly abundant on the southeast coast of England. It is considered a fine fish; and the spawn is sometimes made into an inferior kind of caviare, by drying and salting it. From its partiality to fresh water, this fish has been thought favourable for the experiment of keeping marine fish in fresh-water ponds; and, accordingly, Mr. Arnold, of Guernsey, has fattened them prodigiously in this manner. Of all the salt-water fishes so introduced into ponds, the gray mullet seemed to be the most improved.

SUBSECT. 21.—*The Herring* (*Clupea Harengus*, Linn.).

2137. This excellent fish is peculiar to the northern seas, and is well known to supply abundance of food, particularly to the poorer classes. The name *herring* is derived from the German *heer*, an army, which expresses the number they appear in. Herrings are met with in great plenty, from the highest latitudes, as low as the northern coast of France. They are also found in vast shoals on the coast of America, as low as Carolina; and they are met with in the Sea of Kamtschatka.

2138. *The herring was supposed to be a migrating fish*, and that its chief rendezvous is the icy sea within the arctic circle, which swarms with insect food in greater abundance than warmer latitudes. Pennant and other authors have described the migration of the herring in a very circumstantial manner, which has been copied into numerous publications.

Notwithstanding the almost universal belief, however, of the migration of the herring from the northern regions to the south of Europe, and the detailed description of it, yet some of the best naturalists of the present day consider these accounts to be in most instances erroneous, and think it most probable that the herring, like the mackerel and the sprat, during the winter months inhabit the deepest parts of the sea, but at no great distance from the shore, or plunge beneath the soft mud at the bottom, from whence they rise in the spring season, and approach the shallower water, in order to deposite their spawn. It is thought that the northern migrations supposed by Pennant and others are impracticable in the short period assigned to them, as the fish, in its swiftest progress, is utterly incapable of moving at a rate so rapid as the term allowed for those migrations would require. Many interesting facts and observations on this subject may be found in Dr. M'Culloch's "Description of the Western Islands of Scotland." That they do move about in wandering shoals, like many other fish, is certain; but what renders it improbable that they come from the polar regions, as has been imagined, is, that they have not been observed there by our navigators. Their movements appear to be extremely capricious; for many of the deep bays of the west of Scotland and Ireland, which they frequent at one time, are entirely deserted in another year without any obvious cause: a circumstance which sometimes proves ruinous to the inhabitants of fishing stations.

2139. *Besides the great quantities of this fish consumed at home in a fresh state, much more is cured with salt and exported.* It has been stated that the Hollanders were the first who began the fishery of herrings on an extensive scale, and observed the several seasons of their passage, about 1163; but it is recorded in the Batavian annals that the Scotch sold their herrings to the inhabitants of the Netherlands as early as the ninth century; and this traffic laid the foundation of a commercial alliance between the two countries which subsisted for many ages. The Yarmouth fishery appears to have had its commencement soon after the landing of Cerdic, the Saxon, in 495, and the inhabitants of the town were long considered as the best curers in Europe. They had an advantage over the Dutch in being nearer to the herring shoals, and in possessing plenty of wood to smoke them, which is extremely scarce in Holland.

Willoughby, in his "History of Fishes," ascribes the art of curing herrings by salt to William Beukelz, a Fleming, who died in 1397; and the term *pickling* is supposed to be derived from him. Yarmouth, however, puts in a prior claim to this art. It is recorded that, in 1220, the Abbot of St. Alban's purchased a large house in Yarmouth, "in order to lay up fish, especially herrings, which were bought by his agents at the proper season for the use of the abbey." Prior to 1238, the inhabitants of the opposite coast of Europe were in the habit of resorting to Yarmouth for a supply of this fish. These and other recorded facts show that the method of preserving herrings, probably by salt, must have been known in England more than 200 years before Beukelz.

2140. *The principal British herring fisheries are on the west and east sides of Scotland and the west of Ireland;* the herrings fished in England are comparatively inconsiderable. Yarmouth and Lowestoffe are the principal places; and very large quantities are also caught at the mouth of the Thames by the fishing smacks of London, Folkestone, Dover, &c., for the London markets, and near the coast of Kent and Sussex for general consumption.

2141. *As food*, fresh herrings, though rather oily, form a very good aliment if used moderately; but that is not the case with pickled and salt herrings; these are only fit for those whose powers of digestion are very strong: in small quantities, with plenty of potatoes or other vegetables, they are less objectionable. Red herrings are used less as food than as a luxury. They excite thirst, and tend to create fever.

For the methods of curing herrings, see Book X., "Preservation of Food."

SUBSECT. 22.—*The Pilchard* (*Clupanodun Pilchardus*, Linn.).

2142. *The pilchard is somewhat allied in general appearance to the herring*, but is thicker, or of a less compressed form, the back more elevated, and the scales much larger in proportion. It is also a smaller fish than the herring, but larger than the anchovy, rarely exceeding the length of eight inches. Its geographical distribution is much more limited than the herring; instead of being found on every part of the British coast, like that fish, it occurs in this country in great numbers only on the shores of Devon and Cornwall. It likewise requires a warmer climate than the herring, abounding in the Mediterranean, and the coasts of Dalmatia, from which Greece and Italy are partly supplied. Pilchards appear usually in vast shoals off the Cornish coasts about the middle of July, and disappear in the beginning of winter, though a few return again after Christmas. Their winter retreat is supposed to be the same as that of the herring, in the deep sea.

2143. *The pilchard fishery is a very productive concern on the coast of Cornwall*, where these fish are cured with salt for exportation. Their appearance on the coast, and their term of remaining, are irregular; but when they come, they often appear in shoals so large and dense as almost to exceed belief. The shoals, either when pursued by enemies, or from other causes, crowd occasionally into bays and harbours in enormous quantities. In 1767 there were taken in St. Ive's Bay 3000 hogsheads of pilchards, each hogshead containing 3500 fish; at another time 10,000 hogsheads were caught at one time.

In Cornwall, besides the great number of persons employed in the fishery, and curing fish with salt for exportation, the poor are fed by them, and a large quantity is generally left, sufficient to supply a valuable manure for the land. The pilchard is a fat, oily fish, more so than the herring, and oil is extracted from them; but the Cornish people, nevertheless, use them as food, and many prefer them to the herring. They make a pilchard pie in the following manner: They clean the white part of some large leeks, scald them in milk and water, and place them in layers in a dish, putting between each layer two or three salted pilchards which have been soaked for some hours the day before; the whole is then covered with a good plain crust: on taking the pie out of the oven, the side crust is lifted up with a knife, and all the liquor being emptied out, its place is supplied with half a pint of scalded cream. Pilchards are not brought to London as such, but the young fry are often sold for anchovies.

SUBSECT. 23.—*The Sprat* (*Clupea Sprattus*, Linn.).

2144. This well-known little oily fish never grows to a larger size than four or five inches in length. It is a wandering fish, visits our shores, and continues with us in large shoals, when the herring and other fish have retired to the deep. They enter the River Thames below bridge about the beginning of November, and leave it in March; and being sold at a low price, are, during their season, a great relief to the poor of the capital. At Gravesend and at Yarmouth they are cured like red herrings. They are sometimes pickled, and, when managed properly, are little inferior in flavour to the anchovy, but the bones will not dissolve like those of the latter. In Cornwall the true sprat is very rare; what has been so called is the young of the pilchard. The coasts of Kent, Essex, and Suffolk are the most productive of them. There from 400 to 500 boats are employed during the winter; and, besides the immense supply to the inhabitants of London, many thousand tons are sold at from sixpence to eightpence per bushel to farmers, who employ them as manure to the land, distributing about forty bushels over an acre; they have even been sent up the Medway to manure the hop grounds in Kent.

SUBSECT. 24.—*White Bait* (*Clupea Alosa*, Linn.).

During the month of July there appears in the River Thames, near Blackwall and Greenwich, innumerable multitudes of small fish, which are known to the Londoners by the name of *white bait*. They are esteemed very delicious when fried with fine flour, and occasion, during the season, a vast resort of persons to the taverns contiguous to the places where they are taken. There were various conjectures about this fish; and though most of them terminated in a supposition that they are the fry of some fish, few agreed to which kind they owe their origin. Some attributed them to the shad, others to the sprat, the smelt, or the bleak. Mr. Donovan, in his "History of British Fishes," states that he had ascertained, past all doubt, that the white bait is the fry of the shad. Mr. Yarrell, however, in his late work on fishes, contests this opinion, and maintains that the white bait is a species distinct from every other fish. It is supposed that the parent fish are not taken, from not coming up high enough in the river. While it was supposed that white bait was the fry of other fish, and that using small nets for taking them was destructive to these fish, such nets were forbidden to be employed; but now that the subject is supposed to be better understood, the fishermen resume the use of these nets without any notice being taken of it, and white bait are commonly sold in London.

SUBSECT. 25.—*The Shad* (*Clupea Alosa*, Linn.).

2145. *The shad* is a sea fish that enters our rivers in May in order to spawn; and this accomplished, it returns to the sea by the end of July. Great numbers are taken opposite the Isle of Dogs in the Thames, but they are in little repute. The usual size is about twelve inches in length.

SUBSECT. 26.—*The Anchovy* (*Clupea Enchrasicolus*, Linn.).

2146. The little fish called anchovy is less used with us as food than as affording an agreeable relish, or for sauces and seasonings. It bears a considerable resemblance to the sprat; and its general length is from three to four inches, or, at the utmost, about four inches and a half. It is found in greatest plenty in the Mediterranean, but also in the Northern and Atlantic seas; and, like the herring, is supposed to leave the deep recesses of the sea, approaching the shores in spring for the purpose of depositing its spawn. The great fishery of anchovies is at Gorgona, a small isle to the west of Leghorn; and they are likewise caught in the Zuyder Zee in Holland, where their fishing is a very profitable branch, and many thousand barrels are annually cured at Amsterdam, Monickendam, &c., for exportation. They are taken in vast quantities, and prepared for sale by salting and pickling; they are put into salt as soon as they are taken, while still alive. The bones dissolve in boiling. The anchovy has been observed (and Mr. Yarrell says more frequently than is usually supposed) on the English coast. It is stated by Mr. Crouch that the anchovy abounds on the Cornish coast towards the end of summer, and that sufficient might be procured to supply Great Britain if attention were directed to the fishery in October and November. Anchovies should be chosen small, fresh pickled, white outside, and red within. Their backs should be round, not flattened. The head, being bitter, is removed in pickling.

2147. The *sardine* is a fish so called in the Mediterranean, flatter in the back and larger than anchovies, and is frequently substituted for them; but it is much inferior to the real anchovy; it is said by some naturalists that the sardine is no other than a small pilchard.

2148. *It is known that many adulterations are practised with anchovies* in England, such as putting anchovy liquor upon pickled sprats or pilchards; and as the red colour is considered essential, red-lead, a poisonous substance, has been employed to colour it; others colour them with cochineal, or red bole. It will be prudent, therefore, to procure anchovies fresh as they come over from Gorgona, and to take care that the flesh itself is red, which is not the case with the sprat. Anchovies are offered for sale in London at the rate of 30*s.* the double barrel, of 38 to 40 lbs., or 16*s.* the single barrel. They will keep long if covered with brine, but soon spoil if exposed to the air.

2149. *Essence of anchovies* is most liable to be adulterated. It may be made in the following manner: Take three pounds of anchovies, pulp them through a fine hair sieve; boil the bones with salt and water, seven ounces of salt to six pints of water; strain, and add seven ounces of flour; then pass the whole through a sieve. This should produce one gallon of the essence. No colouring pigment should be added, though this is directed in most of the receipts; all of them spoil the flavour of the anchovy. The addition of lobsters' eggs will, however, not only be harmless, but will improve the flavour, and, says the "Cook's Oracle," is the only rouge to be recommended.

Subsect. 27.—*The Doru, or John Dory* (*Zeus Faber*, Linn.).

2150. This fish is probably so named from the French *dorée*, gilded, in consequence of its golden-yellow colour. It is a rare fish in general, though sometimes taken in profusion on the Cornish and Devonshire coasts: the average weight is about five pounds; but some specimens sent to the London market have been twice as much. It appears to be a wandering fish, and is in high estimation for the table: the flesh, when dressed, is of a clear white. Most of those purchased in London are brought by land-carriage from Plymouth and other parts of the Devonshire coast. Being a ground fish, they are not the worse for keeping till the second or third day. When fresh caught they are tough.

Subsect. 28.—*The Sturgeon* (*Accipenser Sturio*, Linn.).

2151. This is one of those fishes that migrate from the sea to fresh water: the former serves for its production; but it never goes to any great distance from land, and it is only in large rivers that it grows to its usual size. It is found in the ocean, in the Baltic, the Mediterranean, Black Sea, Caspian, and in prodigious numbers in the large rivers which flow into them. The greatest sturgeon fishery is at the mouth of the Volga, in the Caspian Sea. This fish is likewise abundant in the rivers of North America, and there are regular fisheries in the River Garonne, on the coast of France: occasionally it is taken in the Thames, and is one of those fishes considered as only royal property. The rivers Eske and Eden afford large sturgeon; the form of the fish is lengthened and slender, with a long, projecting snout; its body is defended by hard scales and bony tubercles; the mouth is small, placed beneath, and is without teeth. It is a very strong, vigorous fish, grows frequently to the length of five or six feet, continuing to grow as long as it lives, and has been known to attain the length of twenty feet. Those brought to the London market commonly measure from four to eight feet, and sometimes weigh nearly 300 pounds. Notwithstanding its size, it is said to be of a mild character, feeding on small fish and worms. It is extremely fertile, one fish containing 300,000 eggs.

2152. *It belongs to the class of fishes whose bones are entirely cartilaginous*, and its flesh is much esteemed, being delicate, firm, and white as veal, which, indeed, it resembles so much, that slices of sturgeon, dressed in the manner of veal cutlets, are scarcely to be distinguished from them but by a superadded flavour somewhat like that of the scallop shell-fish. Sturgeon pies are much like meat pies; the flesh is sometimes roasted on a spit, like meat, and is excellent stewed with gravy, and made into soup. Sturgeon is rare in the London market, where it sells for 1*s.*, or 1*s.* 6*d.* per pound. Its season is the winter and spring. As it can seldom be had fresh with us, it is brought pickled from the Baltic and North America: those cured at Pillau are the best.

The sturgeon was in high repute among the Greeks and Romans, and Pliny states that it was brought to table with great pomp, accompanied with music, and ornamented with garlands of flowers.

2153. *Cavaire* is a favourite food of the Russians, prepared from the hard roes of the sturgeon chiefly; the roe is cleaned from the strings and fibres, steeped in strong brine, or salt pickle. It is then dried, and pressed into casks or tubs, and formed into small cakes about an inch thick, and three or four inches in breadth. The red caviare is salted and smoked. The fishery of the sturgeon, for this purpose, is extremely profitable to those engaged in it, and likewise to the government of Russia. Caviare is used by that nation as an article of food in the long Lent of the Greek Church, and on the fast days, which they observe with great strictness: it is exported for the same purpose to Italy and Germany. It also finds its way occasionally to the English table. It has lately been brought nearly fresh to London, in the same state as it is used at Riga and Petersburgh, and may be had at Mr. Ball's Italian warehouse, New Bond-street, at fifteen shillings per cask of three pounds. To be good, caviare should be of a reddish-brown colour, and very dry. It is eaten alone, or with oil and lemon, or vinegar, or with a sauce and pickle, like anchovies. The best caviare, as well as the best isinglass, is made by the Cossacks on the River Ural. In winter the roe is eaten fresh, and it is reckoned that the less salt put with it the better; but without some it will not keep.

2154. *The Sterlet* is a smaller species of sturgeon, seldom exceeding the length of three feet. It is found in the Caspian Sea, and in some of the Russian rivers, and is highly celebrated for the delicacy of its flesh. It is recorded of Prince Potemkin of Russia that, in seasons when the sterlet was unusually scarce, he had been known to have given three hundred rubles for a tureen of sterlet soup. The caviare prepared from the roe of the sterlet is a dainty still more expensive, and is said to be almost exclusively confined to the use of Russian royalty.

Subsect. 29.—*The Tunny* (*Thynnus Vulgaris*, Linn.).

2155. This fish rarely appears upon the English coast; but abounds in the Mediterranean, and is occasionally taken among the western isles of Scotland. It is a large fish, three or four feet in length, and sometimes much more. The flesh is considered very delicious, and something between fish and meat; it is as firm as sturgeon, but finer flavoured. In France it is much used, and dressed in a great variety of ways.

Subsect. 30.—*The Sea Lamprey* (*Petromyzon Marinus*, Linn.).

2156. The lamprey is a singular fish. In its general appearance, it approaches the eel tribe, and is distinguished by seven holes, like shot holes, on each side of the head, which are breathing holes. The generality of British specimens are from twenty to twenty-eight inches in length. This fish is an inhabitant of the ocean, ascending rivers chiefly during the latter part of winter and the early months of spring, and, after a residence of a few months in fresh water, it again returns to the sea. When in motion, it is observed to swim with considerable vigour and rapidity; but it is more commonly seen attached by the mouth to some large stone or other substance, the body hanging at rest, or obeying the motion of the current: so strong is the power of adhesion by this animal, that a stone of the weight of more than twelve pounds may be raised without forcing the fish to forego its hold. Like the eel, it is remarkably tenacious of life: the several parts, when cut in pieces, will long continue to move, and the head will strongly attach itself, for several hours, to a stone, though the greater part of the body be cut away from it.

The lamprey belongs to the class of fishes whose bones, instead of being hard, are mere cartilage; its spine is quite soft, without any protuberances. For many ages it has maintained its credit as an exquisite dainty, and has uniformly made its appearance at the most splendid of our entertainments. The death of King Henry I. is attributed to a too luxuriant indulgence in this his favourite dish. It still continues to be in high esteem, and we are told by Mr. Pennant that the city of Gloucester continues to send yearly, at Christmas, a present of a rich lamprey pie to the king. It is, notwithstanding, by some considered not to be wholesome food. Lampreys are most in season during March, April, and May, and are observed to be much more firm when just arrived from sea than when they have been a considerable time in fresh water. They are found in several of the British rivers, but that which is the most celebrated for them is the Severn. In the mouths of the larger of the European rivers they are sometimes taken in such quantities that it is impossible to use them in their fresh state; they are, therefore, grilled and moderately salted, and afterward barrelled up for sale, with the addition of vinegar and spices, or potted. Lampreys are dressed in several ways; they are boiled, roasted, fried, baked, in pies, or salted and dried for keeping.

2157. *The River Lamprey, or Lampern* (*Petromyzon fluvatilis*, Linn.). This species is smaller than the last, and though found chiefly in the rivers, likewise visits the sea. It is caught in considerable quantities in the Thames, the Severn, and the Dee. It is more plentiful than the greater lamprey.

Subsect. 31.—*The Weaver.*

2158. *The great weaver*, or the *sea cat* of Sussex, generally measures about twelve inches in length, swims near the bottom, and is remarkable for living a long time after it is taken out of the water. It is also armed with very sharp spines, which inflict wounds difficult to heal, except friction with oil be used. The fishermen, consequently, cut off these spines previous to bringing them to market. They are a sort of marine perch, and are excellent.

2159. *The lesser weaver* is more common on our coasts than the great weaver, and, having the faculty of striking with its sharp spines, is often called the *sting fish.*

SUBSECT. 32.—*The Wolf Fish, or Sea Cat* (*Annarrhichas Lupus*, Linn.).

2160. This is almost exclusively a northern fish, taken in the north of Europe, the Orkneys, and the coasts of Yorkshire and Norfolk. It has a ferocious-looking head, resembling a cat, and is furnished with strong teeth, with which it inflicts severe wounds. It does much mischief to the fishermen's nets. Those who have eaten it describe it as delicious; but few can overcome the prejudice excited by its appearance. The skin is very thick and strong, and is converted by the northern people into very durable bags.

SUBSECT. 33.—*The Bass.*

2161. *The bass* is a marine perch, found along the whole line of the southern coast of England, and in the Bristol and St. George's Channels; also occasionally on the coast of Scotland. The ordinary size of this fish is from twelve to eighteen inches in length, though it sometimes attains fifteen pounds in weight. They feed upon small fish and crustaceæ, and are caught by angling as well as the net. On the Kentish coast they are known by the name of *sea-dace.* They generally spawn near the mouths of rivers, and live very well in Mr. Arnold's fresh-water lake in Guernsey. They are fish of a good flavour, although by some reckoned coarse

SUBSECT. 34.—*The Sea Bream* (*Pagellus Centradontus*, Cuv.).

2162. This is not an uncommon fish on the south coast of England, and may be frequently seen during the summer in the fish-market of Hastings: they are abundant in Cornwall. The young are commonly known by the name of *chads*, and it is said that the fish spawns twice in the year. It is not much in esteem for the table. Mr. Yarrell recommends the following as the best mode of dressing the sea bream: "When thoroughly cleaned, the fish should be wiped dry, but none of the scales should be taken off. In this state it should be broiled, turning it often, and if the skin cracks, flour it a little to keep the outer case entire. When on table, the whole skin and scales turn off without difficulty, and the muscle beneath, saturated in its own natural juices, which the outside covering has retained, will be of good flavour."

SUBSECT. 35.—*The Lump Sucker* (*Cyclopterus Lumpus*, Linn.).

2163. This fish is sometimes seen at the fishmongers', hung up as a curiosity. It is eatable, but has no particular good quality.

SUBSECT. 36.—*Dog Fish* (*Squalus Canicular, S. Catulus*, Linn.).

2164. These fish belong to the shark tribe, and several species abound on our coasts, where they are very destructive to the fish, being extremely voracious. They are taken frequently in the nets with other fish, but are seldom used as food, being very full of oil, and strong tasted; nevertheless, in the northern parts of the kingdom, as in the Orkney and Shetland Islands, they are dried in the smoke, and even looked upon as dainties by the poorer sort of inhabitants.

SUBSECT. 37.—*The Whale.*

2165. The whale being the largest of all animals, we might suppose that its flesh is too coarse for food; that, however, is not the case. This animal, being one of the *mammalia*, suckling its young with milk, and breathing air without separating it from the water by means of gills, is not properly a fish, and its flesh is much like beef. Parts of the animal, particularly about the tail, are said not to be contemptible as food even by those who are not pressed by hunger; and some species, as the spermaceti whale, are very generally consumed by the Greenlanders, and other inhabitants of the arctic regions.

SUBSECT. 38.—*The Porpoise.*

2166. The porpoise was once a favourite at the tables of the great in this country, and was eaten with a sauce composed of vinegar, bread-crumb, and sugar. The flesh of the young has been compared to veal; but at present, instead of its being "food for kings," not a beggar will touch it.

SUBSECT. 39.—*The Dolphin.*

2167. The dolphin, though celebrated by the poets for its gambols, does not appear to be at present as much valued as formerly, when we read of an English feast consisting of a "roasted dolphin with proper sauce."

SECT. III.—FRESH-WATER FISH.

SUBSECT. 1.—*The Salmon* (*Salmo Salar*, Linn.).

2168. The salmon is styled by Walton, the celebrated angler, "*king of fresh-water fish.*" It is to be found all over the north of Europe and Asia, from Britain to Kamtschatka, but never ventures into the warm latitudes: it has been met with on the coasts of Greenland, and has been seen in some of the rivers of France, but none have been caught so far south as the Mediterranean.

2169. *It is a migratory fish*, and annually ascends rivers in large shoals for the purpose of spawning; but it is only to be found in such rivers as communicate with the sea, in consequence of which it is by some considered as a sea fish. The Romans were well acquainted with it, and our English name is borrowed from their salmo. The long migration of the salmon just before the spawning season forms an interesting part of their history.

It is certain they receive the principal part of their food in the sea, but it appears that the ova or eggs can only be hatched, and the young fish live, in fresh water; in the early period of a salmon's existence, salt water being fatal to it: also, that the causes of the alternate migrations of salmon are the impulse of propagation, and the search after food. In their debilitated condition after spawning, when they are "out of season," they betake themselves to the deep sea in which their haunts are not known.

Having recovered their vigour, they crowd in shoals towards the coast, and roam about in the estuaries until the autumnal floods entice them to enter the rivers. While thus detained on the coast and in the estuaries, they are pursued and preyed upon by numerous herds of seals and grampuses, which consume many more than fall to the lot of the fishermen. The early run fish are in good condition, the roe being still small, and they then mount towards the higher and more distant branches of the river.

In ascending the rivers they not only make their way against the most rapid currents, but overcome obstacles that might be supposed insurmountable. When they arrive at a waterfall or a weir, they leap out of the water to get over it. The salmon leap at Leixlip, on the Liffey, is thirty feet high. When there is little water in rivers they cannot ascend, and are obliged to take advantage of freshets. Towards August and September the roe has acquired such a size as to render the fish nearly useless as food, and greatly to limit the extent of its migrations.

Having arrived at a suitable spawning-ground, for which they prefer a gravelly bottom, the salmon pair, and proceed to the shallow pebbly fords at the top and bottom of pools, and then, in company, make their spawning bed, which sometimes reaches from twelve feet in length to ten in breadth. This bed is furrowed by the parent fish working up against the stream, and the spawn is deposited and covered at the same time. This process frequently occupies more than a week, during which the eggs deposited by a single fish sometimes amount to the astonishing number of 20,000! This spawning season extends from the end of October to the beginning of February, and occurs nearly about the same time throughout all the rivers of the United Kingdom; and during this period salmon is wholly unfit for food.

The parent fish, having thus accomplished the important purposes of their migration into the river, now retire into the deepest pools, were, after remaining a considerable time, they direct their course towards the sea, chiefly during the months of February, March, and April, the male fish appearing to migrate earlier than the females.

The eggs of the salmon remain in the gravel for several months, exposed to the influence of running water; and in the course of the month of March the fry are hatched. At first they are less than an inch in length; but upon leaving the spawning bed they betake themselves to the neighbouring pools, where they speedily increase to two or three inches. They then appear in incredible numbers, and descend to the sea in April, May, and June. It is said that, on first meeting with the tide, they remain some days in the brackish water till they get inured to the change.

At different periods of their progress the young fry have received different names, and there have been doubts whether they all belong to the salmon or to other fish. When under two pounds' weight they are called by some London fishmongers *salmon peel;* and when larger, but under a year old, they are termed *grilse.* These fish of the year breed during the first winter, and return from the sea next spring with the roe enlarged, as has been described, for the purpose of spawning, accompanied generally by the parent fish, when the season of fishing commences, and they are considered to be best as food prior to their entering the fresh water.

Thus the salmon passes the summer in the sea or near the mouth of an estuary; in autumn they push up rivers; in winter they inhabit the pure fresh water; and in spring descend again to the sea. From their regular change every year from salt water, it might be supposed that they could not be bred and kept altogether in a fresh-water lake. The experiment has, however, been tried with success, but it is said that the fish is inferior in flavour to those which have access to the sea.

2170. *When the salmon is in the sea, and about to enter the rivers for the purpose of spawning, or shortly after entering the rivers, it is in the highest perfection;* the flesh is firm and of a fine red colour, and the flavour excellent. The sides are of a bright silvery hue, with few dark spots: great numbers are caught at that time.

When the fish has spawned and is returning to the sea they have fallen off in condition; the colour has become dull, and the sides are streaked all over with red and dark spots; the rays of their skin are jagged and torn, part of their scales are torn off, and their gills are sometimes infested with parasitical fresh-water worms, which stick to them, and which they get rid of in the sea. At this time they are not wholesome, and are supposed to be productive of disease. This circumstance, however, is not sufficient to prevent those who have an opportunity from catching and eating the fish in that state: and the legislature has found it necessary to fix the periods at which salmon fishing is lawful. When they first arrive at the rivers from the sea, an insect, called the salt-water louse, is found adhering to their sides, and is a proof that the fish is in season. Although this subject has excited so much interest, and been so carefully studied, yet so difficult is it to acquire an accurate knowledge of fish, that the habits of the salmon are still involved in some obscurity. It has been said that every salmon, when wishing to return to fresh water after having been in the sea, goes up the same river in which he was spawned, and that each river has its own fish; but this is improbable: perhaps each fish may prefer his own river, but that he can find it always is unlikely.

The salmon is a voracious feeder, and its food consists of small fishes and marine nisects. It increases rapidly in size while in the sea, where it finds the greatest abundance of food.

It is thought that the breed of salmon is decreasing in Britain, from the amazing number that are killed in ascending to spawn, and from the want of protection of the fisheries.

2171. *The chief salmon fisheries in Europe* are along the coasts of England, Scotland, Ireland, and the Baltic. The fish is generally taken by nets, and also in the rivers, by a kind of locks called *weirs*. Near Whitehaven they are also speared. As they are caught in rivers and estuaries, the salmon fisheries are chiefly private property. The consumption of this fish in the metropolis is immense, and the London market is supplied principally from the rivers of the northern part of the island. Formerly salmon was caught in the Thames in abundance, and this was reckoned the finest; but since the water has been deteriorated by numerous sewers and gas works, this fish no longer frequents the river. The salmon of the Severn and Wye is excellent, and is first in season of any in England. Formerly such part of the salmon of the North as could not be consumed at home was pickled and kitted after being boiled, and was in this state sent up to London, under the name of Newcastle salmon. Within the memory of many now living, salted salmon formed a material article of household economy in all the farmhouses in the vale of the Tweed; insomuch that in-door servants used to stipulate that they should not be obliged to take more than two weekly meals of salmon. Its ordinary price was then 2*s*. a stone of 19 lbs. At present an immense quantity is taken in the Tweed, and is sent to London by the Berwick smacks. The fishing in the Tweed begins on November 30th, but there are few taken till after Christmas; and it ends at Michaelmas. Salmon, like all fish that swim near the surface of the water, cannot be eaten too fresh; its fine flavour diminishes rapidly after capture.

2172. *About the year* 1788 *the method was first resorted to, now so much practised, of packing salmon in ice to preserve it*, which enables the proprietors of the fisheries at a distance to send it to London in a fresh state; and salmon preserved in this manner is now despatched in fast-sailing vessels from the Spey, the Tay, the Tweed, the Dee, and other rivers of Scotland. This has amazingly altered the price of the fish, and increased the value of the fisheries. Icehouses are now built at the several rivers, to keep the fish in until the time for sending it arrives. A great deal of fish is often spoiled by this mode, and the flavour is materially injured by freezing. There are also salmon fisheries in some of the English and Irish rivers, but inferior to those of Scotland. The price of salmon in the season in London is frequently as low as 9*d*., and even 6*d*., per lb.

2173. *Salmon is cured or preserved* in various ways: salted or pickled, and dried. For the method of pickling salmon, see Book X., "Preservation of Food."

2174. *As food*, salmon, when in high perfection, is one of the most nutritive and delicious of our fish; but as it is very oily it is rather heating, and with some persons not very digestible; with most constitutions it requires the addition of condiments, as Cayenne pepper and vinegar. It is thought by some that the addition of shrimp, lobster, and other rich sauces, with which it is usually eaten, increases its indigestibility; but there does not appear to be any distinct knowledge on this subject, so much depending upon peculiarity of constitution. It requires to be very well boiled, otherwise it is unwholesome; and when in the best condition and season, it has a fine curdy matter between the flakes, which is a proof of its perfection, and the flavour is then very much superior; but this is seldom seen except near to the places where it is caught, as it melts away in keeping.

2175. *When the salmon runs from six to ten pounds* they are very good fish, and make handsome dishes sent to table whole; but by a late act of Parliament no salmon is permitted to be sold by the fishmonger of less than 6 lbs. weight, to prevent the destruction of the breed.

2176. *We find the following account of the perfect mode of cooking the fish* in Sir Humphrey Davy's "Salmonia:" "We must now prepare him for the pot. Give him a stunning blow on the head to deprive him of sensation, and then give him a transverse cut just below the gills, and crimp him by cutting to the bone on each side, so as almost to divide him into slices; and now hold him by the tail that he may bleed. There is a small spring, I see, close under that bank, which, I dare say, has the mean temperature of the atmosphere in this climate, and is much under 50°; place him there, and let him remain for ten minutes, and then carry him to the pot, and let the water and salt boil furiously before you put in a slice, and give time to the water to recover its heat before you throw in another, and so with the whole fish, and leave the head out, and throw in the thickest pieces first."

The rationale of this process of crimping is thus given: "I conclude that the fat of salmon between the flakes is mixed with much albumen and gelatin, and is extremely liable to decompose, and by keeping it cool the decomposition is retarded, and by the boiling salt and water, which is of a higher temperature than that of common boiling water, the albumen is coagulated, and the curdiness preserved. The crimping, by preventing the irritability of the fibre from being gradually exhausted, seems to preserve it so hard and crisp, that it breaks under the teeth; and a fresh fish not crimped is generally trout."

Salmon crimped in this manner, which preserves the natural taste, should have no other sauce than a spoonful of the salt and water in which it has been boiled, with the addition of a little lemon juice (or, if that cannot be had, vinegar) and pepper. Some persons, however, object to the curdy state of the fish, and prefer it when it has been kept for a day or two, when the curd has partly softened into oil, which gives a richer taste.

2177. *Salmon is seldom taken by the angler in the south part of Britain*; but in Scotland, as well as in Ireland and Wales, fishing it by the line is much practised, and affords much amusement.

SUBSECT. 2.—*The Salmon Trout* (*Salmo Trutta*, Linn.).

2178. This, called also the *sea trout*, appears to connect the salmon and the trout. It, like the salmon, frequents both the sea and rivers, ascending the latter to spawn. It is chiefly found in the rivers of mountainous countries, and is frequent in Wales and the lake district of England. It seldom exceeds a foot in length, but is a very delicious fish.

SUBSECT. 3.—*The Bull Trout* (*Salmo Eriox*, Linn.).

2179. This fish is not held in such estimation as the salmon or salmon trout, but sometimes attains the weight of fifteen or even twenty pounds. Few are sent to the London market.

SUBSECT. 4.—*The Common Trout* (*Salmo Fario*, Linn.).

2180. This fish is an inhabitant of clear and cold streams and lakes in most parts of Europe, and is less rich and oily than the salmon, but is esteemed a great delicacy for the table. It is supposed that there are several varieties; the colour of the flesh of some being reddish, of others yellowish, and of some it is white; the first are generally preferred. The female is of a brighter colour, and more beautiful than the male. It swims rapidly, often, like the salmon, leaping to a great height in ascending the rivers. They are in season during the summer months, or from the end of February till August, but are best in May and June, and afford great sport to the angler. They are of more quick growth than any fish except the salmon, but do not live to a great age; the duration of its life is supposed not to exceed eight or ten years. Its general length, when full grown, is about twelve or fifteen inches. When trout are in season, the scales are very bright and silvery; they should be cleaned and gutted when they are to be sent to any place, and closely packed, lying on their backs in a willow basket with dry straw; grass or rushes are apt to heat and spoil the fish. Before being dressed, they are much improved by crimping, and epicures direct that they should be killed by a blow on the head the moment they are taken out of the water. When the trout have arrived at home, lay them on cold stones until wanted; they should be dressed the day they are caught, and never put to soak or soften over the fire in cold water, as is the general practice. If trout are suffered to remain in water after being sufficiently boiled, they will directly become soft, and lose all the firmness given them by crimping. They should be boiled in water with a handful of salt put in. Salt water acquires more heat than fresh, and, consequently, hardens the curdy matter of the fish more. Trout feed well in stews, and will attain the weight of a dozen or fifteen pounds.

SUBSECT. 5.—*Samlet.*

2181. A fish, called the *parr* or *samlet*, about five inches in length, appears in our rivers in autumn, and has been supposed by some to be a distinct species; but it has been made out by Mr. Shaw that it is nothing more nor less than the fry of the salmon.

SUBSECT. 6.—*Charr* (*Salmo Alpinus*, Linn.).

2182. This delicious little fish, which is considered as superior to the salmon, inhabits deep lakes in alpine countries, even those which are extremely cold, and covered with ice half the year. Its flesh is rich, extremely red, and full of curd or fat. A few are found in certain lakes in Wales; but the largest and most beautiful are in the Lake of Windermere in Westmoreland: these are nine or ten inches in length. Being considered as a rarity, this fish is often preserved potted. Its figure is rather more slender than that of the trout. There are several varieties; that of Wales is different from the charr of the lakes of Westmoreland.

SUBSECT. 7.—*The Grayling* (*Salmo Thymallus*, Linn.).

2183. This fish is not met with in the rivers near London, and seldom in the south of England; but, being an alpine fish, delighting in rivers with rocky bottoms, it abounds in the rivers of Derbyshire, Wales, the Severn, Wye, and Trent. In shape it resembles the trout, but it is rather longer and more slender, being generally about sixteen inches in length. It is much esteemed as a table fish for the delicacy of its flesh, which is firm, white, and of a fine flavour. It is considered in the highest season in the depth of winter. When first taken out of the water, it has a very peculiar smell, resembling thyme, said to be occasioned by its feeding upon water thyme. As the trout is a spring and summer fish, the grayling may be considered an autumnal and winter fish. It has been supposed to be migratory, but Sir H. Davy has shown that it cannot bear even brackish water.

SUBSECT. 8.—*The Gwinead* (*Salmo Lavaretus*, Linn.).

2184. This is said to constitute an intermediate tribe between the trout and the herring; and, like the latter, it dies the instant it is taken out of the water. It has been called the fresh-water herring. Like the charr, it is an inhabitant of lakes in high mountainous regions, and in summer approaches the shores in vast shoals in search of food. It abounds in the lakes of Wales and Westmoreland, and is taken by nets. It is nearly a foot in length, but is considered as an insipid fish. The poorer classes salt them.

Subsect. 9.—*The Pike* (*Esox Lucius*, Linn.).

2185. The pike is styled by Walton the "tyrant of the fresh waters," as the salmon is "the king." It is found abundantly in most of the European lakes, particularly in the northern parts; and although it has been disputed whether it is indigenous in England, yet it is the opinion of our best naturalists that there is sufficient proof of its being a native. Its usual colour is a pale olive gray, deepest on the back, and marked on the sides by several yellowish spots or patches; the abdomen white, slightly spotted with black; and its mouth is furnished with a prodigious number of teeth. The size of the English pike is considerable. Instances have been known of their weighing forty pounds, measuring three feet in length; but in Lapland and Russia they attain the size of eight feet. The pike is highly prolific, and their multiplication is immense in the northern parts of Russia and Siberia, where they are taken in the greatest plenty, and constitute an article of commerce, being prepared by salting and drying for exportation.

The voracity of this fish is notorious. It subsists on other fish, but will also devour frogs, rats, serpents, and other reptiles, and even the young of aquatic fowl. It is also related that it will sometimes bite the noses of cattle who come to drink, as well as the hands of persons who put them into the water where it is kept; but stories respecting its voracity have been exaggerated. It is a remarkable, as well as a fortunate, circumstance, that in the summer months, when the fry of other fish are so numerous, the digestive functions of this fish are rather in a torpid state, by which its voracity is diminished. It is very long-lived: Pennant mentions one ninety years old. They are occasionally kept in ponds, but are expensive to maintain, as they require much food, and are destructive to other fish.

The flesh is of a good quality, but it is a dry fish; and when it makes a good dish, it is much indebted to stuffing and sauce. If small, they will do fried; but if large, they are best roasted. The pike of the Medway, which feed chiefly on smelts, are of excellent flavour, and that of Hornsea Weir, in Norfolk, is much esteemed. In the time of Edward I. this fish was scarce in England, and was only introduced at great feasts, its price being higher than that of salmon, and ten times that of turbot.

The terms of *pike* and *jack* refer only to the age of the fish, the latter name being employed where it has not attained more than three pounds in weight, or more than twenty-four inches in length. It is stated by Sir John Sinclair as a fact which ought to be better known, that it is dangerous to swallow the bones of this fish, as they are sharp, and of a texture so peculiarly hard that they will not dissolve in the stomach.

Subsect. 10.—*The Carp* (*Cyprinus Carpio*, Linn.).

2186. The carp is found in rivers and ponds; but they appear to prefer slow and stagnant waters. Their usual length in this country is from twelve to eighteen inches, but in warmer climates they often attain the length of two or three feet, and weigh from twenty to thirty pounds. In the Lake of Como they are said even to weigh occasionally 200 lbs. The usual food of the carp consists of worms and aquatic insects; but they feed also on herbs, and, when in course of fattening for the table, bread and milk. It is extremely prolific, and very tenacious of life. As they live long after being out of the water, it is recommended to kill them as soon as they are taken, otherwise they waste.

Carp are easy of digestion, and afford pretty good food, but are greatly indebted to the cook for the estimation in which they are held. They are frequently kept in fish ponds, and live to a great age; some live even a century or more: they may be tamed so as to feed out of the hand.

The sale of carp constitutes a part of the revenue of the nobility and gentry in Prussia, Pomerania, Saxony, and other places in Germany; consequently, in these countries, the cultivation of carp is regarded with particular attention. The southern parts of Europe are most congenial to it; a few breed in the ponds in Scotland; it is supposed to have been first introduced into England in 1514. Its season is the spring, in March and April, and from that till October they are to be had; in winter they are supposed to lie in the mud.

A variety, called the *Grecian carp*, is found in some of the ponds about London, in the vicinity of the Thames, and is also common in several of the counties of England. Their usual size is half a pound; and they are supposed to have been introduced from Germany.

2187. *The gold carp*, or *gold fish* (*Cyprinus auratus*, Linn.), is one of the most beautiful and interesting of all the finny animals, but better known among us for its value as an ornament than for its qualities as food, although they are sufficiently large and numerous in some places, as in the Mauritius, to be served up at table as fresh-water fish. The extreme elegance of their form, the splendour of their scaly covering, the grace and agility of their movements, and the facility with which they can be kept alive in small glass vessels, cause them to be ranked among the most pleasing of our pets. This fish breeds freely in small ponds, and even in tanks, in this country; but particularly so, if by any contrivance the temperature of the water can be kept a few degrees above the ordinary mean.

Subsect. 11.—*The Perch* (*Perca Fluviatilis*, Linn.).

2188. This is one of the most common, and, at the same time, one of the best of our fresh-water fishes; its colours are likewise brilliant and striking. It is found in almost all the lakes and rivers in Britain and Ireland, and likewise through the whole of the temperate parts of Europe. It is remarkably voracious, feeding upon worms, insects, and small fish, and is very prolific; a perch weighing half a pound will contain 280,000 ova. The spawning season is at the end of April or beginning of May; and perch angling commences in February, continuing till the cold weather, if winter comes on. The perch is one of our largest fresh-water fish; one weighing a pound is a good fish, and one of three pounds weight is reckoned very large; but they have been known to reach even eight or nine pounds. They abound most in deep, dark, sluggish rivers, and delight to lie about bridges, mill pools, and in any deep and dark holes in the still parts of water, or the gentle eddies about flood-gates, and similar places. Its flesh is white, firm, of a good flavour, and easy of digestion. It is covered with thick scales, which are troublesome to remove; and is so tenacious of life, that they may be carried sixty miles in straw, and yet survive the journey. They are best crimped the moment they are taken out of the water.

2189. *The Ruffe*, or *Pope* (*Perca cernua*, Linn.), is a small fresh-water fish, closely allied to the perch, and found commonly in all the rivers and canals of England, preferring slow, shaded streams; they abound in the Thames, Isis, and Cam. It is much like the perch in flavour, being firm, delicate, and well-tasted, and is excellent broiled in buttered paper.

SUBSECT. 12.—*The Roach* (*Cyprinus Rutilus*, Linn.).

2190. This fish inhabits deep, still rivers with a sandy bottom, in Europe and the adjacent parts of Asia; and is very numerous in most rivers of England. It seldom exceeds a pound and a half. It spawns in May, and is in season from September till March; it is very fertile, the eggs are greenish, but become red by boiling. The roach is a yellowish, silvery fish of the carp kind, and will breed in ponds, but not so well as in rivers. Some prefer dressing them by scoring across the sides, and broiling them with the scales on. It is rather an insipid fish, and very bony. The finest are caught in the Thames about the middle of May, or early in June, or afterward in October; vast shoals are taken in Loch Lomond with nets. "As sound as a roach" is a proverb; but this is derived from the French name of this fish being *roche*, which also signifies a rock.

SUBSECT. 13.—*The Fresh-water Bream* (*Cyprinus Brama*, Linn.).

2191. The bream is found in shoals in rivers and lakes, particularly when the latter are large, as those of Cumberland. It also occurs in most of the rivers near London, and is found in abundance in the River Mole, and some in the Regent's Canal. It may also be bred in ponds. It feeds upon worms and some vegetables, and much resembles the carp. Its best season is May; some think in September. It is not much esteemed for the table, being insipid and very bony. It sometimes grows to the length of two feet, weighing ten pounds.

SUBSECT. 14.—*The Tench* (*Cyprinus Tinca*, Linn.).

2192. The tench is fine-flavoured, and generally considered as a rich fish in England: it appears to be a native of most parts of the globe, inhabiting chiefly large stagnant waters with a muddy bottom, as well as rivers. Its general length is about twelve or fourteen inches, but it grows sometimes to two or three feet; seldom weighing five pounds. Like the common carp, tench delight in warmth; they are scarce near London, and thrive best in foul and weedy waters. Some extensive tracts of stagnant water in Norfolk abound in tench, from which they are removed to stews, where they are fattened upon a mixture of greaves and meal. They do not thrive northward, and few are found near Edinburgh. From the facility with which they may be bred, and the ease in transporting them, from their tenacity of life, they perhaps deserve more attention than is paid to their cultivation. They spawn in the spring.

SUBSECT. 15.—*The Gudgeon* (*Cyprinus Gobio*, Linn.).

2193. This fish is of the carp genus, and in length about eight or nine inches at the utmost, seldom weighing more than half a pound. It is found in gentle streams and lakes. It is tenacious of life, and remarkably fertile. Gudgeons are in season in the spring, or from March and April to May, and may be had for five or six months; yet in the hot summer they are very indifferent. They are firm, well-flavoured fish, and much esteemed for the table, being little inferior to the smelt. They should be cooked in a frying-pan, in a few hours, or as soon as possible, after they are caught, and without being scaled or opened; they only require wiping with a wet cloth: opening and washing spoils them. They afford much amusement to anglers, fifty dozen a day having been taken. Being a gregarious fish, they may be seen in summer in the bottoms of clear rivers by hundreds together, and they will live and breed in ponds. They are very fine and numerous in the Rivers Thames, Lea, Mersy, Colne, Kennet, Avon, and also in the New River. The London fishmongers keep them alive for several weeks in leaden or stone tanks, constantly supplied with fresh water. In Bath, they are exposed for sale alive in tubs, and are thus to be had in perfection: they are considered as very easy of digestion, and therefore fit for invalids. Of the genus Cyprinus, some are migratory, inhabiting both the fresh and salt waters, while others remain in fresh water throughout the year.

Subsect. 16.—*The Barbel* (*Cyprinus Barbus*, Linn.).

2194. *This is a common fresh-water fish*, belonging to the carp family, which derives the appellation of *barbus*, bearded, from the upper jaw advancing far below the lower, and in having four appendant barbs at its mouth. It is found during summer in the rapid currents, and at the stony bottoms of tide rivers, retiring at the approach of winter to the more still and deeper places. Barbels sometimes grow to the length of two or three feet. They are ground, or bottom fishes, lurking among the stones and under-banks, and are usually found when moderate floods bring down small animals, as snails, leeches, &c., as food. There is an ancient idea that the flesh of the barbel is unwholesome, which is, perhaps, a prejudice; but it is not of a very good flavour, and is little esteemed: no doubt when the fish are out of season they are, like most other fish in the same condition, not wholesome. They are seldom eaten except by the lowest of the Jews. They are understood to be very voracious and indiscriminate in their feeding; and it is said that the roe is sometimes violently cathartic. The Thames, from Putney upward, produces barbels of large size and in great quantities; also the Lea in Essex; but they are chiefly valued as affording sport to the angler.

Subsect. 17.—*The Dace* (*Cyprinus Leuciscus*, Linn.).

2195. This fish is of the carp genus, and has a bright, silvery colour. It is considered to be light, nutritious food, though full of bones, and is caught in most rivers and streams, but does not thrive in ponds or still waters. These fish never attain a great size, seldom weighing a pound. They are cooked in the same manner as roach, which they much resemble, and to which they are rather superior, though not so plentiful. They are gregarious, swimming in shoals, and spawning in June. The *Graining* is a variety of the dace, rather more slender.

Subsect. 18.—*The Rudd* (*Cyprinus Erythropthalmus*, Linn.).

2196. This fish is very common in the Thames and other rivers of England, as well as the rivers of the Continent. It may be often purchased in Hungerford fish-market, but is sometimes mistaken for roach, to which it is inferior, the flesh being soft and full of bones. It seldom attains two pounds' weight. The roach, bream, and rudd are much alike.

Subsect. 19.—*The Chub* (*Cyprinus Cephalus*, Linn.).

2197. This is a river fish, of the carp genus, somewhat resembling the tench. They are very common in England and Scotland, and delight in deep holes in ponds and canals, but chiefly in clear and rapid rivers. When full-grown, they are from twelve to fifteen inches long, and in weight four or five pounds. When quite in season, and only two or three pounds, they greatly resemble carp, and are usually dressed in the same manner; but they are not very palatable, being watery, tasteless, and bony, and are apt to acquire a yellow colour in boiling; they are therefore held in little esteem. The best manner of dressing this fish is to stuff and roast, or broil it with the scales on, when it is pretty good. It affords good amusement to anglers on the Thames.

Subsect. 20.—*Bull's Head, or Miller's Thumb.*

2198. This singularly-formed fish is of the gudgeon kind, with the scales extremely small, the head large and flat, and the mouth wide. It seldom exceeds five or six inches in length, and is met with in almost all shallow rivers, abounding in the New River. The fish is well tasted, and turns red or salmon colour on boiling.

Subsect. 21.—*Loach* (*Gobitis Barbatula*).

2199. The loach is a very small fish, generally about three inches long, having a round body with six wattles, or barbs, at its mouth. It is not very common, but is found in small brooks and rivulets. It is chiefly used as bait for fishing large eels and perch; but is delicious fried in batter, or with eggs and crumbs of bread.

Subsect. 22.—*The Bleak* (*Cyprinus Alburnus*, Linn.).

2200. This is of the carp genus, and is abundant in most of our rivers, particularly the Thames and Lea. It is in little esteem for the table, being chiefly taken for the sake of its beautiful, silvery scales, which are made use of in the manufacture of artificial pearl; but it is also occasionally substituted for the anchovy, though it has not the same flavour. Its length is about five or six inches, slender in shape, colour bright silvery, with the back olive-green. Its tail is forked, and, from its continual motion, it has been called the river swallow; by some the fresh-water sprat.

2201. *Stickleback.*—This very small fish, which is generally under two inches in length, is a frequent inhabitant of rivers, ponds, and marshes, as well as the sea; it receives its name from the sharp spines on its back. It is sometimes very troublesome in fishponds when it gets into them, being extremely pugnacious, and attacking the larger fish. In the fens of Lincolnshire they are in such quantities as to be taken out in cart loads, and are employed to manure the fields.

Subsect. 23.—*The common Eel* (*Murœna Anguilla*, Linn.).

2202. This fish is migratory, and inhabits both salt and fresh water; it is, accordingly, taken in rivers, lakes, and ponds, as also in the sea. In its form it makes a near approach to the reptiles, having no fins except the pectoral. In the water, no fish is more vivacious, and, as it clings to life very tenaciously when out of the water, it may be kept alive for several days in wet sand. It is, however, very sensible of cold, and, to avoid this, it buries itself under the mud in the winter. There are no eels in the arctic regions, and none in Siberia.

In some parts of Europe the eel fishery is of surprising magnitude. Dr. Black says that in some places near the mouth of the Baltic so great a quantity is taken that they are salted for exportation, and conveyed by wagons into Saxony, Silesia, &c. Two thousand have been taken in Jutland by a single sweep of the net, and in the River Garonne sixty thousand have been caught in a day by a single net. Ponds are sometimes appropriated in England to the raising of eels; and large quantities are caught in the Thames and other British rivers.

2203. *The consumption of eels in our large cities is considerable.* The London market is principally supplied from Holland, by Dutch fishermen. Mr. Yarrell observes, "There are two companies in Holland, having five vessels each; their vessels are built with a capacious well, in which large quantities of eels are preserved alive till wanted." One or more of these vessels may be constantly seen lying off Billingsgate; the others go to Holland for fresh supplies, each bringing a cargo of 15,000 to 20,000 pounds weight of live eels, for which the Dutch merchant pays a duty of 13*l.* per cargo for his permission to sell.

2204. *As an article of food*, eels are extremely rich and nutritious; but on account of the large quantity of oil which they contain, they are apt to occasion derangements of the digestive function, and require as a corrective to be eaten with vinegar, or some other condiment. Their use in pies is well known. They are also eaten fried, stewed, and plain boiled.

2205. *There are several varieties of the fresh-water eel.* The true *silver eel*, so called from the bright colour of its belly, is caught in the Thames, and is superior to most others. Those taken in running water are preferable to what are taken in ponds; the latter often have a rank, muddy flavour. The *Dutch eels* sold at Billingsgate are of this kind. The *sand eel* is a small fish of a delicate flavour, found buried six or eight inches in the sand left dry at low water.

2206. The body of the eel is covered with a slimy mucous substance, which makes them very slippery, and difficult to hold in the hand, whence the well-known saying. It is a common notion that eels have no scales; but that is an error; they have scales, which are easily seen when they are wiped and dried, particularly if a magnifying glass be used.

2207. *The cruelty of skinning eels alive may be avoided* by first cutting off the head, which destroys the sensibility. The writhing motions which they then exhibit in being skinned are thought not to be owing to their being sensible of pain, but merely to what is termed irritability, which does not cease immediately on the death of the animal. Eels have this peculiar property, that they are never out of season, though they are best in the summer months.

2208. *It is a curious fact in natural history that the manner in which eels breed is yet a problem not completely solved.* It has been generally said that they are viviparous; but Sir H. Davy observes, in his "Salmonia," "No facts are produced in proof of the assertion. It is certain," he says, "that shoals of very small eels are seen in the spring, making their way from the sea to the rivers; and that in the autumn great numbers are known to descend from the rivers to the sea. They even ascend the rivers over wet mossy rocks. In fresh water they fatten and grow large." The opinion of this acute observer was, that eels are oviparous, and deposite their ova in parts of the sea where they may remain warm in the winter, and that the young ascend rivers in search of food.

2209. *Ells were considered* by the ancient Romans as one of the most luxurious articles of the table. They were kept alive in reservoirs, and occasionally tamed to such a degree as to come at the signal of their master, in order to receive their food.

2210. *The Eel Pout*, or *Burbot*, is a fish much resembling the eel, and is found buried among loose sands, weeds, &c., in the Rivers Severn, Trent, and Mersey. They are sweet and nutritious: in length, from twelve to twenty inches.

Subsect. 24.—*The Minnow* (*Cyprinus Forinus*, Linn.).

2211. This is a very small fish, inhabiting rivers, and brooks, and canals, and chiefly known as affording amusement to juvenile anglers. They are of good flavour, and when a sufficient number can be procured by a casting net, make an excellent fry, somewhat like white bait, but rather luscious and cloying. In Walton's time, a dish called minnow tansies was made from them, now out of use. They were gutted, well washed in salt and water, and after their heads and tails were cut off they were put with yolks of eggs, well beat with cowslips and primrose flowers, and a little tansy shred small, and fried in butter; the sauce being butter, vinegar, or verjuice and sugar.

Sect. IV.—Shell-fish.

2212. Under this popular term we comprehend the two divisions of *crustaceous animals*, as lobsters, crabs, shrimps, &c., which have shelly coverings with feet; and *molluscous* *animals*, or molluscæ, as oysters, cockles, periwinkles, &c. These are now separated by naturalists from the class of fishes; they are in immense variety; many are used as food, but some of the naked molluscæ, or those without shells, are poisonous. Arranged under the genus cancer there is an immense number of crustacea in different parts of the world, but only a few species are found on the British shores.

SUBSECT. 1—*Lobster* (*Cancer Gammarus*, Linn.).

2213. *The common lobster frequents* all the northern seas of Europe. They are found on the rocky coasts of England and Scotland, but chiefly where there is a depth of water. Vast quantities are brought to London from the northern parts of Scotland, and particularly from the Orkney Islands, in smacks that have wells for keeping them alive. They are still more abundant on the coast of Norway, from which the metropolis is well supplied at most seasons of the year. A recent traveller in Norway saw an export of 48,000 lobsters shipped for London within three months from one place; and a regular "English lobster company" has agents actively employed all along the coast. Occasionally, though rarely, lobsters are taken by the hand, or rather by a hook, from under hollow stones, at low water, but by far the greatest quantity are caught in a kind of trap formed of twigs and baited with garbage; these are fastened by a cord and sunk into the sea, and their place marked by a buoy.

Lobsters are highly prolific; 12,400 ova or eggs have been counted under the tail of one female, besides that which remained in the body unprotruded. The eggs are deposited in the sand, where they are hatched.

They change their shells annually. Previously to putting off their old one, they appear sickly, languid, and restless; and they acquire a new coat in a few days after casting off the former one. During the time that they are thus defenceless they seek very retired places, for fear of being attacked and devoured by such of their brethren as are not in that weak condition. The new shell is membranous at first, but hardens by degrees, and they grow in size while the shell is in this soft state. The circumstance of lobsters throwing off their great claws voluntarily is very surprising, but sufficiently authenticated. If taken or entangled by the great claw, they will sometimes part with it by a sudden jerk, and thus effect their escape. Pennant says that when irritated, as when it thunders, or when great guns are fired, they will lose their claws. And scarcely less extraordinary is the reproduction of these members, which grow again in the course of a few weeks after the mischance has happened; but the new claws are not quite so large as the former ones. In the water they can run nimbly upon their legs or small claws, and, if alarmed, can spring tail foremost to the surprising distance of thirty feet, and as swift as a bird can fly. They are extremely voracious, feeding upon any kind of dead fish, and sometimes on sea-weed.

2214. *Lobsters are certainly nutritive, but not so much so as is commonly supposed;* they are not very easily digestible, and therefore require condiments, of which the most proper are those usually made use of, vinegar and pepper. On certain constitutions they have sometimes pernicious effects, and are known to have occasioned eruptions on the skin, and other distressing symptoms of derangement. Great care should be taken that they be in good condition, and absolutely fresh. When stale they are undoubtedly unwholesome in a very considerable degree. The fishmongers in London generally underboil them, with a view to their keeping, in which case they are extremely indigestible. According to Dr. Kitchener, they come into season about April, and continue plentiful till the oyster season returns in the autumn.

2215. *Lobsters brought alive from the northern extremity of the island in smacks with wells* for the purpose are often much wasted on their journey; their weight, therefore, is one proof of their goodness: but to ensure their being fresh, it is best always to buy them alive, and to boil them at home.

2216. *The ova* or *eggs, called by the cook berries,* and sometimes the *coral,* appear under the tail of the hen or female lobster only, and are black when raw, becoming in succession nearly as large as elder-berries before they are all deposited; the lobster continues depositing them as long as any remain in the body; when boiled, they are of a beautiful red colour.

It is a common mistake to suppose that a berried lobster is always in perfection for the table. When the berries are large and brownish, the lobster will be found exhausted, watery, and poor. The male lobsters are preferred for eating, particularly during the winter: it is distinguished from the female, not only by its want of the eggs under the tail, but by a narrower back part to the tail, with a strong spine upon the centre of each of the transverse processes underneath it, which supports its four middle plates; the two uppermost fins within his tail being stiff and hard, while those of the female are soft, and her tail broader. The female is best for sauce, on account of her eggs. The bag in the body of the lobster, called the "old lady in her arm-chair," containing the bony teeth, is the stomach, and is not fit to be eaten.

In choosing lobsters that are boiled, select those that are of a middling size, and heaviest for their bulk: to know if they are fresh, try if the tail has a springiness and will flap back again when raised up.

2217. *The common sea crawfish* (*Cancer palinurus*) is similar in its general properties to the lobster, but is less esteemed.

SUBSECT. 2.—*The Crab* (*Cancer Pagurus*, Linn.).

2218. *The crab inhabits most of the rocky shores* of England, and is taken in the same way as the lobster. It is in the highest perfection for the table about Christmas. The same observations which were made with respect to the nutritive and other qualities of the lobster apply to this crustaceous animal. Besides the cancer pagurus, the crab, which grows to a large size, and which is the only one brought to the table, is called, in Scotland, a *parten*; there is another much smaller, and without hairs (*Cancer mœnces*), more frequent about the shore; but this is a very poor, watery animal, of a greenish colour, and eaten only by the more indigent classes of people.

Crabs are found under large stones at low water, and are taken with a long stick having a hook at the end. But, on a larger scale, they are caught on the coasts of England and Scotland, in water from three to five fathoms deep, by sinking wicker traps containing bait, consisting of heads and entrails of fish. Many are brought from Norway. The male crab has the claws larger than the female, and is therefore of greater value. The female has the apron large, broad, and easily opened: that of the male is much smaller and narrower.

The best crabs have a considerable roughness on their claws; those with smooth shells are not so good. The crab is peculiarly tenacious of life, and is capable of exerting a considerable degree of muscular power after it has been removed two days from its natural element. It is often alive and fit for the table when, to all appearance, it seems to be dead. If any spark of life remain, it will be exhibited by the creature's exertions to keep the apron closed with its claws.

Crabs, as well as lobsters, are apt to throw off their claws on the stimulus of any sudden fright or pain, and therefore it is the practice, though a cruel one, in boiling them, to put them into cold water, by which they die gradually as the heat increases.

Crabs are in season all the year, except the months of May, June, and July; and a few may be had good at any time of the year.

Our English crabs are entirely marine; but in other countries there are also freshwater species; and in tropical climates land crabs are plentiful. *The land crab of the West Indies* (*Cancer ruricola*) lives in the mountains, and inhabits clifts in the rocks, hollow stumps of trees, and holes which they dig in the ground. Once a year they march down in a body to the sea side for the purpose of depositing their spawn in the sea, and, having accomplished this object, they bury themselves in holes in the ground, and cast their shells. They are often found in this condition, and in a fattened state, and are then highly prized as a wholesome and delicious food. There are two varieties of the land crab in Jamaica, one white, and the other black. The black crab is found abundantly in the eastern and northern marshes of the island during particular periods of the year; it is of the blackness of the lobster, and of a very light and handsome shape, as compared with any other species; it is very active upon its legs, and runs fast. The white land crab is very abundant in the low districts of the south side of the island: it is not so active in its movements as the black.

SUBSECT. 3.—*The Shrimp* (*Cancer Crangon*, Linn.).

2219. This lively little animal inhabits most sandy shores in Europe. It is too well known to the cook to require any description. As they are sold in London, they have almost always a great quantity of salt to make them keep, which overpowers their delicate and fine flavour. The Isle of Wight is famous for shrimps, where they are potted; but those prepared for London are generally too much salted.

2220. *The Prawn* (*Cancer squilla*, Linn.) is very analagous to the shrimp, but larger, finer, and less common.

SUBSECT. 4.—*The Oyster.*

2221. Oysters are almost universally distributed near the shores in all latitudes, and abound on the coasts of Britain and France, where they form a very important article of food. There are a great many species of oysters in other countries, but all those on our shores that go by the name of the common oyster belong to one species, the *Ostrea edulis* of Linnæus.

The nervous system of the animal is limited to the faculties of sense and touch, no especial organs for seeing having been yet discovered. Each oyster is perfect of itself, that is, capable individually of reproducing its kind.

2222. *In the breeding season*, which is in May, June, and July, the ovary is filled with a milky fluid, which contains a great number of ova, or eggs, of a whitish colour. Oysters are extremely prolific, and the young ones in the ova may be seen by the microscope floating in a viscid liquid. In May or June the young have reached their full size, leave the ovaries, and are then called by the fishermen *spawn* or *spat.*

Oysters adhere not only to rocks, but to any solid bodies that their spawn may light upon when cast, as small stones, wood, sea-plants, old oysters, or other shells, and a thousand things which are found at times with oysters growing in them. The spawn appears at first as a viscid matter, and is in great abundance; but much of it is destroyed by fish and crabs. The material at the bottom of the sea, to which the spawn adheres, is called by the fishermen *cultch;* and they are careful not to destroy it. Places that abound with sea-weeds or mud are not favourable to the propagation of oysters. It is conjectured that in twenty-four hours the spat begins to have a shell.

If an oyster happens to be cast on shore, it soon dies; but if deposited in places which are flooded at high water, they will keep their shells closed when it ebbs, and thus preserve their existence. When oysters are recently taken up from places that are never left dry by the sea, they open their shell, lose their water, and die in a few days; but kept in reservoirs in which they are left occasionally by the sea, exposed to the rays of the sun, or to severe cold, or when they are disturbed in their beds, they acquire the habit of keeping the shell close when they are uncovered with water, and exist without injury for a long time.

2223. *Oysters, being fixed to the rock, or some solid body, are usually supposed to have no power whatever of locomotion; nevertheless, it is said that they do possess this in a small degree*, by means of an organ called the foot, which is composed of various layers of fibres, that by their contraction bestow on it the power of motion. A very strong muscle, which is always cut across when the oyster is opened with the knife, named the adductor muscle, is attached to the interior opposite sides of the valves or shells; when this muscle is in a state of contraction, the shells are kept closed, and when the muscle relaxes, the shells open. When the animal dies, this muscle, of course, loses its power, and the shell gapes.

The oyster has many enemies which prey upon it, notwithstanding its shelly defence: the asteria, or sea star, clasps its arms or rays round the shell, and forces it open: crabs and lobsters are also destructive to a bed of oysters.

2224. *Oyster shells are composed* of carbonate of lime, cemented by animal matter of an albuminous nature: in some places they are burned for lime. A century ago they were employed medicinally calcined, though they are now considered as no way different from any other carbonate of lime.

2225. *The oyster fishery* is so important in Britain that it is regulated by the Admiralty Court. In the month of May, the fishermen have liberty to take every kind of oyster, whatever be their size. When they have collected them, they gently raise with a knife the small brood from the cultch, and then they throw the latter in again, to preserve the ground for the future, unless they have so much spat that they cannot be severed from the cultch, in which case they are permitted to take the stone or shells which the spat is upon, one shell having often twenty spats. The spat is then carried to creeks of the sea, where the water is still, and thrown there in order that they may grow large and fat, and that they may be easily obtained when wanted. In eighteen months they are grown sufficiently to be brought to market, but are not in perfection till about two or three years. The oysters are sick after they have cast their spawn in May, and they are then unfit for food; in June and July they begin to mend, and in the beginning of August they are recovered: on the fourth of that month they are permitted to be brought to the London market. All the winter they continue to be taken, and the oyster season terminates on the 12th of May.

2226. *The oysters fattened in artificial beds* are young, and generally reckoned the most delicate; but some persons prefer those that grow upon their native rocks, as having a higher flavour. Although oysters are among the natural productions of our coasts, yet this source is not entirely depended upon; but young oysters, of a size not exceeding a penny-piece, are obtained from various parts, and carefully planted in the artificial beds. The method of forming these artificial oyster-beds was known to the ancient Romans, who were exceedingly fond of this fish. The beds are mentioned by Pliny as the invention of one Sergius Orata. It is not a little remarkable that the finest oysters eaten in ancient Rome were fed in the channel which then separated the Isle of Thanet from England, and which has since then been filled up, and is now converted into meadows. It is extremely probable that the custom of forming oyster beds has been continued on our coasts ever since. Oysters have been reared in beds, ever since the times of the Romans, in the Lake Facino, on the coast of Baia near Naples, as described by Count Lasteyrie; this lake communicates with the sea by a narrow passage; along the margin of the lake are placed circles of reeds, with their summits above the water; the spawn of the oyster attaches itself to these reeds, and grows there till of an edible size: the reeds are pulled up and examined, and the full-grown oysters are removed, and put into he reserve till wanted: the small-sized and spawn are, with the reeds, put back again. It requires two years before the oysters come to their full size.

2227. *The means adopted for fattening oysters*, when transplanted, is one of the chief causes of their excellence. Nearly all the oysters brought to London have been so improved. The breeding-places are generally held on leases by a copartnery, consisting of a considerable number of individuals; and disputes often occur between the lessees of an oyster-bed and the fishermen. In some places, the latter contend that unfair modes of dredging are practised; and also that from those parts of the coast where no peculiar rights exist, the brood is carried away and planted in the beds, which are protected by law, thus making the weaker party contribute to the success of those who are already in possession of many important advantages.

It is certain, however, that the protected beds are a much more productive source of profit, both to the dredgers and to the public, than those which, from various causes, are left at the mercy of parties who are not locally interested in their preservation. In England, the oysters from the beds at Milton, in Kent, forty miles from London, are in high repute, as the whitest and most delicate, and are consumed in every part of England under the title of "native oysters." The native oysters are properly those that are born and bred in this country; and the Milton natives are mostly spat in the Burnham and Mersey Rivers, and placed in the Milton beds: they do not come into their finest condition till near four years old. The beds at Colchester, Pyfleet, Milford, Maldon, Feversham, Queensborough, Rochester, and those in the Swale and Medway, are also highly esteemed, and help to supply the London market. The common or Colchester oysters come in the 5th of August; but the native Miltons do not come in till the beginning of October, and are in greatest perfection near Christmas. There are also beds in Jersey and on the coast of Wales, which produce large quantities of oysters, some of which are brought to London.

On the Scotch coast oysters are less numerous than on the English, and they are not so frequently reared in beds; but the beds in the Firth of Forth and in Musselborough Bay, taken near the salt-pens, yield oysters of good flavour and of a large size. The Carlingford oyster, on the coast of the county of Louth in Ireland, are said to be of very superior flavour. Oysters from Brittany have been long famous, particularly those from Caucalle, near St. Malo; but those brought from Mercunes in Saintonge are in the highest estimation with the French. The green oysters eaten in Paris are brought from Dieppe. In tropical regions the common oyster is found attached to trees that grow on the edge of the sea, as the mangrove; and though this has been often thought fabulous, it is perfectly true. Many of the branches of these trees grow under water, and are covered with oysters. Instead of taking off the oysters, the branches are sometimes cut off with the fish upon them, carried home in baskets, and placed upon the table in that state.

2228. *Oysters are now most generally eaten raw, and in this state they are every way preferable.* When cooked, they are deprived of their salt water, which promotes their digestion, and they likewise lose much of their nutritive mucilaginous matter, their albumen becoming hard. When good, they are allowed to be, in general, highly nutritious; and with most persons they constitute an extremely light food; but with weak stomachs they are cold, and require the addition of some stimulant; pepper is the best.

2229. Oysters which have been fattened in artificial beds sometimes acquire a green tinge; and it has been supposed that this colour is occasioned by their having grown upon rocks impregnated with copper, and that such oysters, consequently, have a poisonous quality. As this is a popular error, it is proper to set the matter right. The green tinge is not owing in any instance to copper, but is derived, according to some, from the oysters feeding upon the minute plants, called confervæ, that grow abundantly in those places where the water is shallow and the sun has great power; the green colour is thought to be owing to a peculiar state of the bile. Oysters may be made green in such places in three or four days. When persons have been made ill from eating such oysters, they would, in all probability, have experienced the same effects from eating an equal quantity of any others. There are no rocks whatever containing copper in the places where our oysters are taken, nor can the slightest trace of copper be detected in them by chemical tests. The popular notion that oysters possess aphrodisiac properties appears to have no foundation.

2230. *Like all fish, they are out of season at spawning time;* and hence the origin of the old saying that "an oyster is never good except when there is an R in the month;" but this supposes that they are not to be eaten in August, and some are of opinion that they are not thoroughly fit till the beginning of September. During the period from the 12th of May to the 4th of August they are prohibited being taken or sold, in consequence of their being considered as unwholesome, the clerk of Billingsgate being empowered to seize and destroy all that are there offered for sale within the jurisdiction of the lord mayor. The magistrates of Rochester and Milton, however, not being empowered to proceed against the offenders, an illicit trade is carried on there.

2231. *During the season, the consumption of oysters* in London is immense, and no article of diet is more generally used by every class. The number of dealers is proportionably large, the poorest streets not being without one or two, generally supplied, at least, with the large but less delicately flavoured oyster.

They are kept alive for consumption for several days, or a week, in tubs containing water in which a quantity of salt is dissolved, with a little oatmeal added, for the oysters to feed upon, and thus be in condition. They are sent into the country, packed close in small barrels at the beds. Frequently what is sold as barrelled oysters are merely the smallest natives, selected from the stock and put into the tub when ordered; and, instead of being of superior quality, they are sometimes very inferior. At Billingsgate they are sold out of boats which lie alongside the market, in quantities not under one peck; and at the opening of the season the line of dealers extends all along Thames-street and over London Bridge. Many are exported to Holland, Germany, and other parts of the Continent.

SUBSECT. 5.—*The Scallop* (*Ostrea Maxima*, Linn.).

2232. The shell of this fish is well known as that which was formerly worn on the hat or coat by the pilgrims, as a mark that they had crossed the sea for the purpose of paying their devotions in the Holy Land; and in commemoration of this it is still preserved in the arms of many families. It is a *pecten* in the system of Lamarck, and is a very elegant shell, of a great variety of colours, acquiring the size of five or six inches across. It lies at the bottom of deep water, in beds, from which they are dredged up. The fish is very palatable, though of a peculiar flavour, and seldom eaten but in the fishing towns. It is boiled, roasted, or baked, or pickled in vinegar.

SUBSECT. 6.—*The Muscle* (*Mytilus Edulis*, Linn.).

2233. *The muscle is found* adhering to rocks by a strong silky beard, frequently in such quantities as completely to cover them. Since many persons who have eaten muscles have suffered severely, these fish are generally supposed to be occasionally poisonous. The cause of this does not appear to have been sufficiently ascertained. Some pretend to take out the part which they suppose to be deleterious, namely, a dark substance, and, in fact, the heart, which is perfectly harmless; others speak of the beard as indigestible. Lately, M. Bremnil is said to have discovered that the poisonous property of muscles depends upon the presence of a minute star-fish which enters into the shell in summer, but is never found in it in winter. He collected some of these star-fish, and gave them to dogs, upon whom the same symptoms were produced that appear when poisonous muscles are eaten. There are likewise fresh-water muscles, but they are never eaten with us.

SUBSECT. 7.—*The Cockle* (*Cardium Edule*, Linn.).

2234. The common cockle is a bivalved shell-fish found on all the sandy shores of Europe. Cockles bury themselves in the sand, out of which they are dug. They have a peculiar and agreeable flavour, and form an extremely wholesome food. They vary considerably in size on different coasts, and are very large on some of the Scottish shores. They are eaten boiled, plain, or fried, and are frequently used for sauce instead of oysters. Some have described them as of difficult digestion; but this does not appear to be the fact, from their universal use and general good character.

SUBSECT. 8.—*The Razor Fish* (*Solen Siliqua*, Linn.).

2235. This is a bivalved shell-fish, so called from the shells having nearly the form of the handle of a razor; it is only found on some particular coasts, and burrows in the sand. It is about six or seven inches long, and about one inch broad, the hinge being on the middle of the side. When the two shells are closed, they resemble a tube open at both ends. Part of the fish is of a cylindrical form, white and firm. They are eaten boiled or fried, and are very delicate and wholesome, although, perhaps, not very digestible.

SUBSECT. 9.—*The Periwinkle and Whelk.*

2236. These are well known univalved molluscæ, of little importance as general food, though eaten by the poorer classes, and sufficiently wholesome.

SUBSECT. 10.—*Helix Pomatia.*

2237. *A large species of land snail having a shell, called Helix pomatia*, is regularly bred and kept in gardens on the Continent for the table. In Germany, particularly in Vienna, sacks of these molluscæ are brought to the markets and sold; they are there considered as great delicacies. The enclosure in which they are kept is surrounded by boards, having the upper edge covered with small iron spikes, over which the snails never attempt to pass. They are fed upon cabbage leaves. This article of food was highly prized among the ancient inhabitants of Italy. The Romans bred them in prodigious numbers, fattening them in places called *cochlearia*, a particular description of which is given by Varro; and Pliny informs us that the method was invented by Fulvius Hirpinus, who lived a little before the time of Cæsar. This luxury grew to such a height that it was restrained by a special law. The Helix pomatia, or "esculent snail," was first introduced into England from Italy by a branch of the Howard family, one of the daughters of which, when labouring under consumption, having been recommended to eat soup made of it. Its medicinal virtues are, however, disregarded by physicians. These snails are not common in our fields, but are found at Boxhill, and in the vicinity of Dorking in Surrey. They are never brought to table with us.

Sect. V.—reptiles.

2238. Of reptiles, though some are among the luxuries of the table, yet the greater number are of little value for this purpose; and many are so disgusting in their appearance as to excite a strong prejudice against them; but none of them are known to be of a poisonous, or even unwholesome nature. Various species of *turtle* are well known. Of the lizards, the *dracæna* and *squana* form excellent food; and the *frog* supplies a favourite dish to our continental neighbours. The flesh of reptiles in general is delicate: the largest muscles are white, and contain a great deal of gelatinous substance: even serpents and snakes of all kinds, whether poisonous or not, are used as food by various nations. The poison of the serpent lies only in some receptacles attached to the fangs in the mouth; if the head be cut off, the body is innocent food. The *boa-constrictor* is considered as a great delicacy: the *rattlesnake* is broiled like eels by the North American Indians. *Viper broth* is known among us, and was formerly recommended as a restorative, although perhaps it is not superior in this respect to what is made from eels.

2239. *Turtle.*—Of the genus *testudo*, some inhabit the sea, and are called turtle; others are named tortoises, and live on land, or in fresh water.

There are several species of turtle used as food; but the best and most celebrated is called the *green turtle* (*Testudo Myas*, Linn.) from the colour of its fat. This turtle, so much prized as delicious food, is a very gentle and harmless animal, and sometimes grows to a great size, weighing from fifty pounds to five or six hundred weight, and measuring five or six feet in length. They abound in the seas of hot climates, particularly along the coasts of Cochin China and the islands of the East and West Indies, and frequently ascend the mouths of rivers. At the Isle of Ascension fifty have been taken in a week. Turtles are only calculated for swimming, the feet being so formed as to resemble a kind of fins or paddles, and they can move on land only with difficulty; nevertheless, they contrive to come on shore, and scratch holes in the sand to deposite their eggs, which they leave, after covering them up, to be hatched by the sun; in about a month the young ones come out and crawl to the water. The eggs are numerous, often amounting to above 100; and the female lays three times in a year: they are generally about the size of a small hen's egg, but sometimes much larger; they are quite round, consisting only of a yolk enclosed in a soft skin like parchment, are very delicious, and are highly esteemed. One of the usual modes of *taking* the turtle is by turning them on their back when they come on shore, from which position they cannot recover themselves without great difficulty. They are likewise caught while lying asleep on the surface of the water, and sometimes they are struck with the harpoon.

Turtle comes to us from the West Indies, some of the ships being provided with proper accommodations to permit them being brought alive and in tolerable health; but frequently they become emaciated during the long voyages, and then are very inferior for soup. There are various modes of cooking this excellent and nutritious food: one of the most usual methods in the West Indies, and perhaps the most wholesome, is to dress the flesh by boiling or frying like a beefsteak. It is also stewed, and made into the well-known turtle-soup, for which we refer to Book XIII., "Recipes in Cookery." What is called the green fat of the turtle is, in fact, not fat, but a gelatinous substance like the skin of a calf's head, or the tendons of the heel: that which forms part of the upper shield of the animal is called *callipash* by the cooks; and what belongs to the lower shield is the *callipee*. These are considered as the *bonne bouche* of the turtle. The flesh of the turtle is seldom dressed in the London taverns in any other way than in soup; occasionally as a steak. Turtle soup, as it is usually prepared here, is apt to disagree with dyspeptics.

Turtle is often a valuable addition to the live stock at sea; and the flesh may be salted and preserved a long time; in this state it is much used in the West Indies and America. Like other oviparous animals, turtles are best in season when beginning to lay their eggs; those which are full of eggs are reckoned the finest; after this, they are out of season. The introduction of this animal into England as an article of luxury is of no very distant date, and can perhaps scarcely be traced farther back than about 70 or 80 years.

2240. *The loggerhead turtle* (*Testudo Caretta*, Linn.) is often larger than the green turtle, and its shell is beautifully coloured, but too thin for manufacture. It is a strong and fierce animal, and even dangerous: it is found in the Mediterranean, but its flesh is coarse and rank.

2241. *The elegant substance known by the name of tortoise-shell* is made from the shell of a variety of turtle called the *hawksbill*, or *imbricated turtle*, which is a native of the Asiatic seas, but found, though much more rarely, in the Atlantic, and even in the Mediterranean. Its general length is about three feet, and the shell is formed in scales that lap over each other like the tiles of a house. The flesh is said to produce fever and dysentery, but the eggs are wholesome. It is a ferocious creature, and defends itself with vigour.

2242. *Tortoises* are of two kinds: the land and fresh-water tortoise. The land species is distinguished by club-shaped feet, and toes furnished with claws, and has the shell very convex. The fresh-water species have their feet more or less webbed.

2243. *The common land tortoise* (*Testudo Græca*, Linn.) receives its name from abounding in Greece and the countries bordering on the Mediterranean. It is covered by an extremely strong shell, about seven inches in length, and weighs about three pounds. It is a slow, stupid-looking animal, lives upon milky plants, as lettuces, dandelions, &c., delights in warmth, but avoids the heat of the sun in summer, and is equally afraid of rain. In the winter he burrows into the ground, where he remains torpid for some months. Its flesh is eaten by the inhabitants of those countries where it abounds, and likewise its eggs, which it lays in holes in the earth, where they are hatched by the sunbeams. It is well attested that this animal lives to a most extraordinary age, several examples being adduced of its having considerably exceeded the period of a century. One of the most remarkable instances is that of a tortoise introduced into the bishop's garden at Lambeth, in the year 1633, which continued to live there till 1753, when it was supposed to have perished rather from accidental neglect on the part of the gardener than from the mere effect of old age. Its shell is preserved in the library of the palace at Lambeth. The tortoise can refrain from eating as well as breathing for a great part of the year; and, from some experiments made upon it, appears to be tenacious of life in a most extraordinary degree, living and walking about for six months even after being deprived of its brains, and the body lived for twenty-three days without the head.—*Shaw's Lectures.*

The land tortoise occurs in great numbers in various parts of Hungary, more particularly about Fuzcs-Gyarmath, and the marshes of the River Theiss; and being esteemed a delicacy for the table, is caught and kept in preserves. The preserve of Keszthelev encloses about an acre of land, intersected by trenches and ponds, in which the animals feed and enjoy themselves.

2244. *The mud tortoise* (*Testudo lutaria*, Linn.) is rather less than the last, being about seven inches long, and, though rather an aquatic animal, lays its eggs on the ground. It is common in many parts of Europe and Asia, particularly in France, where it is used as food. It moves quicker than the land tortoise; feeds upon vegetables, milk, worms, or offal, and is frequently kept in gardens to clear them of snails. It is destructive to the fish if it gets into a fish-pond. The flesh is considered as restorative, and useful in warm climates, where in summer the cattle are thin from the irritation of insects, and the poultry rank from the quantity of worms they pick up.

2245. *The river or fresh-water tortoises* are more rare: one of the most remarkable is the *Testudo ferox*, or fierce tortoise, a native of many parts of North America; its head is small, and its neck very long, which it withdraws within its shell. It is an animal of swift motion, and will spring forward with great fury to attack its assailant: the usual length from one to two feet, and it is web-footed. The flesh of this is not inferior to that of the green turtle.

2246. *The crocodile* is eaten by the natives of some parts of Africa; but European travellers, who have tasted its flesh, describe it as having a nauseous musky taste, though some parts are more delicate, resembling veal.

2247. *The guana*, or *iguana*, is a lizard four or five feet long, an inhabitant of South America and Africa, and sometimes met with in the West Indies: it is gentle and harmless, and so much prized on account of the delicacy of its flesh, that it has become rare in many places where formerly it abounded. Stewed guana is a favourite dish in the West Indies. Its eggs are a great dainty.

2248. *Various other lizards* are eaten in different parts of the world, and none of them are injurious as food.

2249. *The frog* (*Rana*, Linn.), which is so frequently eaten in France and many parts of the Continent, and which we hear so much about, is not our common frog, but another species somewhat larger, the *Rana esculenta*, Linn. It is of a green colour, spotted with black, and having two pale yellow lines down the back. It is the hind quarters only that are eaten, and these are more fleshy than the thigh of our common frog, resembling the most delicate chicken; when fricasseed or made into patties, it makes a most excellent dish, which, however, in Paris is by no means cheap. The livers and fore legs are used in soup. They are brought alive in thousands to the capital cities of France, Belgium, Germany, and Italy, and in some places there are regular conservatories for keeping them alive. This frog is rare in England.

2250. We are told by Montfort, a French naturalist, that frogs are much in request at Vienna, where not only the thighs are eaten, as in France, but every part of the animal. At the commencement of winter the dealers in these creatures fill a pit with thousands of frogs, which the country people collect in the marshes and ponds, and cover them with straw and planks to keep them from the frost. In this manner they are preserved alive to supply the market as required, and there are few individuals who in the winter season do not occasionally regale themselves with a few dozen of these reptiles, which are made into dishes highly prized by the gourmands. There are even some houses where they may always be had in the choicest condition, dressed with the greatest care, and sold at a great price.

2251. *The common frog* is much inferior, but is also eaten occasionally, and is sometimes fraudulently substituted for the other species.

2252. *The bull frog* (*Rana taurina*, Linn.) of warm climates is considered equal to the turtle.

2253. *The toad* is often here supposed to be poisonous, though this is doubtful: it is a very harmless creature; but, from its ugliness, excites disgust, and is not desired as food. Among the negroes, however, it is said to be eaten without any bad consequences.

2254. *Insects.*—Few insects are used as food. The *locust* is, however, consumed in great quantities, which affords some compensation for the ravages it occasions. In Abyssinia, and among the Moors of Barbary, they are eaten both fresh and salted, and some are dried in the sun. Niebuhr informs us that in Arabia they preserve them in the same manner, and they consider them a delicacy, their taste resembling that of a crayfish. Among the natives of South Africa they are made into a kind of soup. Diodorus Siculus describes the natives of Ethiopia as feeding upon locusts. This explains what we are told of John the Baptist, who lived upon locusts and wild honey. Many insects, however, are of a poisonous nature, and it is remarkable that, as we descend in the grades or classes of animals both of land and sea, the number increases of those which are un fit for human food.

CHAPTER VII.

ON VEGETABLES USED AS FOOD.

SECT. I.—GENERAL VIEW OF THE CONSTITUTION OF VEGETABLES.

2255. *The larger portion of the food consumed by the human race is, perhaps, derived from the vegetable kingdom.* We learn from the sacred writings that vegetable food was the first employed by mankind; and ancient profane writers, as Diodorus Siculus, Ælian, and Pliny, represent the primeval races of mankind as ranging over the fields and woods in search of fruits and wild herbs. Wild pease and acorns are mentioned as constituting the greatest part of the food of the first inhabitants of Greece. The cultivation of corn, which is by Hesiod ascribed to Ceres, was an important step in civilization; and divine honours were paid to her on that account. In warm climates, fruits and other kinds of vegetable nutriment are produced spontaneously in great abundance, and several nations at present subsist almost solely upon this diet.

2256. *Only a small part of the numerous tribes of plants are, however, available for food in their natural state:* unlike the animal kingdom in this respect, the greater number of vegetables are useless as food, and many are extremely deleterious. The choice of vegetables, therefore, for this purpose requires more precaution than that of animals. Botanical knowledge can often point out those which may be considered as poisonous, and those which may be safely eaten; but in meeting with new or undescribed species, great caution should be used, and it may be prudent first to try their effects on quadrupeds.

Although nature supplies the inhabitants of tropical regions with abundance of vegetable food, almost without the trouble of cultivation, yet that is not the case in temperate climates. Almost all the esculent vegetables which are found in Europe have been introduced from other regions by the industry of man, and many of them may almost be considered as the produce of art, since they have been gradually brought to the state in which we now see them by the gardener and agriculturist, who, by cultivation, have metamorphosed certain wild and unsavoury herbs into the delicious and varied produce of our gardens. Many of these changes have been brought about at a very early period in the history of mankind; for instance, the originals from which the varieties of cerealia, or corn plants, have been derived, cannot now be traced by the botanist in their wild state; and yet corn supplies all the civilized world with its chief article of food. Here we perceive the advantages which have accrued to mankind from the employment of their reasoning faculties. The whole of our cabbages and cauliflowers, whose leaves alone often weigh several pounds, have been acquired by the gradual transformation of the wild colewort, a plant of scanty leaves, not weighing more than half an ounce. From the sour sloe has been produced the delicious plum, and the austere crab has been transformed into an almost endless variety of apples, possessing the richest flavours and the utmost beauty of colour.

2257. *Some vegetables undergo extraordinary changes* at different periods of their growth. While young, they may be safely eaten; yet when they attain such an age that they are capable of reproduction, they possess properties which render them poisonous if employed in the same manner, though they may be used as active medicines in small quantities.

2258. *Different species of plants vary exceedingly according to the parts which afford wholesome and proper nutriment.* In some this is found only in the seeds; in others in the leaves; in some, again, in the roots; of others all the parts may be eaten. Some are even poisonous, until they are deprived of a certain juice, and then the rest is harmless food.

The fibrous and membranous parts of vegetables are not easily digestible, or not at all. The skins of fruits in general, as of grapes, pass through the stomach unchanged; so do the husks of pease; and corn, grains, or seeds of various kinds, often go through the stomachs of horses, birds, and other animals in a state still fit for germination, on account of the indigestibility of the husks, which points out the advantage of first boiling or soaking them in hot water till they burst. The green leaves of vegetables, though in general acting somewhat on the bowels, are apt to produce acidity and flatulence with dyspeptic persons, and are therefore less fit for them than farinaceous food.

2259. *Vegetables, though devoid of sensation, possess what is termed the living principle;* but this is of a very different kind from what we denominate the life of an animal; yet between both there are analogies which are very remarkable. Animals receive food into their mouths, from which it passes into the stomach; plants take in their food by the roots, which are their mouths. Both animals and vegetables possess a power, depending upon the vital principle, by which the food is digested, converted into nutriment, and assimilated, so as to enter into the substance of their frames. In order to this, it is made to move through a series of vessels, in which it undergoes certain alterations, by which it is transformed into several different juices adapted for different purposes in the living body. The mode in which these changes are effected is absolutely unknown to us, the chemistry of nature being beyond our power of investigation. But by these means are formed all the substances called *secretions*, whether gum and sugar in vegetables, or bile in animals. Plants are even provided, as well as animals, with a breathing apparatus, consisting of an infinity of minute pores which open upon the surface of the leaves, and communicate with the tubes that contain the flowing juices; and in both cases air is essential to the life and health of the organic being. Not only do various plants secrete different substances, but they require different kinds of food, and various temperatures, in order to flourish, as is the case with animals. Notwithstanding these points of agreement, however, the difference between the two classes is sufficiently marked in general, although certain species in each approach so near together that it is sometimes difficult to say to which of the two kingdoms they properly belong.

2260. *In considering the nature of vegetable matter as employed for food,* we shall follow the same plan as that by which we examined the nutritive properties of animal food. We shall inquire into the chemical nature of vegetables in general, and collect together those *proximate principles* into which all vegetable substances may be resolved.

2261. *It has been already stated that the elements of which all vegetable bodies consist* are carbon, oxygen, hydrogen, and nitrogen.

But nitrogen exists in the vegetable kingdom in much smaller quantity than in animals. This constitutes a marked difference between animal and vegetable matter. The former has *always* a large proportion of nitrogen in its composition; whereas, in the latter, this element is found in any considerable quantity only in particular parts of plants, as, for example, in their gluten and albumen; in many other parts it is entirely wanting, a few vegetables, as the fungi, which abound in nitrogen, being exceptions. Thus (as we have already stated, but which we here repeat for the convenience of the reader) the same elements are found both in the animal and vegetable kingdom; and the very same particles may at one time compose part of an animal, and at another time be a portion of a vegetable. There is not, therefore, as some persons might suppose, a kind of substance absolutely and permanently of a vegetable nature, but matter is only vegetable for a time. Thus, animals feed upon vegetables; and the elementary particles of which the latter consist enter as food, and are made to supply the waste in animal bodies; the particles unite with the animal substance, and become of the same kind; they are assimilated, and are now a portion of an animal. The animal dies, undergoes decomposition, and its carcass, or a part of it, mixes with the soil, and is often employed as manure to vegetables. A portion of the decomposed animal matter acts either directly or indirectly in supplying food to the roots of the plant, which it forms into wood, bark, juices, or other parts of its body. In this new condition, the particles may belong essentially to the vegetable: but they have suffered no actual change; they have only been arranged in a new form, and are differently combined. The elements we have mentioned as common to the two kingdoms are exactly of the same nature, whether they are drawn from the one or the other. But nature only can make these arrangements: human art can decompose both animal and vegetable matter into its ultimate elements, but cannot form out of them either an animal or a vegetable, nor can it change the one into the other. Nature, in forming vegetable matter, or vegetable arrangements, follows the same plan as when composing animal matter: in both cases, *proximate principles are first composed;* but the proximate principles of vegetables are different, except a few, from those of animals.

2262. *By what means plants compose their proximate principles* out of the four elements is a mystery which we cannot penetrate; it must be classed with the incomprehensible functions by which they increase and propagate their species, and with those laws by which they continue to present the same forms and qualities through innumerable generations: phenomena which cannot fail to impress upon the mind of the careful inquirer a conviction that the whole is regulated by causes and powers far transcending our limited capacities to explain, and demonstrating an omniscient and superintending Providence.

We shall, therefore, in studying vegetable substances, have to enumerate a set of bodies called *proximate principles*, belonging to the vegetable kingdom, generally distinct from those appertaining to animals. All these exist ready formed in the plant, in the same manner as in the case of animals; and all vegetables may be resolved first into these before their final dissolution into their elementary constituents, carbon, oxygen, and hydrogen.

2263. *The proximate principles of vegetables are:*

1. Starch, or fecula.
2. Gluten.
3. Vegetable albumen.
4. Sugar, or the saccharine principle.
5. Gum, or mucilage.
6. Lignin, or woody fibre.
7. Vegetable jelly, or pectin.
8. Vegetable oils, fixed and volatile.
9. Vegetable wax.
10. Resin.
11. Balsams.
12. Gum resins
13. Camphor.
14. Tannin, or tannic acid.
15. Colouring matter.
16. Vegetable acids.
17. Vegetable alkalies.

The first five of these principles, viz., starch, gluten, vegetable albumen, sugar, and gum, constitute the principal ingredients in most of the esculent vegetables; and starch and gluten are much more nutritious than the rest.

2264. *The comparative nutritive properties of the several vegetable substances* used as food is best known by chemical analysis. It having been already determined by long observation which of the vegetable proximate principles afford the most nourishment, or tend most to the support of life by the process of digestion, chemical analysis will, by showing the relative proportions of these principles in each species of plants, enable us readily to distinguish which kind is most nutritive.

Vegetable Substances.	Whole Quantity of soluble or nutritive Matter.	Starch or Mucilage.	Saccharine Matter.	Gluten or Albumen.	Extract or Matter rendered insoluble during Evaporation.
Middlesex wheat, average crop	955	765	—	190	—
Spring wheat	940	700	—	240	—
Mildewed wheat of 1806	210	178	—	32	—
Blighted wheat of 1804	650	520	—	130	—
Thick-skinned Sicilian wheat of 1810	955	725	—	230	—
Wheat from Poland	950	750	—	200	—
North American wheat	955	730	—	235	—
Norfolk barley	920	790	70	60	—
Oats from Scotland	743	641	15	87	—
Rye from Yorkshire	792	645	38	109	—
Common beans	570	426	—	103	41
Dry pease	574	501	22	35	16
Potatoes	from 260 to 200	from 200 to 155	from 20 to 15	from 40 to 30	— —
Linseed cake	151	123	11	17	—
Red beet	148	14	121	14	—
White beet	136	13	119	4	—
Parsnip	99	9	90	—	—
Carrots	98	3	95	—	—
Common turnips	42	7	34	1	—
Swedish turnips	64	9	51	2	2
Cabbage	73	41	24	8	—
Broad-leaved clover	39	31	3	2	3
Long-rooted clover	39	30	4	3	2
White clover	32	29	1	3	5
Sainfoin	39	28	2	3	6
Lucern	23	18	1	—	4
Meadow fox-tail grass	33	24	3	—	6
Perennial rye grass	39	26	4	—	5
Fertile meadow grass	78	65	6	—	7
Roughish meadow grass	39	29	5	—	6
Crested dog-tail grass	35	28	3	—	4
Spiked fescue grass	19	15	2	—	2
Sweet-scented soft grass	82	72	4	—	6
Sweet-scented vernal grass	50	43	4	—	3
Fiorin	54	46	5	1	2
Fiorin, cut in winter	76	64	8	1	3

2265. *The preceding table, drawn up by Sir H. Davy,* and published in his excellent work "On Agricultural Chemistry," exhibits the nature of most of our vegetables used commonly as food. To form it, 1000 parts of each vegetable were analyzed, and the table states the quantity of nutritive matter extracted, consisting of mucilage or starch, saccharine matter, gluten or albumen, and extract. The first column shows the entire quantity of nutritive matter, and the difference between that and the 1000 parts consisted of water, or inert or indigestible vegetable matter, possessing the properties of woody fibre.

2266. It must not be supposed that the above proportions are always exactly the same in the vegetables described in the above table, since much depends upon their cultivation and growth; yet they are probably never very different, and the results of the analysis offer some interesting facts. They show that wheat is the most nutritive of all the vegetables in common use among us, consisting almost entirely of starch and gluten, both of them highly nutritive principles. The other kinds of grain, as barley, oats, rye, as well as pease and beans, contain a more considerable portion of gluten than other vegetables, but much less than wheat.

2267. *There is one remarkable difference between vegetable and animal substances.* The attractive power or affinity by which the particles of the vegetable proximate principles are held together appears not to be so powerful as that by which those of animal bodies are united, for slight circumstances are sufficient to convert one vegetable proximate principle into another. Thus, gum, starch, and woody fibre may be converted into sugar or into acids; but no such change can be effected upon animal matter: we cannot convert fibrin into gelatin nor into albumen.

This easy conversion of vegetable principles into each other is important to attend to; for, in consequence of this, it is often supposed that vegetables contain what they do not; a substance may be apparently drawn from a vegetable, while, at the same time, it is very certain that no such substance exists in the plant. This error happens because, during the process employed, a change takes place in the arrangement of the matter acted upon, as may be exemplified in the case of obtaining spirit or alcohol from fermented barley or carrots. No spirit exists in barley, carrots, nor in any other plant; but the spirit is formed during the fermentation.

2268. *In considering the chemical constitution of the several proximate principles of vegetables, MM. Gay Lussac and Thenard have observed a curious law,* which, though it cannot be considered as positive or free from exceptions, is yet highly deserving of attention, as assisting us in forming general views, which are always important in classifying and arranging our knowledge.

First. Water is known to consist of hydrogen and oxygen only in fixed proportions; and certain proximate principles, as starch, gum, sugar, and woody fibre, which consist of carbon, hydrogen, and oxygen, have their hydrogen and oxygen in the precise proportion necessary to form water; so that, although we cannot say that these substances are composed of carbon and water, yet they consist of carbon and the elements of water in a triple combination: hence it follows that the composition of these four bodies is so nearly the same that chemists are somewhat at a loss to say in what the chemical difference consists, although they vary so much in their actual properties; but that there is a chemical difference no one doubts.

Secondly. If the proportion of *oxygen* in vegetable substances be more than is sufficient to form water with its hydrogen, that substance will be found to have *acid* properties; and all the vegetable acids are of this kind.

Thirdly. If they contain more *hydrogen* than is necessary to form water with the oxygen, then the bodies are either *oily*, *waxy*, or *resinous*. Thus we may perceive, in the proximate principles of vegetables, three great natural groups: the *saccharine*, the *acid*, and the *oily* groups; to which may be added a fourth—an *alkaline* group—distinguished by all the substances composing it, with a very few exceptions, containing *nitrogen* in addition to the other three elements.

These groups may be arranged as follows:

SACCHARINE GROUP.

Starch.
Gluten.
Vegetable albumen.
Sugar.
Mucilage.
Gum.
Lignin.
Vegetable jell

OILY GROUP.

Vegetable fixed oil.
Vegetable volatile oil.
Resin.
Gum resins.
Wax.
Camphor.
Extractive matter.
Bitter principle.
Caoutchouc.
Colouring matter.

ACIDS.

Acetic acid.
Malic acid.
Citric acid.
Tartaric acid.
Oxalic acid.
Gallic acid.
Tannic acid.

ALKALIES.

Soda.
Potash.
Quinea.
Cinchonia.
Strychnia.
Veratria.
Emetia.
Picrotoxia.
Solania.
Synopia
Atropia.
Conia.
Nicotina.
Hyoscyamia.
Daturia.
Colchica.

SECT. II.—STARCH.

2269. *This principle, which is also called Fecula, and the amylaceous principle,* from the Latin *amylum*, is one of the most important in the vegetable kingdom, as it constitutes the principal nutritious matter in all the farinaceous vegetables used as food. It is likewise chiefly owing to the starch of grain that malt is so well calculated for the purposes of brewing: in short, from its numerous uses, it is very necessary that we should be accurately acquainted with it.

2270. *Starch is a substance ready formed by nature,* and it exists in many plants, in the form of extremely minute globular or oval grains; but these are so small that they cannot be distinguished separately without the assistance of a very powerful microscope. These grains consist of a membrane enclosing the starchy or amylaceous matter; and it is said that they do not readily burst with the heat of the stomach, and that, on this account, all such substances, when used as food, ought to be boiled to produce this effect. When cooked, farinaceous substances (those which abound in starch) constitute food that is mild, nutritious, easily digestible, and little stimulating, consequently very fit for infancy, though not sufficiently strengthening for manhood. Starch is found in the roots of some plants, as potatoes; in the stems of others, as the palm, from which sago is extracted; in the seeds of leguminous plants, as pease and beans; but most of all, in the seeds of corn-plants, and chiefly wheat: in all these it is very nearly the same, and is united in them with gluten, mucilage, and saccharine matter.

To understand this, and some of the other important vegetable principles, a simple experiment may be made: Get some flour, and, keeping it in the hand, knead it well in a basin of cold water, while another person pours gently some more water over it until the latter no longer runs off milky and turbid. The substance that remains now in the hand will be a tenacious, elastic sort of paste called gluten, which we shall have occasion to describe afterward. If the water in which the handful of flour had been worked, and which is milky-looking, be suffered to stand still for a few hours, a very white sediment will fall to the bottom; this is the starch, which has been washed out of the flour. If the clear water standing over it be poured off, and boiled till it be nearly all evaporated, the thickened extract will be a mucilaginous substance, a little sweet; and it will contain the mucilage, or gum, and the saccharine matter of the flour. In this manner the several constituent principles of flour may be separated from each other for examination.

2271. *Common starch*, as it is found in the shops, is procured from wheat by a process nearly similar to what we have just described, and is the pure fecula we are treating of; but our object at present is not to describe the mode of its manufacture; this will be shown in Book XXII., "On the Laundry." The process for extracting the starch from any other vegetable is the same: they are all bruised and agitated in water, when the starch separates readily, and subsides; then, after standing some time, the clear water is poured off, and the starch is obtained. The starch procured in this manner from potatoes is essentially the same as that from wheat, differing only in a few slight particulars.

2272. *Starch, when pure*, is very insipid, or without taste, and of a brilliant snow-white. It will not dissolve in water, either cold or below 160°; but in water between 160° and 180° it forms an important solution, thickened into a gelatinous mass, which is the state in which it is employed for stiffening linen.

On exposing dried starch to a temperature a little above 212°, it acquires a slight red tint, emits an odour like baked bread, and is slightly soluble in cold water. When roasted in a flat vessel it becomes brown, and is converted into a substance called *British gum*, which is soluble in cold water, and used instead of gum by the calico-printers. Potato starch answers best for this purpose.

2273. *Starch, when decomposed*, or separated by chemical means into its ultimate elements, is found to consist, like most vegetable matter, of oxygen, carbon, and hydrogen; and, although it is so very different from sugar in its ordinary properties, yet, as has been already observed, it differs but little from that substance in the proportion of its constituents.

In consequence of this close analogy, *starch is very easily converted into a kind of sugar*, a fact, the importance of which will be perceived when we come to the subject of brewing, where we shall find that the formation of malt depends upon the change of the starch of the barley into sugar during the process of malting.

2274. *Starch has even been converted into this kind of sugar, in considerable quantities, by a very simple chemical process*, which consists merely in boiling it with a certain proportion of water and sulphuric acid. As this conversion is well calculated to illustrate some of the chemical changes which occur in several of the arts which we have to treat of, we give the details of the process in this place.

A pound and a half of potato-starch was kept simmering at a boiling heat in a mixture of six pints of distilled water and a quarter of an ounce (by weight) of sulphuric acid. The mixture was afterward stirred, and fresh water occasionally added to supply the loss by evaporation. After thirty-four hours an ounce of powdered charcoal was added, and the boiling resumed for two hours. The acid was then carefully saturated with lime, and the boiling continued for half an hour, when the liquor was strained through calico. The insoluble residue, after having been washed and dried, consisted of charcoal and sulphate of lime. The filtered liquor was evaporated to the consistence of sirup, and, being set aside, became in eight days a crystallized mass, resembling brown sugar and treacle. The sugar weighed a pound and a quarter. One pound of it fermented in the usual way, and afforded on distillation fourteen drachms of proof spirit.

This sugar from starch is not exactly the same as that made from the sugar-cane; it is less sweet, requiring two and a half times the quantity of cane-sugar to sweeten to the same degree, and it is not quite so soluble. It agrees in its properties with the sugar of grapes, and, like it, is capable of being converted into spirit by fermentation; it is, in fact, the very substance that affords the spirit in malt liquors. How the conversion of starch into sugar is effected is not very well understood, and we wish to avoid entering into theoretical views not yet quite established; but, as has been observed above, it is supposed that, the mutual attractions of the elementary principles of vegetable bodies being very slight, they are made to change their situations by very slight causes, and a very minute difference in their arrangement occasions a sensible difference of properties: a fact of which chemistry furnishes many examples. Few substances, indeed, appear at first more unlike than starch and sugar; the former is very insoluble and insipid, the latter very soluble and sapid. Since, as we have stated, the elementary principles, hydrogen and oxygen, exist in the proportion necessary to form water in starch, sugar, gum, and ligneous or woody fibre, these substances may be considered as so many compounds of the elements of water with carbon, the remaining element; and since, in the processes just described, the weight of the sugar obtained exceeds that of the starch employed by ten per cent., it has been supposed that the sugar is a chemical combination of starch with water.

2275. *Nature produces the change from starch to sugar during the germination of seeds in the earth.* When, under the proper circumstances of heat and moisture, germination has commenced, it will be found that the farina, or white internal kernel of the seed, has in a great measure disappeared, and that its place is supplied by a substance having a saccharine taste. It is this peculiar sugary substance that constitutes the food of the embryo plant, and it is for the purpose of supplying this food that nature has effected the change.

2276. *Man has imitated this process* in the malting of barley for the purpose of producing fermented liquor. When we treat of "Brewing and Distilling," this subject will be entered into more fully; at present it is merely hinted at, to bring all the points into the same view; and we shall then see, also, why all the substances possessing starch may also produce alcohol or spirit; first, by the conversion of the starch into sugar, and then the latter into spirit.

2277. *But starch, or fecula, cannot be always separated,* in the manner described above, from all the plants in which it exists. Sometimes it is intimately united to mucilage and oil, as in the case of the almond, and many other kernel seeds. In such plants, all these principles become diffused in the water in an equal degree on pressure, and the fecula will not be deposited by mere subsidence; nor can it, in this case, be obtained pure in any way under these circumstances.

2278. *Starch is an extremely nutritive material,* and constitutes one of the chief ingredients in almost all the most valuable vegetables used as food by man. In many instances it is not separated from the vegetables before being employed as aliment, but, in other cases, processes are employed to extract it distinct from the other ingredients, some of which are nutritious, and others injurious.

2279. By this means various species of food have been produced in foreign countries, and are in use among us, while few persons have an idea of their origin, or their relation to common starch. Of this kind are *arrow-root,* which is the starch extracted from the tubers of a plant that grows in the East and West Indies, the *Maranta arundinacea*; *sago,* a starch procured from the pith of several species of palms; and tapioca, made from the starch of *Jatropha Manihot,* a South American plant. *Tous les mois* is a substance of this class lately brought here from St. Kitt's, and said to be the starch of the *Canna coccinea.* All these boil to a jelly like starch, and are light and nutritive. They will be described more particularly in Chapter III., Book IX., "On Bread."

2280. *From the nutritious substances which have been just mentioned,* all of which consist of mere starch, we may perceive how very important is this principle in the vegetable kingdom; but this importance will be much increased when it is pointed out, as it will be when we come to the article "Bread," that it is chiefly the starch they contain which renders all the kinds of corn and leguminous seeds so valuable as food. In these, indeed it is combined with the other proximate principles, such as gluten, sugar, oil, &c.; but it is the starch, much more than all the rest, which constitutes the nutritious part of corn and other vegetables.

2281. *Starch has the remarkable property of assuming a blue colour,* by means of the substance called *iodine,* which is accordingly employed as a test for ascertaining its presence.

Sect. III.—gluten.

2282. In the experiment with wheat flour which was mentioned above, when starch was separated by washing, a viscid substance remained in the hand, which received the name of vegetable gluten from its discoverer, Beccaria, on account of its resemblance to glue. It is a gray, viscid, tenacious, and ductile substance, insoluble in cold water, that may be stretched out in a manner somewhat like Indian rubber. It is found more or less in a great variety of plants, but very abundantly in the kinds of grain used for making bread. Wheat contains the largest portion of it; and this is one reason why wheaten bread is superior to that made from other kinds of grain, for gluten is the most nutritious principle, though not the most abundant, contained in vegetables. It is the gluten in wheat flour that renders it so proper for light fermented bread, by occasioning its making a tenacious paste with cold water, the viscid elastic nature of which enables the carbonic acid disengaged during fermentation to form numerous vesicles that distend the mass of dough, and produce what is called the *rising.* This will be fully explained under the article "Making Bread."

2283. But it has been shown by Einhoff that the viscid substance which we have mentioned as obtained by kneading wheat flour is not pure gluten, but consists of gluten and another vegetable principle, called vegetable albumen. They may be separated from each other by boiling in alcohol, or by kneading them with the hand in alcohol; the latter being soluble, and the former insoluble, in it.

2284. *Pure gluten*, thus obtained, is of a full yellow colour, with a slight balsamic taste and a peculiar odour; it is very tenacious and elastic, and does not dissolve in cold water; but though gluten is so nutritive, it is only so when united with other vegetable principles, for by itself it is scarcely digestible. When kept moist in a warm place it ferments, and disengages carbonic acid, but afterward gives out acetic acid, which is the cause of the sourness perceived in leavened bread; in a few days, if left to itself, it acquires a smell and taste much like cheese, then it putrefies, and gives out an offensive odour like animal matter. When exposed to the air, it gradually dries, and becomes hard and brittle, like glue, from which property it has been employed to mend broken china. It loses its tenacity entirely by boiling. Gluten, though insoluble in water alone, forms a compound with acetic acid or vinegar that is soluble in water; and this is the reason why, in the manufacture of starch, just described, the souring, or formation of vinegar, acts upon the gluten that was united to the starch, and thus removes it from the latter.

Gluten differs from all the other vegetable proximate principles, except vegetable albumen, in containing nitrogen, of which it contains from 14 to 20 per cent., and this is supposed to be the cause of its being so nutritious.

SECT. IV.—VEGETABLE ALBUMEN.

2285. *Albumen has lately been discovered to be common to the vegetable as well as to the animal kingdom, though in a smaller quantity.* In its pure state it is a thick, glairy, tasteless fluid, analogous to white of egg. It is found abundantly in the juices of green leaves, as well as in the flour from wheat. It resembles gluten considerably in its composition, containing also nitrogen, but it is soluble in alcohol, and in cold water, which gluten is not. When the juice of cabbage leaves, or other similar plants, is pressed out and passed through a cloth, it is not at once transparent, but a fine green powder is suspended in it, which will require a week to settle to the bottom: this is called green fecula, and it consists of three substances: 1, a green colouring matter, which is resinous; 2, woody fibre that has been entangled in the juice; 3, vegetable albumen. If a glass bottle filled with the green juice as soon as it is filtered, and before it has time to settle, be placed in a vessel with boiling water, the liquor will deposite a flocculent or cheesy matter, which consists of the albumen, which has coagulated by the heat; and as it resembles the white of egg, when washed and deprived of colour, it has received the name of *albumen*, though not absolutely identical with animal albumen; it appears to be sometimes a vegeto-animal substance.

It can scarcely be necessary to state that this principle contained in the juice must coagulate in the same manner as animal albumen when vegetables are boiled; and on this depends the method taken to clarify many vegetable juices.

It is found in many plants; in nuts, grains, apples, grapes, and fruit of all kinds; in flowers, young shoots of trees, green leaves, &c. It abounds in the juice of the Papau-tree; when this juice is boiled, the albumen falls down in a coagulated state; it is likewise met with abundantly in mushrooms and in different species of fungi. The principal part of the almond, and of the kernels of many other nuts, appears, from the experiment of Prout, to be a substance analogous to coagulated albumen. The juice of the fruit of the Ochra (*Hibiscus esculentus*) contains a liquid albumen in such quantities, that it is employed in Dominica as a substitute for the whites of eggs in clarifying the juice of the sugar-cane. Like gluten, it soon putrefies, particularly when kept moist, or in stagnant water. It is contained under the fibrous rind of flax and hemp, and its decomposition during steeping occasions the ready separation of the fibres, and likewise the unwholesome and offensive odour of water in which this has taken place. It is this also which occasions the disagreeable and unhealthy smell of decaying leaves of vegetables, and particularly of cabbages, and of the water in which they have been boiled. Like animal albumen, it consists of carbon, oxygen, hydrogen, and nitrogen.

2286. *Yeast, or the vegetable ferment,* which we shall see more of under "Fermentation," is supposed to be either gluten or vegetable albumen; but it does not appear to be absolutely certain whether it is one, or modification of both.

2287. *Vegetable fibrin and vegetable casein* are enumerated among the proximate principles of vegetables by some late writers; but as it does not appear certain that they are not identical with those already known and described, we avoid rendering our subject unnecessarily complicated.

SECT. V.—SUGAR, OR THE SACCHARINE PRINCIPLE.

2288. *Sugar is very generally diffused through the vegetable kingdom;* but its importance demands that it should be treated of at large in a separate part of this work. At present it is proposed to consider it only in brief as one of the proximate principles of vegetables. Sugar exists more or less in almost all vegetables, but abundantly in ripe fruits, and the roots of the beet, carrot, &c. It is procured most plentifully, as is well known, from the juice of the sugar-cane and of the maple-tree.

2289. *There are several species of sugar* which agree in having a sweet taste, but which differ in other respects. 1. *Cane-sugar*, or common sugar, which is seen in its purest state when crystallized in white sugar-candy, and in refined sugar. Sugar from the maple-tree and beet root is the same as that from the cane. 2. *Sugar from grapes* contains less carbon than cane-sugar, and is not so sweet; it requires two and a half times as much of this sugar to sweeten to the same degree as cane-sugar; it cannot be made to crystallize distinctly, but solidifies in grains; it dissolves less rapidly than cane-sugar, and gives a more fluid sirup. Sugar of malt agrees with this, and also the sugar of honey, of raisins, figs, and many other sweet fruits. There are other varieties of sugar from various vegetables, but as they are not well understood, and not important, we need not mention them.

2290. *We have already stated that sugar can be prepared from starch;* and hence the reader may be less surprised at being informed that the woody fibre, or the wood of vegetables, a principle which will be described, has been employed for the same purpose. Persons not familiarized with chemistry may, perhaps, consider it as a piece of pleasantry to be told that sugar has been made from common wood, deal boards, sawdust, straw, and even linen rags, all of which consist of woody fibre; yet this has been effected by Braconnot through the action of sulphuric acid; but as the fact is rather illustrative of the powers of chemistry, and the nature of vegetable substances, than applicable at present to any practical purpose, we shall not enter into farther details respecting it.

2291. *The only sugar in general use in Britain* is that of the sugar-cane made in the West and East Indies; the maple-tree sugar is made and used in North America, and the beet root sugar in France. Besides the use of sugar for domestic purposes, it is extensively employed for producing ardent spirit, either pure, or in wine, beer, and all fermented liquors; and it is the only substance from which this can be procured, as will be fully explained under "Fermentation," "Brewing," "Wine-making," and "Distilling." It is likewise employed in the preservation of fruits.

There are various opinions respecting the nutritive properties of sugar. It is readily digested by the healthy stomach; but with some dyspeptic individuals it does not agree.

Sect. VI.—mucilage.

2292. *It is usual to consider mucilage and a solution of gum in water as the same;* but Hermstadt makes this distinction: the solution of gum in water is transparent and glutinous, and can be drawn out into threads, whereas that of mucilage is opaque, does not feel glutinous, but slippery, and cannot be drawn into threads. Dr. Bostock also takes a similar view of the subject. Of mucilages there are a great variety of kinds existing in the roots, stems, leaves, and seeds of many plants. They seldom or never separate spontaneously, but may be obtained artificially in a state of tolerable purity, though it is impossible to separate them completely from starch, gluten, sugar, &c. Only a few species have been examined, and we are uncertain how far their properties agree. Linseed yields one of the purest, which is well known in what is called linseed tea; when thick, it much resembles solution of gum Arabic. Mucilage is perfectly soluble in cold and hot water, and is easily extracted by boiling, as from the roots of marshmallows, the kernels of quinces, and most bulbous roots and fleshy leaves. Many of the fuci also yield a large quantity; some lichens have so much, that they have been used for the purpose of gum in calico printing. Mucilage is found more or less in barley, wheat, and all the grains used for brewing and baking.

Sect. VII.—gum.

2293. *Some trees suffer their gum to transude* either spontaneously or by incisions made in them; it becomes concrete by drying in the air. All gums are easily dissolved in water, and are then nearly analogous to mucilage; but they do not dissolve in spirits of wine nor in oils. They readily unite with sugar, and their composition is so analogous to it, that they are easily converted into that substance by a chemical process, which, however, is not employed, because sugar is procured more economically in another way. The uses of gum are well known. The principal gums among us are:

2294. *Gum Arabic*, the most valuable kind, which exudes from different species of mimosa, particularly the *vera*, a native of Arabia. The best is colourless, and very transparent.

2295. *Gum Senegal* does not differ much from the last, but comes to us in large pieces, and is much employed by the calico printers. It is the produce of the Acacia *Senegalensis*.

2296. *Gum tragacanth* is very different from the gums already mentioned, and is the produce of the *Astragalus tragacantha*, a thorny shrub growing in Syria and the islands in the Levant. It does not dissolve in cold water, but swells up into a mucilaginous mass. and requires digesting in hot water.

2297. *Cherry gum* is more analogous to gum tragacanth than to gum Arabic, as it dissolves in hot water, but not in cold. It exudes from the *Prunus avicum*, or black cherry-tree of this country; also from the plum, peach, and apricot-trees.

The gums are seldom employed as food, and, it is said, are not very nutritious, though the Africans in Senegal sometimes subsist upon it during the gum harvest.

SECT. VIII.—LIGNIN, OR WOODY FIBRE.

2298. *This name has been given to the solid skeleton, as it may be called, of plants,* or what remains after all the principles which have been just described are separated. This skeleton is composed of an infinite number of extremely minute fibres, which are arranged in bundles; so as to constitute the various forms of stems, branches, and leaves; and these, together with the cellular or pithy part between them, make up the solid through which the juices flow. Every one has seen leaves, in the autumn and beginning of winter, decayed, so as to have only the veins or fibres remaining: this is the lignin, or wood, of the leaves.

2299. *The properties of lignin may be examined* by boiling some wood rasped, or sawdust, for a long time in water, to carry away such substances as are soluble in this fluid, and then treating it with alcohol, to dissolve the resinous principles. After this, nothing would be found to remain but a fibrous substance, without taste or odour, and which would undergo no change by keeping in the dry: this would be pure lignin, and would amount to about 96 per cent. in most kinds of wood.

2300. *The ligneous part, or lignin, of esculent vegetables is in far less proportion than in wood; yet it is never absent,* since it is necessary to form the skeleton of the plant. It is seen in the stringy part of culinary vegetables, as in many parts of the cabbage; but is most striking in the hemp and flax plants, their long fibres consisting of this very woody matter arranged round the external part of the stem.

2301. *Lignin is itself composed of* the same elements as all the other proximate principles consist of; in 100 parts there are 51·43 of carbon, 42·73 of oxygen, and 5·82 of hydrogen; and when it is burned, the oxygen, hydrogen, and part of the carbon fly off, leaving only remaining the carbonaceous part of the skeleton, in the form of charcoal.

Wood, under ordinary circumstances, as is well known, is indigestible, and unfit for food; those vegetables which have much of it in their structure are improper; and it is only the most succulent, that is, those which have much juice, or other nutritious principles, in proportion to their woody fibre, that are employed; yet the substance we are now considering is (as we have already hinted) not entirely incapable of being employed for human sustenance.

2302. We shall see under the article "Bread," in Book IX., Chap. III., that wood itself can be used in various ways to assist in increasing the quantity of nutriment; and chemistry has opened a new view of the subject, which may, perhaps, some day, extend the bounds of the vegetable kingdom to the support of life. We mention these discoveries, because, although they are not applied at present in practice, yet they are intimately connected with the subject of aliment, and the view which we are attempting to give would be altogether incomplete without noticing them.

2303. *The discoveries to which we allude were made by M. Braconnot,* a French chemist, and are described at length in Vol. XII. of the *Annales de Chimie.* If the sawdust of hard wood be mixed up with strong sulphuric acid, it will be dissolved: when the mixture has got clear, add chalk to saturate the acid; then strain off the liquor from the insoluble sulphate of lime, and boil it down to dryness. A substance will now be found in the bottom of the vessel very much like gum Arabic, and which is the produce of the sulphuric acid acting upon the lignin, or dry indigestible fibre of the wood. This substance, indeed, appears to have all the properties of gum; it is transparent and yellow, shining like gum, dissolves in water, making a viscid, adhesive paste that will join bodies together. Gum is known to be to a certain degree nutritious; and here is a new substance possessing similar properties. But this is not all. If this gum be once more treated with sulphuric acid, by mixing and heating them together, the gum is converted into sugar capable of being granulated, and which, though not of the same strength as cane sugar, would serve for the purpose of distillation, and many others. To say that these processes would be too expensive to be applied at present to any practical use is trifling; and we envy not the person who could urge the objection with a view to lessen the interest which such discoveries must excite. In the progress which mankind has been making from the rudest state, facts themselves have been first ascertained: their application has been a second step, and often very gradual and slow. But it is quite unnecessary to enlarge upon this subject: the history of inventions, and the advancement of society, present innumerable proofs of the most striking kind, that discoveries are not to be undervalued because we cannot see their immediate bearing; and if even nothing farther shall be accomplished, yet the beautiful simplicity of vegetable nature flashes at once upon the understanding, and this knowledge seems to give man a power hitherto unknown and unsuspected.

2304. *It now appears that starch, gum, sugar, lignin, and probably other vegetable principles, are so nearly allied in their composition* (as we have already pointed out), that little is necessary to cause one to assume the form and properties of the other. But here we must make a distinction, and draw the line between the feeble powers of human chemistry and those extraordinary, but altogether incomprehensible, powers which belong to the chemistry of nature.

2305. *Starch is not merely a substance consisting of definite elements, but it is a substance having an organic structure:* it consists of minute vesicles, of oval forms, that can be seen only by a good microscope: now, though we can convert these into the substance called sugar, yet the chemist cannot bring this sugar back again to starch; though he can make sugar from starch, he cannot make starch from sugar; he cannot organize. In like manner is lignin, a most extraordinary organized substance, composed of bundles of tubes fifty times finer than a hair, the finer fibre of flax being a bundle; now lignin can be made, as we have seen, into sugar, but the latter substance cannot be brought back to the state of those minute woody fibres. We know from chemistry the composition of all those substances: we know that they all consist of carbon, oxygen, and hydrogen; elements which we can procure from mineral bodies; yet, though we have these elementary bodies in abundance, we cannot out of them compose the simplest organic body. The work of organization is altogether beyond the comprehension of the human mind.

2306. *Now it is a fact which we learn from extensive observation,* that, in order that matter shall be fitted for the food of animals of any kind, it should be prepared by having first passed through the vegetable kingdom; and that it should there have been employed in forming vegetable structures; in short, it must have been what we term an *organized* body, or a body possessed of a certain species of life, and constructed in a peculiar manner very different from mineral substances. No animal can subsist upon mineral bodies, even though they should contain nearly the same elementary principles as vegetables: these elements must have been first organized before they can constitute food for an animal. Vegetables can extract food from mineral substances, and prepare it for animals, by first converting it into their substance; after this, the same matter may be introduced into the animal system, and undergo such farther modification as to be *animalized;* it now passes into the animal kingdom, and is capable of affording sustenance to this higher class of beings. Here, then, is a part of that beautiful order and gradation which we discover in every part of creation. This chief use of vegetable life, that of conducting to a higher order, may seem to be contradicted by animals feeding upon each other; but, on closer examination, it will be found that this exception is more apparent than real, as we may observe that carnivorous animals live upon those that feed upon vegetables, so that still we trace that the entrance of matter into the living system is through the vegetable kingdom.

2307. *A bar seems, therefore, opposed to the extent of our chemical power;* we cannot by its means increase the quantity of organized matter; but it is evident that human knowledge and art have already wonderfully modified the nature of organized matter, so as to render available as food much that in its natural state was unfit; of which the arts of agriculture and of cooking furnish eminent examples.

2308. *In prosecuting these researches, Braconnot was desirous of trying how far* the changes from lignin to sugar could be effected, and whether every condition of this principle could be so converted. For this purpose he tried, not only sawdust, but, with equal success, hemp, straw, and even linen rags and paper, all of which consist of lignin, and all of which he converted into sugar.

2309. *But it is now many years since that Professor Auchtenrieth of Tubingen showed* that, by proper management, lignin might be converted into a species of bread (Prout, *Phil. Trans.*, 1827. See receipt in Chap. III., Book IX., "On Bread"). "This discovery," Sir John Herschel observes, "which renders famine next to impossible, deserves a higher degree of celebrity than it has obtained." And lest it might be supposed, in what we have said above, that there is a certain dash of the extravagant, we shall beg leave to quote a few farther remarks from the authority we have just cited, whose practical as well as enlarged views no one will dispute. "The transformations of chemistry, by which we are enabled to convert the most apparently useless materials into important objects in the arts, are opening up to us every day sources of wealth and convenience of which former ages had no idea, and which have been pure gifts of science to man. Every department of art has felt their influence, and new instances are continually starting forth of the unlimited resources which this wonderful science developes in the most steril parts of nature. Who, for instance, would have conceived that linen rags were capable of producing *more than their own weight* of sugar by the simple agency of one of the cheapest and most abundant acids; that dry bones could be a magazine of nutriment capable of preservation for years, and ready to yield up their sustenance in the form best adapted to the support of life, on the application of that powerful agent steam, which enters so largely into all our processes, or of an acid at once cheap and durable; thus, sawdust itself is susceptible of conversion into a substance bearing no remote analogy to bread, and though less palatable than that of flour, yet no way disagreeable, and both wholesome and digestible, as well as highly nutritive?"

Notwithstanding these announcements, however, it is but just to add, that some persons think it possible that the apparently nutritive properties of lignin, as treated by Professor Auchtenrieth, might have been partly owing to some starch which generally accompanies the woody fibre; and we have said so much, rather to show the power of chemistry as applied to our subject, than as anything of great practical advantage.

Sect IX.—Vegetable Jelly.

2310. Several vegetables, but particularly ripe fruits, as currants and gooseberries, yield a juice by pressure, which, when carefully evaporated at a temperature of 200°, the concentrated portion of it concretes into a tremulous gelatinous mass, quite distinct from animal gelatin, and from gluten, as it contains no nitrogen. This substance is well known by the name of *jelly.* It is scarcely soluble in cold water, but very soluble in hot water, and when cold, again coagulates into the form of jelly. When long boiled, it loses the property of gelatinizing by cooling, and becomes analogous to mucilage. This is the reason that, in making currant, or any other vegetable jelly, when the quantity of sugar added is not sufficient to absorb all the watery parts of the fruit, and, consequently, it is necessary to concentrate the liquor by long boiling, the mixture often loses the property of gelatinizing, and the jelly, of course, is spoiled. Vegetable jelly exists more or less in all ripe acid fruits, as the orange, lemon, gooseberry, &c. It is considered very analogous to gum with vegetable acid.

To procure the jelly free from the acid, if the jelly which has gelatinized be put into a sieve, the acid gradually filters through, and, by washing with water, may be separated, leaving the jelly pure; this will dry into a hard mass, not very different from gum. Braconnot, who first observed this fact, proposes the name of *pectin* for the substance.

SECT. X.—VEGETABLE OILS.

2311. *Oil is distinguished by its peculiar unctuous feel, by its inflammability, and refusing to mix with water.* Animal oil has been described as "Fat," Chap. II., Book VII. The vegetable oils are divided into fixed and volatile. They are called *fixed* when the greasy stain which they give to paper does not disappear on the application of heat, and when they do not rise in distillation at the temperature of boiling water. *Volatile* oils are those whose stain on paper disappears with a gentle heat, and which, when distilled with water, rise at the temperature of 212°. The fixed vegetable oils form a numerous and important class.

2212. *Fixed Vegetable Oils.*—These exist ready formed, and uncombined with any other substance, in the kernels of many seeds. They are also found in the roots, bark, and wood; but there they are intimately combined with other principles of the plants. These are usually procured from the seeds and kernels of plants by pressure; hence they are often called *expressed* oils. The substances are put into bags of hemp or hair cloth, and subjected to the action of pressing-mills, at first without heat; what is expressed first is the purest oil, and is called *cold drawn;* afterward some heat is applied, by which a second quantity is obtained of an inferior kind. By this process some mucilage is pressed out together with the oil; and as this deteriorates the quality of the oil, it is afterward, but with some difficulty, separated, and the oil is said to be purified. Fixed oils, when perfectly pure, are quite transparent, either colourless, or of a pale yellowish or greenish tinge, and without smell or taste; when they possess these in their ordinary state, it is owing to the mucilage and other matters mingled with them. They are usually fluid, but of thickish consistence, and they congeal at moderately low temperatures; some are naturally concrete. They combine readily with alkali, forming soaps.

Fixed oils do not boil by being converted into vapour until they are heated to 600°. When a sufficient heat is applied, and vapour is formed and then condensed, the condensed oil is found to have had its properties altered: it has become more limpid and volatile, having lost some of its carbon. When expressed oils are exposed to a warm atmosphere, they gradually acquire a sharp taste and smell, and become thick. This change is termed *rancidity*, and is owing to their absorbing oxygen.

2313. Fixed vegetable oils are subdivided into *fat* and *drying* oils.

2314. *Fat vegetable oils* are those which will not dry or become hard of themselves when spread on any substance, but remain always liquid, or soft and greasy, in the ordinary temperature of our climate. Fat oils, in general, will not unite with water alone; yet, by the addition of mucilage or sugar, they mix with it by agitation, and such mixtures are called *emulsions*. These oils require to be heated to 600° before they boil, and do not inflame until their temperature is elevated to this point. When exposed to the air, they become more viscid, and acquire a degree of rancidity; but when fresh, they have little or no smell; they are never perfectly transparent, but have always a slight yellowish or greenish tinge. The principal fat vegetable oils in use with us as food are olive oil, rape-seed oil, and almond oil: others, employed by us only for procuring light, as palm oil and cocoanut oil, have been described in Chap. II., Book IV., "On Artificial Illumination."

2315. *Olive oil* is so useful in domestic economy as to demand more attention. The description of the olive, from the pulpy part of which it is obtained, will be given in Chapter IX., on "Fruits." Olive oil is brought to us from Italy, Spain, and the Ionian Islands, but chiefly from the first of these countries. The best oil known in our markets is made in Florence and Lucca, and comes from Leghorn; but most of our olive oil is Neapolitan, produced in the provinces of Puglia and Calabria Ultra, and called *Galipoli oil*, from the place whence it is exported. A great deal is used by the wool manufacturers. It is produced in the following manner:

The oil is contained in the pulpy outside of the fruit, whereas most other fruits have their oil in the nuts or kernels. The olives are gathered ripe in November, and immediately bruised in a mill, the stones of which are set wide enough not to crush the kernel; the pulp is then subjected to the press in bags made of rushes. By the first gentle pressure the best, or *virgin* oil, is obtained; and by increasing the pressure so as to break the kernels, at the same time moistening the residuum with water, and applying sometimes a slight degree of heat, a second quality is procured, which, though mixed with the water, on being suffered to remain undisturbed, soon separates, and, although inferior to the first, is still fit for the table. Sometimes a third quality is produced by boiling the pressed cakes in water, and skimming off the oil; this is used by the soap-boiler and other manufacturers. Much depends, not only on the quality of the fruit, but also on its being exactly in the proper degree of maturity; if not sufficiently ripe, the oil has a bitterish taste; if too ripe, the oil is fatty. After the oil has been expressed, it is necessary that it be separated from the mucilaginous matter that accompanies it. For this purpose it is suffered to rest till the mucilage and impurities subside, and the oil is found upon the top. If it be immediately put carefully into clean glass flasks, and secured from the air, it undergoes no farther change. The common oil put into casks cannot be preserved above a year and a half or two years. The oil used for the table is sometimes adulterated with poppy oil. This fraud may be detected by exposing the oil to a freezing cold: the olive oil will congeal, while that of poppies will remain fluid. But a contamination of a pernicious kind by lead is said to occur from its having been kept in leaden cisterns, either in Spain, where this is practised, or in this country. Good olive oil should be inodorous, insipid, soft, and agreeable in the mouth. Its analysis, according to Gay Lussac and Thenard, is, in 100, carbon, 77·21; hydrogen, 13·3; oxygen, 9·4.

2316. *Rape-seed oil* is extracted from the *Brassica napus* and *campestris.* It is made chiefly in Flanders, where it is used for the table, and is said to be employed for adulterating olive oil; but though very pleasant when quite fresh, it is liable to become rancid.

2317. *Almond Oil.*—This oil being united to much albuminous and mucilaginous matter, easily mixes with water, and forms emulsions, for which purpose it is much employed in pharmacy. The oil is obtained by expression from the fruit of the almond-tree (*Amygdalus communis*). When pure, it is perfectly inodorous, and of an agreeable taste.

2318. *Castor oil,* obtained from the seed of *Ricinus communis*, or *Palma Christi,* is used only medicinally.

2319. *Many fixed vegetable oils do not remain liquid in our ordinary temperatures;* some of them are called *vegetable butters.* These are very numerous; but the principal ones known to us are *palm oil,* from the palm; *cocoanut oil,* from the kernels of the cocoanut; *butter of cacao,* procured from the kernels of the *Theobroma cacao*, or chocolate nut. These oils, which are solid with us, but always soft or liquid in warm climates, are employed in India and Africa as substitutes for butter in cooking, and also for making candles. See Book IV., "On Artificial Illumination."

2320. *Drying oils,* when exposed to the air, acquire a pellicle on the surface; and if they are spread in a very thin layer, they harden and become solid, resembling resinous bodies, from the absorption of oxygen: on which account they are employed to mix with colours in painting, which the fat oils will not serve for, on account of their not drying. The principal drying oils are linseed oil, poppy oil, nut oil, hempseed oil.

2321. *Linseed oil,* from the seeds of the flax plant (*Linum usitatissimum* and *perenne*). The seeds are generally roasted before the oil is expressed, for the purpose of drying up the mucilage; it is only used in oil painting and in varnishing.

2322. *Poppy oil,* extracted from the seeds of *Papaver somniferum*, is much cultivated in France, Holland, and Germany for this purpose. It is clear and transparent, and dries readily; it is therefore employed in painting; when pure, it is without taste or odour. It is occasionally also used for the same purposes as olive oil, having none of the narcotic qualities of the poppy.

2323. *Hempseed oil,* made from the seed of the hemp (*Cannabis sativa*), is sometimes employed in painting; but in Russia it is extensively used as food, though its taste is harsh and disagreeable.

2324. *Nut oil,* from the fruit of *Corylus avelana*, is used in this country only for painting; but in the middle departments of France it is employed as a seasoning for food; it is apt to become rancid.

2325. *The drying quality of these oils is increased by boiling,* before which they are said to be *raw.* The method of boiling for this purpose has been described in Book I., under "House Painting."

2326. *Resins and natural balsams are dissolved by fat oils,* with the assistance of heat; and these oils, united to the fixed alkalies, make *soap,* an article of such importance as to demand a separate description in a subsequent part of this work. See Book XXII.

2327. *Volatile oils,* called also *essential oils,* are obtained from various parts of aromatic plants, as the flowers, leaves, bark, wood, and roots, rarely from the seeds, which mostly contain fixed oils. When these oils exist in the plants in great abundance, and are contained in cells near the surface, they are sometimes procured by simple expression, as is the case with the oil which lies in the rind of oranges and lemons; but the greatest number are procured by distillation as they rise, or are converted into vapour at the same heat as water, 212° ; hence their name *volatile;* for, as we stated, the fixed oils require 600° to make them volatilize or change into vapour. The parts of the plant containing the volatile oil are put into a still with a quantity of water, and a moderate heat is applied. The oil is separated, rises with the aqueous vapour, and is condensed with it. Most of these oils, being lighter than water, swim upon the top; a few are heavier, and sink to the bottom. The volatile oils have not the unctuous quality of the fixed oils, but are generally as liquid as water, though a few are somewhat viscid. They have an acrid and burning taste, and an odour extremely powerful, often very fragrant; the delightful odour of flowers proceeds from the evaporation of the essential oils, which are formed and are contained in their cells.

They are soluble in strong alcohol, and hence the *essences* of perfumers; but, on adding water to the solution, they are precipitated. They unite with water in a small quantity, which takes place in the above-mentioned process of distilling them; and this union constitutes the distilled waters of pharmacy. From their great volatility, and having no fatty qualities, the stain which they make on paper when dropped upon it disappears altogether when held near the fire, if the oil has been quite pure: if a greasy spot remain, it has been mixed with fixed oil.

They do not unite readily with alkalies, like the fixed oils, forming a species of soapy compound called by the French *savonules.* When exposed to the air, they thicken from the absorption of oxygen. The most abundant and useful of the essential oils is the oil of turpentine, obtained by distillation from the natural juice, in which it is combined with resin in the fir tribe. Most of these oils are employed in pharmacy or as perfumes. Among the latter are the essence of jasmine, violets, roses, bergamot, &c. (See farther, "On Distilled Waters and Oils," Chap. III., Book XX.) Oil of turpentine has been described in Book I., among the materials for painting.

SECT. XI.—VEGETABLE WAX.

2328. *A species of wax is a product of the vegetable kingdom,* and may be extracted in considerable quantities from various plants. The varnish which appears upon the surface of many leaves consists of this substance, and it is found also in the pollen of flowers, from which, and its analogy to the honeycomb, it has been supposed that the bees only collect their wax from the vegetable kingdom; but it has been shown by Opperman (*Ann. de Chim.*, xlix., 240) that animal and vegetable wax differ somewhat in their constituents; and Huber found that bees made wax when fed upon sugar only. Hunter also pointed out that the substance which the bees procure from the pollen is not wax, but a substance which they gather for the bee-maggots, and called *bee-bread.* Bees' wax, therefore, is an animal substance secreted from the organs of the bee, as has been mentioned under "Artificial Illumination."

2329. *Vegetable wax may be regarded as a fat oil,* having become concrete by the absorption of oxygen in a natural state: accordingly, we find in different vegetables various degrees between oil and solid wax, which constitute the vegetable *butters,* as the butter of cacao; when they become more solid, they are called vegetable *tallow,* as the tallow of croton; when it is very solid, it takes the name of wax, as the *myrtle wax* of America, extracted from the seeds of *Myrica cerifera,* and the *pela* of the Chinese.

The varieties of vegetable wax employed in artificial illumination have been already described in Chap. II., Book IV.

SECT. XII.—RESIN.

2330. *Resins are solid substances of vegetable origin,* highly inflammable, giving much soot by combustion; insoluble in water, but soluble in essential oils and in alcohol. They are supposed to be volatile oil saturated with oxygen, in the same manner as wax is thought to be fixed oil with oxygen. They often exude spontaneously from trees, sometimes from their artificial wounds, and are generally, at first, combined with volatile oil, from which they may be separated by distillation. Common resins may furnish a good example of this. Every one has seen a yellow, transparent, highly viscous substance, called *turpentine,* occasionally exuding from deal or fir. This substance consists of the essential oil of turpentine holding in solution common resin. Large quantities of this are produced from the *Pinus sylvestris,* or Scotch fir, in the north of Europe, where there are vast forests of it; and by distillation the common oil of turpentine (improperly called spirit) is drawn off, leaving behind masses of the yellow resin in the solid state. *Venice turpentine* is procured from the larch (*Pinus larix*). *Tar* and *pitch* are also made from the pine and fir tribe; but to form tar, the logs of wood are cut down and exposed to a strong heat in tar-furnaces, by which the turpentine is partly decomposed and converted into an empyreumatic pitchy oil, called tar; and the latter, when inspissated by boiling it, pitch. The term gum is improperly applied to many substances which are resins, as gum mastic, gum sandarach, gum copal, &c. Gums are soluble in water, while these substances are not, but only in spirits of wine.

2331. *Gum resins* are substances intermediate between gums and resins. If they be digested in water, the gum dissolves and leaves the resin; and when they are digested in spirits of wine, the resin dissolves and leaves the gum. If they are digested in a mixture of alcohol and water, great part of both resin and gum is dissolved. Under gum resins are comprehended aloes, asafœtida, gamboge, myrrh, guaiacum, &c.

2332. *Balsams* are both fluid and solid. They consist of resin, volatile oil, and benzoic acid, without the last of which they are not balsams. The terms *Canada balsam* and *copaiva balsam* are improper and obsolete, these substances not being balsams. *Benzoin, tolu, Peruvian balsams,* are real balsams.

Sect. XIII.—Camphor.

2333. *Camphor appears to possess* some of the properties of a concrete volatile oil; but it is a matter quite distinct from all other bodies. It is solid, white, and transparent; friable, but not easily pulverized; has a peculiar penetrating fragrant odour, and a bitterish acrid taste, followed by a sensation of coldness in the palate. It is extremely volatile and combustible, giving out much smoke, swims on water, and is scarcely dissolved by it, though it is easily by alcohol.

Camphor exists in a greater or less quantity in the roots, branches, and leaves of many plants, particularly in the essential oils, as the oils of rosemary, marjoram, sage, and lavender. But what is brought to this country, and used in medicine, is procured by distillation from the roots and smaller branches of the *Laurus camphora* and *Sumatrensis*. From its volatility, it is soon dissipated when exposed to the air; and if enclosed in a glass vessel, its vapour crystallizes on the inside. When thus diffused through the air, it acts as a poison to many insects; hence its use in defending clothes from moths. It is poisonous to all animals taken into the stomach in large quantities, although, like many other poisons, it is useful in very small quantities when employed medicinally.

Sect. XIV.—Tannin, or Tannic Acid.

2334. *Tannic acid has been frequently named the astringent principle*, and is very abundant in the barks of trees, and in all plants that are of an astringent nature. It exists abundantly in the bark of oak, and in large quantity in the excrescences called gall-nuts on several species of oak. It is found also plentifully in tea, sumach, and whortleberries; but in these it is always associated with gallic acid: in catechu and cinchona bark it exists in the greatest abundance, and without gallic acid. When tannic acid is prepared quite pure, it is highly astringent, and soluble both in water and alcohol. It is white, and without odour, but on exposure to air it becomes brown, as it is generally seen. Though it is itself soluble in water and alcohol, it has the useful property of forming with gelatin a compound not soluble in water; in fact, rendering gelatin, which is a very soluble substance, insoluble; hence the use of bark in making leather.

2335. *To make leather*, skins, which consist almost entirely of gelatin, are steeped in the tan-pit with a quantity of bark, chiefly of the oak; they thus become converted, by combination with the tannin, into a substance insoluble in water, and this, after going through certain operations, constitutes that useful material, leather, which is no longer liable to putrescence. A great deal of tannic acid exists also in red port and in coffee. Dr. Thomson is of opinion that tannic acid, like most other vegetable substances, is susceptible of different modifications, and that what is procured from different plants is not exactly of the same quality independently of the quantity. 100 parts of tannic acid are composed of carbon, 52·69; oxygen, 43·45; and hydrogen, 3·86. By some it is arranged among the vegetable acids.

Sect. XV.—Colouring Matter.

2336. Peculiar substances exist in vegetables called colouring matter; but this rarely or never occurs in an insulated state, being always attached to some other proximate principle, such as mucilaginous, resinous, or other substances, by which their solubility is affected. For these, see Chap. XI., Book XVII., "Dyeing."

Sect. XVI.—Vegetable Acids.

2337. *Acids form a class of substances having peculiar properties. They are sour to the taste, and they change vegetable blues to red.* The latter property is the surest and most delicate test, for it may happen that an acid may be diluted so much with water that its sourness is not sensible to the taste; but if a little of the decoction of red cabbage, which is blue, be dropped into it, the colour will instantly be changed to red: or, if pieces of paper died with vegetable blue be dipped into a liquid supposed to contain an acid, the same change will be effected. Paper coloured blue by litmus is kept by chemists for this purpose, under the name of *litmus test paper*.

2338. *Another property possessed by acids is*, that when they are united to an alkali, salts are formed that are neither acid nor alkaline, and hence called *neutral salts*. The acid and alkali in this case are said to *neutralize* each other.

2339. Of acids, some are formed by chemical action among mineral bodies, as nitric acid, sulphuric acid, &c.; these are called *mineral acids;* but at present we propose considering only such of the vegetable acids as exist ready formed in plants, and which enter into the composition of materials employed as food.

2340. The researches of modern chemistry of late have greatly added to the number of vegetable acids; but some are extremely rare, and could only find a place in a system of chemistry which should contain an account of every known substance. The following are the principal vegetable acids: acetic acid, malic acid, citric acid, tartaric acid, oxalic acid, and gallic acid.

2341. *Acetic acid* exists ready formed in the juices of many plants, either in a separate or free state, or combined with lime or potash, forming salts. It is an abundant product of the acetous fermentation, and it is also formed by the destructive distillation of vegetables, as in the case of wood vinegar. Common vinegar is an impure acetic acid; but this being an article of great importance, it will be treated of at large in another part of this work. See Chap. VI., Book VII.

2342. *Malic Acid.*—This acid derives its name from the apple, in which it abounds, particularly before they are ripe: it is likewise found in many other fruits, together with other vegetable acids, and is almost the only one in the service-tree (*Sorbus aucuparia*), from which it is sometimes called the *sorbic acid.* When pure it is exceedingly sour.

2343. *Citric Acid.*—This acid exists naturally in many acidulous fruits, but in the greatest quantity in the juice of the lime and lemon, from which it is now obtained pure in a crystallized state. The crystals are transparent; if kept dry, they may be preserved for any length of time, and are sometimes employed as a substitute for lemon-juice.

2344. *Tartaric Acid.*—This exists in several acidulous fruits, particularly the grape and the tamarind, but always combined with lime or potash; and these combinations are neutral salts, called *tartrates* of lime or of potash. The juice of the grape is remarkable for containing abundance of the bitartrate of potash; and during the process of making wine this salt is deposited in the form of a hard crust, and particularly on the sides and bottom of the wooden casks in which the wine is kept to depurate. This substance is called *tartar*, and being impure, and coloured by the wine, it is dissolved and purified; it is then white, and becomes the acidulous substance called *cream of tartar* of the shops. From this the pure *tartaric acid* is prepared by separating the potash from it by a chemical process. When the tartar of the wine-casks is burned to ashes, the tartaric acid is driven off, and the potash remains, which was formerly known under the name of *salt of tartar.*

2345. *Oxalic Acid.*—This acid, so violent a poison in its pure state, abounds in wood sorrel (*Oxalis acetosella*); but it is there combined with a small quantity of potash, and in that case it is not poisonous. When this salt, the oxalate of potash, has been prepared from sorrel, it is sometimes sold, under the improper term of *salt of lemons*, for taking out iron moulds and ink spots, for which purpose it answers equally well.

The resemblance of oxalic acid to Epsom salts has occasioned many fatal mistakes. In cases of poisoning by this substance, the best antidote is chalk or whiting mixed with water, which is preferable to emetics, or potash, soda, or magnesia, which have been also employed. Oxalic acid is easily distinguished by its strongly *acid* taste (and it may be *tasted* without danger), whereas Epsom salts have a *bitter saline* taste.

2346. *Gallic Acid.*—This acid is found in the bark of many trees, and in gall nuts, but always associated with tannin, or tannic acid, already described. It has but a very weakly acid taste, and is astringent and bitter. It is particularly remarkable for striking a deep bluish-black with iron, and from this property it forms the basis of writing ink.

2347. *Prussic Acid.*—This, in modern chemistry, is called the *hydrocyanic acid;* but it is still popularly known by its former name, which was derived from its being a constituent of the pigment Prussian blue. It is one of the most virulent poisons known, a drop or two laid on the tongue being sufficient to occasion death; but, like most poisons, when employed in very minute quantities, it is a useful medicine. It is introduced here only to correct a general opinion respecting it, which now proves to be erroneous, in consequence of the recent discoveries in vegetable chemistry. Although Prussic acid is procured by the distillation of the leaves and kernels of the *Prunus Lauro-cerasus*, or cherry laurel, *peach*, and *bitter almond*, it does not exist, as has been supposed, ready formed in these vegetables. They only contain the ultimate components called *amygdalin* and *emulsin*, from which Prussic acid is formed by their mutual action and that of water during the process of distillation. By this process, a poisonous essential oil, called by chemists *hydruret of benzueli*, is likewise formed from the same ultimate components; and it is to this essential oil, and not to the Prussic acid, that the odour of the peach-blossom is owing. Prussic acid, therefore, being merely the product of a process, cannot be considered as one of the proximate principles of vegetables. See farther, in the description of the "Cherry" and "Peach," Chap. IX., Book VII.

The composition of hydrocyanic acid is very different from acids in general; instead of oxygen, hydrogen is its acidifying principle: it is composed of hydrogen and a gaseous body called *cyanogen*, the latter consisting of nitrogen and oxygen.

Sect. XVII.—VEGETABLE ALKALIES.

2348. *Alkalies constitute a peculiar class of bodies*, which, however, it is difficult to define accurately. They are distinguished by a peculiar *nauseous taste, called alkaline*, and which, as it cannot be described, may be understood by tasting carbonate of soda: they change vegetable blues green, and yellow ones to brown, and they neutralize or destroy the action of acids, and, consequently, restore the blue colour of such vegetable solutions as have been rendered red by them. The most convenient tests for an alkali are slips of paper dyed yellow with turmeric, and sold for the purpose by chemists: if put into any liquid containing *free* alkali, they will be changed to *brown*.

2349. Formerly there were but three alkalies known: soda, called mineral alkali; potash, the vegetable alkali; and ammonia, the volatile alkali: the first two were named, also, *fixed* alkalies. The terms mineral alkali and vegetable alkali, though formerly employed, and constantly met with in old books, and therefore introduced here, are now laid aside as not applicable, since both of them are found in abundance in the mineral and in the vegetable kingdoms. The two *mineral* alkalies, soda and potash, have for their bases peculiar metals, called sodium and potassium; these alkalies are, in fact, oxydes of the metals.

2350. *What are in modern chemistry denominated the vegetable alkalies* are certain substances existing in plants that are possessed of alkaline properties; but they are very different from the fixed alkalies just mentioned, for they do not consist of metallic bases, but are composed of the usual elements of which vegetables are formed. It is interesting to observe that, in all these vegetable alkalies, as has been already noticed, nitrogen is found in considerable proportion, contrary to what is the case in the other proximate principles of the vegetable kingdom.

Soda and potash, though differing altogether from these, being metallic oxydes, occur in abundance in plants; and, although they do not come under the denomination of vegetable alkalies, as the term is now understood by chemists, yet we feel it will be useful to describe them in this place as constituents of vegetables, premising that they must not be confounded with those vegetable alkalies which are not metallic oxydes.

2351. *Soda was called the mineral alkali* because it was originally dug up out of the ground in Africa and other countries; this state of carbonate of soda is called *natron*. But carbonate of soda is likewise procured from the combustion of marine plants, or such as grow on the seashore. *Kelp* is a substance produced by the burning of the fucus or other sea-weeds, and contains much impure soda; it is used in making glass and soap. *Barilla*, a purer kind of the same substance, is made by burning the *Salsola soda*, a plant that grows abundantly at the seaside in Spain. These carbonates of soda, when purified, are much in request by the laundress. (For its use, see Book XXII., "Economy of the Laundry.") Pure carbonate of soda is employed for making effervescing draughts with lemon juice, citric acid, or tartaric acid. Soda, deprived of carbonic acid and every other substance by a chemical process, is called *caustic*, or *pure soda*. Common salt is muriatic acid and soda, or muriate of soda, according to the late nomenclature of chemistry; but at present it is considered to be chloride of sodium, or the elementary principle chlorine united to the metal sodium; consequently, having no oxygen in its composition. It is remarkable that the metal sodium is never met with by itself in nature; having so greedy an attraction for oxygen, that when procured pure by art it falls into the state of an oxyde in a short time; and this oxyde is *caustic potash*.

2352. *Potash was formerly called the vegetable alkali*, because it was obtained from the ashes of land vegetables. When the ashes are mixed with water, the potash is dissolved, and the earths and impurities settle to the bottom. This water is then evaporated by boiling in iron vessels; and the solid substance that remains is the *potash* of commerce, so called from the manner of its production. When this is strongly heated in a furnace, it becomes whiter, and is then *pearlash*. These substances, however, are not the pure alkali or potash; for they are thus united to carbonic acid, being, in fact, *carbonate of potash*. Potash deprived of the carbonic acid by another process is called *caustic* potash, which instantaneously acts upon and corrodes animal substances, and is used by surgeons in their operations. United to carbonic acid in the usual way, it is called *mild* potash, and still preserves somewhat of causticity, as may be observed from its effects upon the skin in washing. Potash, both mild and caustic, is an extremely useful material, being employed in medicine, and for domestic purposes in a great variety of ways, which will be described under their several heads. Potash is also extensively employed in the manufacture of soap, in bleaching, scouring wool, &c. It is principally manufactured in America, Russia, and Poland, where the vast forests furnish an inexhaustible supply of ashes. Small quantities are also made here in country places from the burning of vegetables, particularly fern in mountainous districts; and *wood ashes* of any kind contain potash, to which they owe their detergent quality. *Salt of tartar* has been mentioned as an impure carbonate of potash. See, farther, Book XXII., "Economy of the Laundry."

2353. We will now say something of the most remarkable of those substances to which the term vegetable alkalies is at present restricted.

2354. *Morphia.*—It is well known that certain plants, as opium, possess a principle that induces sleep, called the narcotic principle, and which, if taken in a large quantity, occasions death. This principle has lately been detached from all others, and named Morphia, from Morpheus, the god of sleep. It is now ascertained that morphia, if employed as a medicine in lieu of opium, produces the soothing effects of that drug without the usual feverish excitement, heat, and headache.

2355. *Quinia and Cinchonia.*—These alkaline substances are supposed to contain the febrifuge virtues of Peruvian bark, from which they are extracted. United to sulphuric acid, forming sulphate of quinia and cinchonia, they are considered as more efficacious than the bark itself.

2356. *Strychnia*, a substance extremely poisonous, is extracted from the fruit of the *Nux vomica*, St. Ignatius's bean, and other plants of the genus Strychnos.

2357. *Veratria*, another poisonous substance found in the root of white hellebore (Veratrum album) and meadow saffron (Colchicum autumnale), which last, also, contains colchica.

2358. *Emetia*, a principle extracted from ipecacuanha, and which is the cause of the emetic properties of that root.

2359. *Picrotonia*, the bitter poisonous principle of the Cocculus indicus.

2360. *Solania*, the poison of the woody night shade.

2361. *Cynopia*, procured from the lesser hemlock (Æthusa Cynapium).

2362. *Conia*, from hemlock (Conium *maculatum*).

2363. *Atropia*, from belladonna (Atropa *belladonna*).

2364. *Hyoscyama*, from henbane (Hyoscyamus *niger*).

2365. *Daturia*, from stramonium (Datura *stramonium*).

Sect. XVIII.—Bitter Principle.

2366. It was formerly supposed that there was *one peculiar principle* that occasioned the bitter taste, and which was the same in all plants; but chemists are now of opinion that there is no such determinate principle common to all vegetables; and that the bitter taste proceeds from principles varying, perhaps, in each plant. There are therefore various bitter principles which have different properties. The bitter is intense in quassia, and is called *quassin.* Dr. Thomson thinks it is probable that hops, gentian, and broom contain the same bitter principle. Another called *caffein* is found in coffee. *Scillitin* is the bitter principle of squills. Many varieties of the bitter principle are deadly poisons, as *strychnia*, the bitter of the Nux vomica; *morphia*, of opium. *Nicotin* is a poisonous principle extracted from tobacco. It is important to notice these facts, since very erroneous reasoning has been founded upon the supposition that there was one distinct bitter principle having always the same properties.

Sect. XIX.—A few other Vegetable Principles.

2367. *Extractive Matter.*—In works on chemistry this term has been often employed to express a peculiar supposed principle existing in plants; but Dr. Turner and other chemists observe that it is now doubted whether there be any distinct substance to which the name ought to apply. The term *extract* in pharmacy originally meant any substance extracted by means of some menstruum: and therefore it varied according to the nature of that menstrum; thus, there were *watery extracts* and *spirituous extracts*, since many of the vegetable principles are soluble in water, others, as resins, only soluble in alcohol. From the descriptions given of what has been termed extractive, it appears to be very analogous to some of the bitter principles, which are not yet well understood.

2368. *Caoutchouc.*—This very singular substance, commonly known by the name of Indian rubber, was, not many years ago, used only to rub out black-lead pencil marks; at present, its uses are very extensive, and it will be noticed in various places through this work. (See Index.) It coagulates from the sap of a particular class of tropical trees, from which it flows out by incisions made for the purpose. See, farther, "On Elastic Fabrics," in Chap. VIII., Book XVII.

2369. *Charcoal* is such portion of the lignin as has escaped complete combustion in burning vegetables, and where the carbonaceous part of it alone remains. In this state it admits of no farther spontaneous alteration, and is perfectly incorruptible. It is used for a great variety of purposes. It is an excellent substance for filtering water; it corrects incipient putrefaction in animal substances, and is extensively used as fuel.

2370. *Wood-ashes.*—When vegetables are completely burned in the open air, all the principles above enumerated are volatilized, with the exception of the potash and soda, which have been already described, and which are separated from the ashes that remain. After these alkalies have been extracted, the remainder consists of a small portion of various earths, and even metals, particularly iron, which entered into the organic structure of the vegetables, but which probably were not always essential constituents. Wood-ashes, from the alkali they contain, are often employed for the same purposes as soap.

2371. *Silica*, or the earth of flints, is a substance which one would not expect to meet with as a necessary ingredient in plants, and yet a whole tribe of vegetables has a varnish of siliceous matter on the outside of their stems; the most remarkable of these is the bamboo; the shining polish of this plant proceeds from a thin coating of pure silex, and small concretions of siliceous matter are often formed in the joints of the stems. The greater number of the grasses, and the various species of corn plants, have an external coating of this substance, which nature has the power of dissolving and converting into a varnish. The existence of this flinty epidermis in the stalks of corn is easily shown by the blowpipe, which fuses it into a minute globule of glass. Silica likewise exists in many plants in minute quantities, but in combination with potash, soda, or lime, and appears on their analysis.

2372. *Besides these, several other elementary substances* are found in vegetables on analysis in minute proportion, as phosphorus, sulphur, lime, iron. All vegetables contain a large proportion of water. Indeed, the greater accuracy with which organic matter is now analyzed by experienced chemists, compared with what was the case only a few years back, has very much increased the number of substances that enter into the composition of vegetables in very small quantities, and have, no doubt, their effect in the production of their several properties; but to enter into all the details necessary to exhibit this increased complicacy of constitution would render our work unintelligible to the greater number of our readers, and depart from the simplicity which we are desirous of retaining by confining ourselves to what belongs more particularly to domestic economy. Those who are desirous of following up all the discoveries of modern analysts should consult their late publications.

CHAPTER VIII.

DESCRIPTION OF THE VEGETABLES AND FRUITS USED AS FOOD IN THE BRITISH ISLES.

SECT. I.—INTRODUCTION.

2373. One of the principal advantages resulting to Europe from exploring distant regions has been the introduction of numerous useful vegetables and fruits, which are at present cultivated with much success. Whatever horticulture may have been practised in Britain by the Romans, while they had possession of this island, must have been nearly, if not wholly, lost during the disturbed state of several succeeding centuries; and it is indeed remarkable, surrounded as we are with abundance of every kind of useful fruit and vegetable that our climate will admit of, and which many suppose to be natural to the soil, to find that the introduction of by far the greatest number date no farther back than the reign of Henry VIII.

The edible wild plants indigenous in this island are mostly of small growth and harsh taste; and to the skill of the gardener we owe almost all those which at present form valuable articles of diet.

2374. *In this chapter we propose to give a general description* of all the vegetables and fruits used at present as food in the British isles; but the manner of their production or cultivation will be found in works on Gardening and Agriculture.

2375. *In our arrangement we shall adopt the method* followed by Mr. Loudon in his "Encyclopædia of Gardening," to which we are obliged for many useful facts:

1. The Cabbage tribe; 2. Leguminous vegetables; 3. Esculent roots; 4. Spinaceous plants; 5. Alliaceous plants, or the onion tribe; 6. Asparaginous plants, or the asparagus tribe; 7. Acetaceous plants, or salads; 8. Pot-herbs and garnishings; 9. Sweet herbs; 10. Plants used in tarts, confectionery, and domestic medicine; 11. Plants used as preserves and pickles; 12. Edible indigenous plants not cultivated; 13. Poisonous plants; 14. Edible fungi; 15. Edible marine plants.

SECT. II.—CABBAGE TRIBE.

SUBSECT. 1.—*General Account of the Cabbage Tribe.*

2376. The cabbage tribe belongs to the numerous botanical family of the *Cruciferæ*, or, as Professor Burnett has named them, *Brassicaceæ*, some of which are found as weeds in every field; and to one of them, by means of cultivation, we are indebted for all the varieties at present in use.

2377. *The original wild plant*, called *sea-colewort* (*Brassica oleracea*, Linn.), may be seen growing on the cliffs in various parts of the south coast of England, as at Dover and Penzance; and no one unacquainted with the subject would suspect that it had been the parent of so important and numerous a progeny. It is there seen as a plant of scanty leaves, scarcely weighing altogether half an ounce; and, though it may be eaten, it is salt, and not very tender. It is not supposed, however, that all our cabbages, originating from this wild plant, have been the result of English gardening only. This plant is very liable to run into varieties, and some of these have probably been cultivated in other countries from the earliest times.

2378. *The cabbage was known to the Romans*, and was with them a favourite vegetable. Columella informs us that it was produced in sufficient quantity to be used abundantly as an article of food by all classes of people; and as it was a principle with the Romans to carry the arts of civilization into those countries which they conquered, several fruits and culinary vegetables found their way, through this source, into Germany, Gaul, and Britain. Much, also, is probably due to the earliest monastic institutions. It is not accurately known, however, at what time the cabbage was introduced into this island, but it was supposed to have been cultivated here pretty generally in the times of the Saxon heptarchy, the Saxon term for this vegetable being *kale*, a name by which it is still known in Scotland. The close-hearted variety was for many years brought from Holland, and Ben Jonson speaks of this being the case in his time. It is said that cabbages were first introduced into the north of Scotland by the soldiers of Cromwell, though some refer their being planted there to an earlier date: for a long time they were the only garden vegetable in the northern parts of that country. From the abundance, cheapness, and wholesomeness of this plant, it appears to be the most useful of all the culinary vegetables; and so many are the varieties, that one or other is procurable at every season of the year.

2379. *The cabbage tribe putrefy very quickly*, and in decomposing give out a very offensive odour, owing, it is supposed, to their containing a small portion of nitrogen, in addition to the usual constituents of vegetables. Decayed cabbage leaves should therefore never be suffered to lie about in the vicinity of dwellings, and the water in which this vegetable has been boiled should not be retained on the premises, but be passed off into the drains.

2380. *Cabbages are found in general to be wholesome and nutritive*, and to supply a valuable mixture with animal food; but with some constitutions, particularly those who are dyspeptic, they are occasionally indigestible, and productive of flatulency. Dr. Paris is of opinion that they contain an essential oil which is apt to produce bad effects, and he recommends that they should be boiled in two successive waters till they are soft and digestible. But they may be boiled too much, as well as not enough: in the former case, when soft water is used, much of their nutritive properties are extracted, and are lost in the water.

2381. *The varieties of cabbages* are divided into, 1, the various sorts of Borecoles or Kales; 2, the headed Cabbages; 3, the several kinds of Cauliflowers and Broccoli.

Subsect. 2.—*Borecoles, or Kales* (*Brassica Oleracea*, Linn. Division 1, *Acephala*).

2382. The character of these is to have the leaves loose, and not formed into a close round head, and their leaves are generally curled or wrinkled. They resemble most the original wild plant. They form an excellent vegetable for the table, and being extremely hardy, are considered by many as the best winter greens, and most to be depended upon. They have been particularly recommended for cottage gardens. In an experiment tried to blanch them, they were found to be much improved. They are not in the least injured by frost. There are several varieties of borecole; one variety well known in London, and in almost every garden in Britain, is the *Scotch kale*, which in Scotland is known by the name of *German kale*, or *curlies*, or curly greens.* Some other varieties are more rare, as *Buda* and *Russian kale*. The former is a low and rather delicate plant, which is excellent for the table when blanched: the sprouts are preferable to the heart. It is from the seeds of a variety of kale that the Colza oil, so much used in France for burning in lamps, is procured by expression.

2383. *The Couve Tronchuda* (*Brassica costata*), or Portuguese cabbage, from Tranxuda, Portugal, is much cultivated on the Continent, and was introduced here in 1821; it is grown chiefly for the midribs of the outward large leaves, which, when divested of their green parts, and well boiled, make a good dish, somewhat resembling sea kale. The heart or middle part of the plant is, however, the best for use; it is peculiarly delicate, tender, and agreeably flavoured, without any of the coarseness which often belongs to the cabbage tribe.

2384. *The palm kale, and the true kale, or Cæsarean cow-cabbage*, are both arborescent varieties of brassica; the first growing to the height of ten or twelve feet, and the latter said even to reach to sixteen feet in La Vendée; their stems are simple, and crowned with tufts of leaves, therefore something resembling the palms in part. The heart of the bud is tender and palatable; the outer leaves are given as fodder to cattle, for which purpose the plant is cultivated extensively in Jersey, and the other Anglo-Norman isles.

2385. *Sea kale*, notwithstanding its name, does not belong to this class of plants, but to the asparagus tribe; its description will be found with them.

Subsect. 3.—*Close-headed Cabbages* (*Brassica Oleracea*, Division 2, *Capitata*).

2386. The second division of the brassica consists of those which form their leaves into a round head, as the common white and red cabbage, or into a long head, as the savoys; besides the common white and red, there are several other varieties, as the drum-head, sugar-loaf, &c., and the sub-varieties are brought into use in different seasons, as they are required, some being early, others late.

2387. *The white cabbage is the most common* garden sort. The heads, when well formed, are externally of a yellowish-green colour, and the internal part is very white or blanched; these are from three to twelve, or even fifteen, inches in diameter, and weigh from two to twenty pounds; but the larger varieties are used only for cattle. They are all raised from seeds, are biennials, and are therefore sown the year before it is expected they will have large heads. The first season, while the plants are young, they are often employed as *greens*, under the name of *cabbage plants*, or *cabbage coleworts*; these are pulled up by the roots, and carried to market in that state, which preserves the sap better than when the roots are cut off. Others are transplanted; and when a little farther advanced, when the heads begin to form, they constitute what are called *summer cabbages*. The heads are cut off at various times, according to taste, and the demand for them. In the winter their form is completely round and compact, and they are employed for various purposes, for family use, sea stores, or for cattle. If the ground is wanted, the stalks are pulled up, but sometimes they are left in the ground all the win-

* Some consider another variety, the purple or brown kale, as quite equal, if not superior. The Siberian and the dwarf borecole are also excellent.

ter; and in the next spring fine new shoots proceed from the stems, which are gathered for greens, under the name of *cabbage sprouts*, and which are not inferior to young cabbages. In early cut cabbages these sprouts often form little, tolerably firm heads in the autumn; in the sugar-loaf cabbage particularly, and other forward kinds; these, while young and green, constitute some of the most excellent culinary greens of the season. Gardeners generally suffer a certain number of the strongest cabbage to remain for the purpose of producing sprouts.

2388. *The red cabbage* is of the same general form as the white, but is naturally rather of a purplish colour, mixed with brown, than red. The bluish purple colour, like all vegetable blues, is turned red by any acid; and hence its colour, when employed as a pickle, which is the chief use to which it is applied with us. Its bluish juice is an excellent test for both acids and alkalies; for it turns red with the former, and green by the latter. In Germany they make from this cabbage, as well as from the other varieties, their favourite *sauer kraut;* for the manner of preparing which see Book X., Chap. III., "Pickling." The best kind for pickling is the large red Dutch. The dwarf red, which is more delicate, is principally used for stewing, and is much grown for that purpose on the Continent.

2389. *Savoys* are likewise close-hearted cabbages; but they are distinguished from those already described, by their leaves being very much wrinkled. They are sweeter, and of a more tender texture than the others, particularly the central leaves. They are a winter vegetable, and their season is from November till spring. The dwarf savoy is much improved by frost; and the yellow savoy will bear very severe weather without injury. The green is most tender.

2390. *Brussels Sprouts.*—These are considered as a sub-variety of the last, and are thought by some to be the most agreeable of the cabbage tribe. The stem, particularly in Flanders, is sometimes four feet high; and from the places where the leaves join on sprouts shoot out, which form small green heads, like cabbages in miniature, each being from one to two inches in diameter; the main leaves drop off early. The top of the plant resembles a savoy planted late in the season; it is very delicate in taste, and quite different from the leaves. At Brussels, where they are used as winter greens, they are usually served up at table with a *sauce blanche*, comprised of vinegar, butter, and nutmeg. The tops should be gathered a week or ten days before the sprouts; and the latter, when cooked, should be carefully drained before the sauce is added. The sprouts are best if they have been touched by the frost, resembling in this respect savoys.

2391. *Cauliflower and broccoli* (*Brassica oleracea*, Division *Botrytis*). This division comprehends those which form a head of their stalks and flowers. It was a favourite saying of Dr. Johnson, "Of all the flowers in the garden, I like the cauliflower best." It is, indeed, the most delicate of the brassica tribe.

2392. *It differs from the other varieties* in having its flowers extremely numerous and compact, planted upon a short, thick, succulent stem, and forming a curd-like head that scarcely rises above the leaves. This stem, with the mass of closely-planted flowers, is the part which is cut off and dressed.

2393. *It is not certain at what period the cauliflower was introduced into English horticulture;* but it was cultivated here about the beginning of the seventeenth century, and came to us from the Island of Cyprus. Its cultivation in England has been very successful; and though the Dutch horticulture long excelled the English, yet this vegetable was produced here in greater perfection than in Holland; and, before the French Revolution, used to be exported to that country.

2394. As it requires a richer soil and warmer situation than the other varieties of the brassica tribe, it must always be higher in price; but from the great industry and spirit of our gardeners, it is now become so cheap as to be within the reach of all classes. In 1619, two cauliflowers cost three shillings. The heads of the cauliflowers are not nearly so liable to putrescency after being cut as its leaves, which in this respect are similar to those of the cabbage; and they may be preserved for months through the winter by pulling up the plant entire, picking off the decayed leaves, and hanging them up in a cellar or shed, or by burying them in pits in the ground.

2395. *Broccoli.*—The name is Italian; it is usually considered as a sub-variety of the cauliflower, and is distinguished from it by the head being of a dark green or purplish colour, instead of white, as the latter; though lately gardeners have produced a white broccoli that very much resembles cauliflower in all its valuable qualities. The purple sort, when boiled, becomes green. Broccoli is likewise much hardier, and is made to stand the winter; and it is a great advantage that cauliflower and broccoli bear their heads at different seasons of the year. Both are excellent and wholesome.

Sect. III.—Leguminous vegetables.

2396. *The legumes*, or, as they are also called, *pulse*, contain the greatest quantity of albumen and gluten next to the grains or seeds of the corn plants, and rank the nearest to them in their nutritive qualities. Except the corn plants (which will be treated of under the article "Bread") and the potato, pulse are the most important of the farinaceous esculent vegetables. They consist of the pea, common bean, and kidney bean, lentil, tare, and vetch: the first three only are used as food for man in Britain. Next to fruits and the nut species, perhaps, the pulse tribe were earliest resorted to for nourishment, as it required little labour to prepare it. In their young state, when succulent, several of them form favourite articles on the table; but when they have come to maturity, or are dried, they are less acceptable, requiring strong powers of digestion. It is fortunate, however, that even then they furnish excellent food for various domestic animals; and thus the soil, which would be exhausted by perpetual crops of grain, is enabled to recover its fertility under the less severe production of the various sorts of pulse.

SUBSECT. 1.—*The Common Pea* (*Pisum Sativum*, Linn.).

2397. Of the pea there are many species, but this is the only one cultivated in this country. It has long been known as a culinary vegetable in India, China, and Japan, but is probably not originally a native of a very warm climate. It has no doubt found its way into Britain from the southern parts of Europe, and appears to have been extensively used as one of the staple articles of food in England at a very early period; for it is on record that in 1299, when the English forces were besieging a castle in Lothian, they subsisted upon pease and beans grown in the vicinity, after their provisions were exhausted. The more delicate varieties, however, do not appear to have been known in England until much later, since it was observed by Fuller, in the time of Queen Elizabeth, that pease brought from Holland were "fit dainties for ladies, they came so far, and cost so dear."

2398. *Though culture has produced a great many varieties of pease*, yet they may be all included under two divisions, the white or yellow, and the gray. Of the white, the choicest sorts are raised in gardens, to be eaten green; but vast quantities are likewise cultivated in the fields, and are allowed to ripen to be dried. The gray pease are coarse-flavoured, and are used only as food for horses and cattle.

2399. *The sub-varieties of the common pea are very numerous*, and are continually changing from culture: even the names of them vary, which renders it difficult to determine with respect to the best sorts. Among the principal varieties at present are the *marrow fats*, the *egg*, the *moratto*, the *Prussian blue*, the *rouncival*, &c. Pease form a light, wholesome food when they are green and succulent, and gardeners sow them at various periods, so as to have them fit for gathering in succession. They are generally distinguished into *early* and *late;* the former are often forced on hot beds, and form the grand vegetable luxury at the approach of summer. These, however, are never so rich and saccharine as those which come to maturity by the natural heat of the season; hence green pease are really of the best quality when they are so abundant and cheap that they can be purchased by every one. When the white or yellow sorts are ripened for drying and splitting, they are called *boilers*, as they are mostly used for soup, or pease pudding. Vast quantities of these are consumed in the navy. It is found that, after they have been kept a year, they do not break or fall well in the soup; and this property likewise depends much upon the soil in which they grow. Pease are also ground into flour, which forms a milky solution with water, owing to the presence of an oily matter. Although highly nutritive, ripe pease are much more indigestible than the corns, and the bread they afford is apt to lie heavy on the stomach: it is chiefly confined to the labouring classes, and those who have strong powers of digestion.

2400. When green pease are sent to market in sacks, they are apt to heat, and a fermentation commences in a few hours, by which the pea loses its sweetness and fine flavour; this may be observed constantly in the season in Covent Garden market. Those sent in sieves, or flat, shallow baskets, are not liable to this objection.

2401. *Ripe pease analyzed by Einhoff* gave, in 3000 parts, starch 1265 parts; fibrous matter analogous to starch, with the coats of the pease, 840; mucilage, 249; saccharine matter, 81; albumen, 66; earthy phosphate, 11; volatile matter, 540; loss, 229.

2402. *Sugar Pea.*—This is a variety lately introduced, very sweet, and in which the tough internal film of the pod is wanting. These pods, when young, are boiled whole, and eaten in the manner of French beans.

2403. *The chick pea* is little known in Britain. It is a very small variety, much cultivated in the south of Europe. The seeds do not become soft by boiling; but are sometimes parched in a frying-pan in Egypt and Syria, where they are considered as convenient food for travellers who make long journeys. In Spain, they form an ingredient in the *olla*, a national dish. In Italy, and the south of France, they are sometimes roasted as a substitute for coffee.

Some other small varieties of the pea are known and used in Arabia and India, but they are not of much value, except to the poorest classes.

SUBSECT. 2.—*The Garden Bean* (*Vicia Faba*, Linn.).

2404. *The common or garden bean* has been cultivated in Britain from time immemorial, but is supposed to have been introduced by the Romans, and to have come originally from Asia, whence it spread into Italy, Egypt, and Barbary.

2405. *The seeds* of the large variety of garden bean, called the *Windsor bean*, are preferred for the table. The *Mazagan* is one of the earliest and best flavoured, and the

Green China is late; the seeds of the last remain green when ripe and dried. Other varieties, as the *common horse bean*, the *tick bean*, and the *small Dutch bean*, are cultivated in the fields for fattening domestic animals, for which they are admirably adapted. In some places, meal from beans is mixed with other meal for making coarse bread, and a small quantity of them is generally mixed with new wheat when ground to flour; the millers pretend that soft wheat will not grind well without beans, and they generally contrive that there shall be no deficiency in the necessary proportion. This practice is well known to bakers and dealers. Bean meal mixed with water, and given to cows, increases the quantity of their milk.

2406. *The bean contains much more nutritious matter than most other vegetables.* From the analysis by Sir H. Davy, more than half its weight consists of principles fit for nutriment. Ripe beans contain, according to Einhoff, 84 per cent. of nutritive matter, of which 50 is pure farina, the rest chiefly gluten and mucilage; when young, they are tender and digestible, but when old they become tougher, and prove flatulent to some persons. They are often eaten with bacon or pork by the country people of England, with whom this is a favourite and wholesome dish, the farina of the bean correcting the oily nature of the bacon. The epidermis or skin becomes tough as the beans get old, and, containing a bitter, should be removed.

2407. *The Kidney Bean* (*Phaseolus*, Linn.).—Two species of kidney beans are cultivated in England: the dwarf kidney, usually called the *French bean*; and another, somewhat larger, called the *scarlet runner*, distinguished by the beauty of its flowers, and long cultivated for them before it was used as food. The first (*Phaseolus vulgaris*) is a native of India; and the second (*Phaseolus multiflorus*) was brought from South America in 1633, being first cultivated by Tradescant, the celebrated gardener, at Lambeth; it is the hardiest of the two. In England, the unripe pods of both, but particularly the French bean, are cooked whole in the green or unripe state. In France, where both kinds of kidney beans are cultivated extensively in the fields, the seeds are suffered to ripen, and, under the name of *haricot blancs*, form part of a great variety of dishes, and are much esteemed as very nutritious food; but the green pods used by us are not so. The scarlet runners are also with us dressed in the pods, and have the advantage of being procurable for a longer time than the French bean. They are also the sort most esteemed in France for haricots, their seeds being more farinaceous than the dwarf. (See "*Le bon Jardinier*," 1835, p. 242.) The French bean is wholesome and nutritious in a fresh state, rarely disagreeing with any one for whom vegetables are proper, and may be readily preserved for winter use or sea voyages by salting in casks. For this purpose the large-podded Dutch white runner is preferred. See Book X., "Preservation of Food."

2408. *Lentils* are not used as the food of man in England, though they are on the Continent, where they are cultivated for soups and other culinary preparations; but they are of a larger kind than ours, which are considered as the best food for pigeons.

Sect. IV.—Esculent Roots.

2409. *The roots of many plants supply food, and hence are called esculent.* Those cultivated in Britain may be divided into two groups: the *farinaceous*, as the potato and the Jerusalem artichoke, to which may be added the yam; and the *succulent*, as the turnip, carrot, parsnip, beet, radish, and a few more of less importance. This class of culinary vegetables is that on which the British people chiefly depend; and it is that which is decidedly the best suited to the climate. The potatoes and other esculent roots grown in the British islands are very far superior to those of the Continent in quality, and the quantity consumed is much more considerable.

Subsect. 1.—*The Potato* (*Solanum Tuberosum*).

2410. *The potato, a well-known tuber, popularly, though not with botanical correctness, considered as a root,* may be ranked next in importance to corn as a vegetable food. There is no doubt that it was originally brought to Europe from South America; but its early history has been involved in some obscurity, partly from their being another root very similar, the sweet potato (*Convolvulus batata*), with which it had been confounded, and from which it appears to have received its name.

2411. *The batata* was originally a Malayan plant, and was imported into England from Spain and the Canaries long before the introduction of the potato. It was esteemed a great delicacy, and made into a confection, and is still partially cultivated in Spain and the south of France. It was this that was alluded to by Shakspeare in his Merry Wives of Windsor, "Let the skye rain potatoes, and hail kissing-comfits."

2412. *The true potato is said to have been first brought into this country* from Virginia by Hackluyt in 1584, and planted by Sir Walter Raleigh on his estate at Goughall, near Cork, in Ireland, where it was cultivated to a considerable extent before its value was known in England. Gerarde, in his Herbal (1597), mentions it as "a delicate dish;" and Parkinson, in 1629, says that they were roasted, and then steeped in sack and sugar, or baked with marrow and spices. For many years afterward they were considered as inferior to the Jerusalem artichoke; and, indeed, it was not till the middle of the eighteenth century that they came into general cultivation. Even so lately as the beginning of the nineteenth century, a strong prejudice against potatoes existed in France, though now they are cultivated there to a great extent, and a market in Paris is exclusively devoted to their sale.

2413. *The question as to what is the indigenous country of the potato is now set at rest*, by its being found abundantly in the wild state in the highlands of Chili and Peru, from whence tubers were sent by Mr. Caldcleugh in 1828, and planted in the garden of the Horticultural Society. Potatoes in their wild state in America are of a very small size, and by no means of an agreeable taste. The varieties which we now find in the markets are entirely the result of cultivation.

2414. *The potato has now been introduced into almost every quarter of the globe*, and its cultivation has made the most rapid progress of late. It is the more valuable, as it grows readily in almost every climate, and its culture is extremely easy; it has also this grand advantage, that it will succeed on land which will not produce grain, and may be raised at a small expense. A given quantity of land planted with potatoes will produce as much food as twice that quantity sown with wheat.

2415. *It forms a wholesome food*, and, having no great peculiarity of taste, is relished by every palate; hence it is now a regular standing dish at every table; with many, particularly in Ireland, it serves as a substitute for bread.

The most correct opinion respecting the nutritive properties of potatoes will be obtained from the consideration of their constituent principles. They have been analyzed by various chemists: the analysis by Einhoff, which is generally received as the best, is, in 100 parts, water, 72·6; starch, 15·0; fibrous matter, 7·0; albumen, 1·4; mucilage, 4·0. Here it is essential to observe the large proportion of water, and it is only the remainder that is to be considered as farinaceous. Tartaric acid is abundant in the potato apple; and it is important to notice that the young shoots of the potato yield *Solanea*, an alkali which is, to a certain degree, poisonous.

The fibrous part appears to be a peculiar modification of starch, which, as well as that substance, may be employed for food; but it is to be noticed that there is no gluten, except the albumen may be considered as nearly the same thing. Various kinds of potatoes afford these constituents in proportions a little different; but the above may be considered as the average of the best mealy potatoes, the nutritive part being about twenty-seven per cent., of which the starch is the principal portion. No doubt can be entertained of their wholesome nature, when we consider the numerous hardy peasantry of Ireland, many of whom subsist entirely upon this useful vegetable. It must not, however, be imagined that potatoes contain the same nutritive powers as bread, weight for weight. It has been estimated, as the result of experiments, by two French chemists, MM. Percy and Vauquelin, that one pound of good bread is equal to two pounds and a half or three pounds of potatoes; that seventy-five pounds of bread and thirty of meat are equal to three hundred pounds of potatoes.

2416. *A considerable deduction must be made from the advantages of potatoes*, on account of their requiring much manure for their cultivation, together with the difficulty of transporting and preserving them in consequence of their bulkiness. The time occupied by labouring people in cooking them in the usual way is also a drawback from their usefulness. From their want of gluten, they cannot be fermented alone into bread, but they are advantageously mixed with wheat flour for this purpose.

2417. *London is well supplied with potatoes* from various parts of the country; and the varieties are so numerous, that almost every town has some sort peculiar to its vicinity, the names varying in different districts. They are distinguished as being *farinaceous* or *mealy*; *glutinous* or *watery*; or, according to the ripening, *early* and *late*. Those varieties that are mealy are most esteemed, afford the most nutriment, and are most easily digested; the waxy kinds are inferior in all these particulars. New potatoes are less mealy and less digestible than old ones.

2418. *The earliest potatoes* are cultivated by the gardeners: of the field potatoes, among the most remarkable early sorts are the *early kidney*, *nonsuch*, *early Shaw*, and *early champion*, which last is more generally grown near London. Among the best sorts of late potatoes are the *red round kidneys*, the *large kidney*, the *bread fruit*, &c. The most mealy sorts are the most nutritive, as containing the greatest quantity of starch, and they are likewise the most digestible. The kinds called waxy are said to be very improper for dyspeptic persons.

2419. *In England potatoes are most frequently brought to table boiled plain;* but in *France* they are cooked in a great variety of ways, and furnish many very agreeable dishes.

The boiling of potatoes in the best manner, which to some may appear an operation of no difficulty, requires considerable attention; and much of the goodness of this vegetable depends upon its being properly cooked. The Irish have long had the reputation of being particularly successful in this part of the culinary art. The directions given in the Farmers' Magazine, vol. v., p. 191 and 503, are as follows: "It is of consequence that they be as nearly as possible of one size; that they be well washed and cleared of earth or dirt; that they be put, with cold water, into a pan or kettle, well rinsed about, and kept there for an hour or two, which will extract the black liquor with which they are impregnated. They ought then to be put, with their skins on, not into boiling water, like greens, but into fresh cold water, with a little salt, and boiled in a kettle or saucepan, closely covered, in the most rapid manner. No more water should be put in than merely to cover them, as they produce themselves a considerable quantity of fluid. When sufficiently done, the water should be instantly poured off, and the vessel containing the cooked potatoes is to be placed on the side of the fire, with the cover off, until the steam be completely evaporated; the potatoes are thus rendered quite dry and mealy." There is some difference among cooks in England in the mode of boiling them. Some pare them when raw, like turnips; but this renders them tasteless and insipid; and some think they should be boiled slowly, and for this reason throw in occasionally a little cold water to check the boiling when too fast, which is apt to crack the outside, and let in the water before the heart is done.

2420. *Cooking them by steam* is a good method, as, should they break, to which they are very liable, they cannot imbibe such a quantity of water, and are therefore more easily obtained in the floury state, which is generally preferred.

2421. *Roasting* is another very excellent mode; and Dr. Paris considers it as the best way of preparing them for invalids. Sometimes they are parboiled, and then roasted. *Baking* is not so good a mode of cooking them. They are perhaps the only root grown in Britain which may be eaten every day without satiating the palate.

2422. *Potatoes in their raw state* contain an acrid matter, which is deleterious in some degree even to cattle.

2423. *Potatoes are employed in some other ways*, as largely in the manufacture of bread; see Book IX., "On Bread;" also for starch, see Book XXII., "Laundry."

2424. *Potato flour is, in fact, dry starch powder* procured from the potato, and is much used in Paris in fine bread and pastry: it is also sold in the shops here, but often as arrow-root, to which it is inferior. It is said that several other articles found in our shops are only potato starch, as *Bright's nutritious farina*, *Indian corn starch*, &c.; these are sufficiently wholesome and light, but not very nutritive. Potato starch is easily convertible into sugar; but this is much inferior in sweetness to that of the sugar-cane. It is clammy, and has something of a floury appearance; but, being very white, it is said to be employed by the grocers for adulterating. It is also used for distilling ardent spirits, and for the making of beer. The refuse of the potatoes, after the starch has been extracted, has been found useful in scouring woollen cloths without hurting their colour; and the water decanted from potato starch is excellent for cleaning silks with the smallest injury to the colour.

For the effects of frost on potatoes, see Book X., "On the Preservation of Food."

Potatoes have been found to be an excellent preventive of scurvy, cooked in the ordinary way, or baked under ashes.

2425. *The sweet potato* (*Convolvulus batata*) is a tuberose root common in tropical countries, but of quite a different species from the common potato. It forms a sweet, nourishing food used as potatoes. This plant had been introduced into England by Sir Francis Drake and Sir John Hawkins before the common potato; but, though it is cultivated in other parts of Europe, our climate was found to be too cold for its growth in the open air.

SUBSECT. 2.—*Jerusalem Artichoke* (*Helianthus Tuberosus*, Linn.).

2426. *Notwithstanding the name, this plant is no way allied to the artichoke*, but is of the same genus as the sunflower, and much resembles it. The term Jerusalem is a corruption of girasole, the Italian name for sunflower; and it derives the appellation of artichoke from some agreement of its taste with that of artichoke bottoms. The root, which is the part that is eaten, consists of a cluster of tubers in shape somewhat like the potato; and there are often thirty or forty together. It is a native of Brazil, having been brought to England in 1617; and, before potatoes were so generally adopted, was much in use. It was at first called the Canada potato, to distinguish it from the common potato, which was called the Virginian potato, to which it was at first greatly preferred. It is wholesome and of an agreeable taste, though it is never dry and mealy like the potato, but rather moist and soft in its texture; and, when they do not disagree, they are nutritious. They are extremely productive, and succeed in almost every soil: when once planted, being a hardy perennial, they will continue to flourish without requiring much manure or attention. They likewise form a nutritive food for horses, hogs, &c., containing much farinaceous matter.

SUBSECT. 3.—*Yam* (*Dioscorea Sativa*, Linn.).

2427. *This tuberose root is extensively cultivated in the West Indies, Africa, America,* and *the East Indies*, where it is eaten, roasted or boiled, as a substitute for bread. Its taste nearly resembles that of the potato, but it is rather sweeter, and of a firmer texture. The root is flat, and often palmated or divided somewhat like fingers, and about a foot across; a variety called the *winged yam* is three feet long, and weighs thirty pounds. It is a native of India, where it grows in the woods, and was carried to the West Indies. It is sometimes imported into this country, but rather as an article of curiosity. When fresh, it contains an acrid juice, which causes itching if applied to the skin; but, by heat, this acrid principle is wholly dissipated; and, as it contains a great deal of farinaceous matter, it forms a light, nutritious, and palatable food, either boiled or roasted. Yams are also made into puddings. In Otaheite, a favourite dish is made of them with scraped cocoanut and the pulpy fruit of the banana.

SUBSECT. 4.—*Turnip* (*Brassica Rapa*, Linn.).

2428. *Turnips grow wild in England*, but these cannot by cultivation be brought to resemble exactly the cultivated vegetable. It is said that they were brought here from Hanover. Turnips contain mucilage, little or no gluten, but a good deal of sugar, though the quantity of the latter varies exceedingly, and is not so considerable as in the carrot. The quantity of nutritious matter, upon the whole, in turnips is small; according to Sir H. Davy, only 42 parts in 1000. They are an excellent culinary vegetable, much used all over Europe, and are either eaten alone, mashed, or cooked in soups and stews. A hot climate does not seem to agree with them; and in India they and many of our garden vegetables lose their flavour, and are comparatively tasteless. The Swedish is the largest variety, but too coarse for the table; it is excellent for cattle. The green leaves of the turnip, gathered young in the spring, make good greens, well known by the name of *turnip tops*. The leaves for greens are good from any of the varieties, but are less acrid from the Swedish. Turnips grown in the field will be found of a better flavour than those produced in the garden; and the same remark applies to all the brassica tribe, with the exception of the cauliflower and broccoli, as also to potatoes and tuberous roots.

2429. *The French navet* is a variety of turnip (*Brassica napus esculenta*), but has more the shape of the carrot. It is of a very fine flavour, and is much esteemed on the Continent for soups and made dishes. Two or three of them will give as much flavour as a dozen common turnips; stewed in gravy, it forms an excellent dish. The peculiar flavour resides in the rind; consequently, this is not cut off, but only scraped. The *navet* was once grown here; at present it is seldom to be found in our gardens, though very deserving of being cultivated. It is of a yellowish-white colour, and resembles the carrot in form. It is often, on the Continent, served up with them as ornamental, on account of the contrast of colour. It is sometimes imported to the London market.

Subsect. 5.—*Carrot* (*Daucus Carota*, Linn.).

2430. *A wild carrot* grows in England in sandy soils, but it is small, white, and stringy, and of a strong flavour. Our garden carrot was introduced by the Flemish refugees who settled at Sandwich in the reign of Queen Elizabeth. This plant was so esteemed that the ladies wore the leaves as ornaments in their headdresses. At present a pretty winter ornament is made from the carrot, by placing a slice from the top of the root in a shallow vessel of water, when the young and delicate leaves shoot out, and form an elegant radiated tuft.

2431. *The carrot contains a larger proportion of sugar than any of the corn plants:* in 1000 parts they have 95 parts of sugar, and 3 of starch; this is about six times as much as is found in potatoes; hence a large quantity of spirit can be distilled from them, about half a pint from ten pounds, and they may be used instead of malt for beer. Attempts have been made to obtain the sugar in a crystallized state, but without success.

2432. *Their value in the culinary art is well known;* they are extremely useful in soups and stews. When eaten alone, they should be well boiled, and not too old, as they contain a large proportion of fibrous matter which does not digest very easily. Cattle are extremely fond of them, and they form an excellent fattening food.

2433. *M. Vilmorin of Paris has lately introduced two good varieties* of the carrot, the short yellow and the violet. The latter, which he obtained from Spain, grows to a large size, and is remarkably sweet. The carrot is cultivated by some farmers in their gardens for the purpose of colouring butter; but this is the large red variety, or field carrot. The orange carrot is the kind usually cultivated as a garden vegetable, and is of a more delicate flavour.

2434. *When a carrot is cut across*, it will be seen to consist of two parts, the outer one reddish, and the inner more yellow; the first answers to the bark of wood, and is the most pulpy and sweetest; the latter is the wood itself, and is more stringy. The greater the proportion of this external part in any variety, the more valuable it will be. The carrot may be kept in a succulent and fresh state for a long time, nothing more being necessary than to bury it in sand, and protect it from the frost.

Subsect. 6.—*Parsnip* (*Pastinaca Sativa*, Linn.).

2435. This also is a native British plant, being often found growing by the road-side; but it has not altered so much as the carrot. It is generally used with salt fish in Lent.

2436. *It contains still more sugar than the carrot*, and some persons dislike it on account of its peculiar sweet taste. Besides its use at the table, a pleasant beverage can be brewed from it with hops, as is practiced in the north of Ireland: it will also furnish an ardent spirit and wine. In Scotland, parsnips and potatoes are beat up with butter into a dish for children, who are remarkably fond of it. They are excellent fried.

2437. *The Guernsey parsnip* appears to be an improved variety: it grows there to the length of four feet, and three or four inches in diameter. When parsnips are grown in a poor soil, they lose much of the rank taste which they acquire in richer ground; and when they are roasted, as they are in the north on peat ashes, they become sweet and agreeable, and almost as farinaceous as potatoes.

Subsect. 7.—*Beet Root.*

2438. *There are two varieties of the beet commonly cultivated;* one having a large fleshy root (*B. vulgaris*, Linn.), and the other producing large succulent leaves (*B. cicla*), which we arrange among the spinaceous plants.

2439. *The common beet root* is of a fine red colour, and is originally a native of the sea-coast of the south of Europe, growing wild all along the coast of the Mediterranean. It was brought into this country, in 1656, by Tradescant. It is chiefly employed in England as a garnish for salads and other dishes, on account of the beauty of its colour, and it is also used as pickle. On the Continent it is sometimes boiled sliced, and eaten cold with oil and vinegar; when warm, boiled or baked, its taste is mawkish, and it is said to be not very wholesome if eaten in any quantity.

2440. A variety of beet root called *mangel wurzel* is a coarser kind, grows to a very large size, and is cultivated in the fields for cattle. An improved and smaller variety, which has a red skin, and when cut through is white or veined with white, is extensively employed in France for the manufacture of sugar. See "Sugar," Chap. XIII., Book VII.

From their containing so much saccharine matter, they may be made available for the production of beer or of spirits instead of malt. The French greatly esteem a sort called *castelnandin*, which is said to have the flavour of a nut.

Subsect. 8.—*Radish* (*Raphanus Sativus*, Linn.).

2441. The radish is supposed to be a native of China, but has long been cultivated here. They contain little else than water, woody fibre, and acrid matter, which resides in the external part; they cannot, therefore, be very nutritive, but they may prove a useful stimulant. There are various kinds, but they are generally divided into the turnip and spindle-rooted radish. Many are forced for the early market, and the young seedling leaves are sometimes used for small salad. The seed pods, when green, used to be pickled as a substitute for capers, and formerly the leaves were boiled as pot-herbs. The colour of radishes varies extremely; passing from white to red, and through every shade of that to a dark purple, approaching to black. Professor Burnet states that the roots when boiled and served with toast and butter, and seasoned with pepper, have much the taste of sea kale or asparagus, and form a very palatable dish.

Subsect. 9.—*Skirret* (*Sium Sisarum*, Linn.).

2442. This root is composed of several tap roots, the size of the little finger; and, though now little used, was formerly much esteemed boiled and served up with butter. Worlidge, in 1682, speaks of them as the "sweetest, whitest, and most pleasant of roots." It is a native of China.

Sect. V.—spinaceous plants.

The name of this tribe is derived from spinach, the principle plant among them.

Subsect. 1.—*Spinach* (*Spinacia Oleracea*, Linn.).

2443. *A wild spinach grows in England*, somewhat different from the garden variety, but cultivated in Lincolnshire in preference. The leaves are used as spinach, and the young shoots as asparagus. Spinach is known to have grown here at an early period; and in the monasteries on the Continent it was employed, in 1351, as we do at present.

2444. *The leaves of the garden spinach* are softer and more succulent than any of the brassica tribe. There are three principal varieties; one, the *common spinach*, having the leaves round; *another*, having long triangular leaves; the third is called *Flander's spinach*, and has remarkably large leaves; the round-leaved is procured in the spring, and the long-leaved in the winter. Spinach forms a useful ingredient in soups, and the leaves are also boiled alone and mashed as greens.

2445. *Orache*, or *mountain spinach*, is a hardy sort, much esteemed in France, that produces abundance of large leaves, and forms an excellent summer vegetable. It is a native of Tartary, introduced in 1548. There are two varieties, the white and the red: the young and tender stalks are eaten as well as the leaves.

2446. *New-Zealand spinach* (*Tetragonia expansa*) was discovered in New-Zealand by Sir Joseph Banks, who brought it to England. It is found to grow here perfectly well in the open air, and its leaves are larger and more juicy than the common spinach. It produces fine succulent leaves in the hottest weather in great luxuriance, and has the advantage of being in season when the common spinach is not.

2447. *Chenopodium Quinoa.* This variety is not only useful in its leaves for spinach, but the seeds of the yellow variety are excellent when used as millet, and it bears them abundantly.

Subsect. 2.—*White Beet* (*Beta Cicla*, Linn.).

2448. *This variety of beet is distinguished by its large succulent leaves*, which alone are eaten, and not the root, which is small. It is cultivated in gardens as a culinary vegetable, and is boiled as spinach, or put into soups. It is less known here than on the Continent, where, in many parts of Germany, France, and Switzerland, it forms one of the principal vegetables used by agricultural labourers and small occupiers of land.

2449. A large variety, known by the name of *Swiss chard*, produces numerous large succulent leaves, which have a solid rib running along the middle. The leafy part being stripped off and boiled, is used as a substitute for greens and spinach, and the ribs and stalks are dressed like asparagus or scorzonera, or sliced and stewed; they have a sweetish taste like sea kale, and are more wholesome than the cabbage tribe; but some consider them as having an earthy taste, and, upon the whole, they are not much esteemed. Cattle are very fond of the leaves, which occasion them to give much milk without affecting its taste like turnips or cabbages.

SUBSECT. 3.—*Sorrel* (*Rumen Acetosa*, Linn.).

2450. *Sorrel is much used in French*, and but little in English cookery. It grows wild in our meadows, but is sometimes cultivated in the garden. The leaves are remarkable for their acidity, and are much employed on the Continent in soups, sauces, and salads; but the French sorrel is different from ours, being round-leaved, and very superior in flavour to our common garden sorrel.

2451. *The acid juice contained in the common sorrel* just mentioned, and likewise in another variety called wood sorrel (*Oxalis acetocella*), is what chemists term an oxalate of potash, or, more strictly, a binoxalate of potash; that is, it consists of potash combined with the oxalic acid. This salt, existing ready formed in the plant, though in a state of solution in the juice, may be procured in a dry state by evaporation; and it is then popularly named *salt of sorrel*. Large quantities of it are prepared from wood sorrel in Switzerland and other neighbouring countries; sixty or seventy pounds of leaves yield about five ounces of the crystallized salt. With sugar and water the salt of sorrel forms a pleasant beverage; and in consequence of its having been substituted for lemons for purposes of this kind, it has obtained the very absurd name of *essential salt of lemons*, though having nothing to do with the lemon. But it is proper to state that one of the component parts of this salt, namely, the oxalic acid, is a deadly poison; and that, although the oxalate of potash is not so dangerous, it is by no means safe to use it in any quantity, and therefore very improper to employ it in any way in drink, though it has been ignorantly recommended to make a refreshing beverage in febrile diseases, or as imparting flavour to punch. If the result has not proved fatal, is has probably been because the quantity taken was small.

2452. *The most useful property possessed by the salt of sorrel* is that of taking out spots of ink or iron moulds from linen: it is also used by the cook in flavouring, instead of the leaves.

The process by which the salt of sorrel is obtained is very simple. The expressed juice of the leaves, being diluted with water, is suffered to remain at rest for a few days until the feculent parts have subsided; or, if greater despatch be necessary, it is clarified with the whites of eggs. When the liquor is sufficiently clear, it is drawn off and evaporated by boiling, until a pellicle appears on the surface. It is then set in a cool place to crystallize. When the first crop of crystals has been obtained, the liquor which remains is again evaporated and crystallized; and so the process continues until no more of the salt can be separated.

In the late Professor Burnett's Botany it is stated that, since Scheele discovered that oxalic acid may be formed by acting on sugar with nitric acid, his process, being far the most economical, has in general superseded its extraction from the plant.

SUBSECT. 4.—*Patience Dock* (*Rumen Patientia*, Linn.).

2453. This is called by the Germans winter spinach, and is a hardy perennial plant, the leaves of which may be cut several times in a season. It was formerly much used mixed with sorrel, but is now neglected.

SECT. VI.—ALLIACEOUS PLANTS.

2454. *This tribe*, which takes its name from *allium*, the onion, is distinguished by their bulbous roots, and the high pungent flavour of their bulbs and leaves. They consist of the onion, leek, chive, garlic, and shallot. These plants are, perhaps, more generally diffused all over the world as an article of food than any other; and, from the Indus to the northern tribes of Asia, they were always held in high estimation.

SUBSECT. 1.—*Onion* (*Allium Cepa*, Linn.).

2455. The onion was cultivated in very remote times, having been known to the ancient Egyptians, who worshipped it under some mystic signification 2000 years before the Christian era. It forms a favourite food in Egypt, and in various other parts of Africa, where it is distinguished by its delicate flavour. It is not known when onions were first introduced into England, but they have been long used, and esteemed chiefly as a seasoning for various dishes.

2456. The onion contains much nutritive mucilage. It is much more succulent, and of a milder flavour in warm climates than with us. Those imported from Spain and Portugal are large and mild, and those from Strasburgh are much esteemed. These varieties, when planted in England, degenerate, and become smaller and more pungent. Onions are wholesome employed in any way; they are eaten raw by labouring people, and in this state are strongly stimulant. When young they are sometimes introduced into salads. The large mild kinds, called Spanish onions, are often boiled or roasted, and are considered as an agreeable and nutritive food. They become much more succulent, and their peculiar smell and taste are nearly destroyed, after having undergone culinary preparation. They form one of the most essential productions of the kitchen garden; but the odour which they communicate to the breath is a great objection to their use in the raw state: the best way of removing it is by chewing a little raw parsley.

2457. *The potato onion* is a curious variety, multiplying by numerous bulbs, like the potato.

2458. *The Ciboule*, or *Welsh onion*, never forms any bulb at bottom, and is only cultivated to be drawn as young green onions for salad in the spring: its taste is, however, stronger than the garden onion. It is very hardy, surviving the severest winter, in which, though their blades be cut off, the roots remain sound, and shoot out vigorously in the spring.

2459. *The onion has been analyzed* by Fourcroy and Vauquelin, and found to contain water, sulphur, phosphoric and acetic acids, some vegeto-animal matter, and a little manna; to the latter is owing the sweetish taste observable in onions, particularly in pickled onions, when the acrimony has been extracted by the vinegar.

Subsect. 2.—*Leek* (*Allium Porrum*, Linn.).

2460. The leek is supposed to be a native of Switzerland. Shakspeare, in Henry V., mentions it as the badge of the Welsh before his time, and derives the origin of this from the battle of Cressy. Its hardiness and pungency have recommended it in cold mountainous districts, and it was an ingredient in two very old Scotch dishes, "Cock a leekie," a great favourite with James I.; and in the famed "Haggies." The leeks which are cultivated in the colder parts of the Highlands of Scotland, and in Wales, are more pungent than those of England. Worlidge observes of Wales, "I have seen the greater part of a garden there stored with leeks, and part of the remainder with onions and garlic." Tradition says it was introduced into that country by St. David.

2461. Many prefer its flavour to that of the onion in broth; and, as it stands the winter, it is a very useful pot-herb. Leek porridge is a very ancient dish. The whole plant is used in soups and stews, but the blanched stem is most esteemed; these are very good boiled, and served up on toasted bread and white sauce. Notwithstanding its unpleasant odour, it is very wholesome, but requires to be well boiled, that it may not taint the breath.

Subsect. 3.—*Chive* (*Allium Schœnoprasum*, Linn.).

2462. This is the smallest of the onion kind, rising but a few inches high: it is a native of Britain, and is found occasionally in our pastures. Its taste much resembles that of the onion, but is milder. The bulbs are extremely small, and in clusters. Both these and the leaves are employed as a pot-herb, and as they are very hardy and easily cultivated, they would be very useful in the garden of the cottager, were he accustomed to live more upon broths. The leaves rise early in the spring, and are sometimes employed in spring salads, and also in omelets and soups.

Subsect. 4.—*Garlic* (*Alium Sativum*, Linn.).

2463. This gives its name to the alliaceous tribe; it possesses the most acrimonious taste of the whole, and a smell that is considered by most persons offensive. It grows naturally in Sicily, the South of France, and other countries bordering on the Mediterranean; it was introduced into England in 1548. It is extensively used as a seasoning herb on the Continent, particularly in Italy, and was more relished by our ancestors than in our times. The root, which is the part made use of, consists of a group of several bulbs called *cloves of garlic*, enclosed in a common membranous skin. In foreign cookery it is seldom employed in substance, but introduced for a short time only into the dish that is cooking, and withdrawn when it has communicated a sufficient flavour. At present the French use it much, and consider it essential to many dishes.

Subsect. 5.—*Shallot* (*Allium Ascalonicum*, Linn.).

2464. This was originally found growing wild near Ascalon in Palestine, whence its botanical appellation, and is supposed to have been brought to England by the Crusaders. It is a bulbous root, resembling the garlic in being divided into several cloves enclosed in a skin. The leaves wither in July, when the roots are full-grown: the latter are taken up in autumn, and are dried and housed for use: they will keep till the spring. Its flavour is more pungent than that of the garlic, but more agreeable. It is employed in soups and made dishes, also in sauces and pickles; and it forms a favourite accompaniment to steaks and chops. It was called by old authors the *barren onion*, from the circumstance of its scarcely ever sending up a flower stalk.

Subsect. 6.—*Rosambole* (*Allium Scorodoprasum*, Linn.).

2465. This bulbous root has a flavour between that of the shallot and garlic, and, like them, is divided into cloves: its uses are also similar. It is a native of Denmark, but is cultivated here occasionally.

Sect. VII.—Asparaginous Plants.

2466. *The name of this division is derived* from the practice of the ancients, who called all young sprouts of vegetables by the term asparagus, although this name is now confined to a particular species. This class comprehends *asparagus*, *sea kale*, *artichoke*, *cardoon*, *rampion*, and *alisander*. In all of them it is only a small portion of the vegetable that is eaten, and that most generally in a young and undeveloped state; they belong to the class of luxuries rather than of necessary food, and they are brought to perfection only by great care and attention on the part of the gardener, and at a considerable expense in preparing the ground. In their wild state they are chiefly seashore plants unfit for human food.

SUBSECT. 1.—*Asparagus* (*Asparagus Officinalis*, Linn.).

2467. *Asparagus*, often, in London, vulgarly and absurdly called *sparrow grass*, is a vegetable highly esteemed and largely cultivated in the garden for the London market. It has been so much improved by cultivation that the original plant from which it has been derived could not be recognised except by the botanist.

2468. Wild asparagus is a very small vegetable that grows in poor sandy soils both in North and South Britain, on the seashore, but is not very common. In the saline and sandy steppes of Russia and Poland it is abundant, and is fed on by horses and cattle. The Romans had asparagus of very large size, and it was cultivated with great success in Holland, but it is now grown in greater quantities in the environs of London than anywhere else in the world; at Deptford and Mortlake there are hundreds of acres planted with this vegetable.

2469. The part which is eaten is the young shoot, as far as the flower not yet developed. Asparagus is a light, digestible food, but not particularly nutritious. The tops of the shoots are not blanched in this country, but in Spain the whole is blanched by placing pieces of cane over it.

SUBSECT. 2.—*Sea-kale* (*Crambe Maritima*, Linn.).

2470. *This plant is so named* from its growing naturally *on our seashores*, particularly in the West of England, and near Dublin. The young spring shoots just as they begin to appear, and the stalks of the unfolded leaves, then blanched and tender, are the parts that are cut off and boiled for use. Though collected by the peasants, and eaten as a pot-herb time out of mind, and even cultivated in the garden, yet it appears that it was Dr. Letsom, in 1767, who first gave it a good character, and that it did not come into high repute until 1794. It is now in very general use, and, within the last ten or fifteen years, has become a very common and cheap vegetable. It is one of the most valuable esculents indigenous to Britain.

2471. *It is dressed and eaten in the manner of asparagus*, and the shoots are usually blanched; but it requires to be very well boiled, as it is naturally hard. It is easily cultivated, and forced in the winter season; and it is a great luxury at table, since in that season many vegetables are difficult to be procured. It might be produced in many places on the seashore, where no other edible vegetable would grow, seeming to prefer a poor sandy soil. The flowers form a favourite resort for bees.

SUBSECT. 3.—*Artichoke* (*Cynara Scolymus*, Linn.).

2472. *Like the sea kale, the artichoke is a maritime plant*, and succeeds best when manured with sea-weeds. It was probably brought from the Mediterranean and cultivated in England about 1580. The part which is eaten is the flower head in an immature state; what is called the *artichoke bottom* is the fleshy receptacle, which is surrounded by the bristles and seed down, vulgarly called the *choke*, and by also a soft substance on the lower part of the leaves of the calyx. In England artichokes are boiled plain and eaten with melted butter and pepper; the bottoms are also stewed in milk; occasionally they are pickled. The French fry them and use them in ragouts; or thin slices of the bottoms are cut off, each having a leaf attached, by which it is lifted and eaten raw, as salad. The flowers may be used for coagulating milk. The shoots and young leaves are sometimes blanched by earthing, and eaten as chard. Artichokes may be dried and preserved for use.

SUBSECT. 4.—*Cardoon* (*Cynara Cardunculus*, Linn.).

2473. This plant is a native of Candia, and was brought into England a century after the artichoke. It much resembles the artichoke, but grows higher. It is esteemed on the Continent, but is little used in England; the stalks and ribs of the inner leaves are employed in soups and ragouts. The Spanish cardoon is the best.

SUBSECT. 5.—*Rampion* (*Campanula Rapunculus*, Linn.).

2474. This is a native of England, but not common. The root, which is the part that is eaten, is long, white, and spindle-shaped; it is eaten raw like a radish, and has a pleasant nutty flavour; both it and the leaves are sometimes used in winter salad.

SUBSECT. 6.—*Prussian Asparagus* (*Ornithogalum Pyrenaicum*).

2475. A plant is sold under this name in Bath, and the south and west of England, as a substitute for asparagus. The part which is eaten are the flower stalks before the buds are expanded. They are served up in the same way as asparagus, and are tolerably good, but rather insipid.

2476. *Hop Tops.*—The young shoots of the hop, when they have risen two or three inches, are also employed sometimes as a substitute for asparagus. In Belgium they are blanched; and they are very strongly recommended as an admirable ingredient in a variety of dishes, such as soups, omelets, &c., by an experienced cook from Sardinia, who mentions them in the "Gardener's Magazine."

Subsect. 7.—*Alisander* (*Smyrnium Olusatrum*, Linn.).

2477. This plant also grows naturally near the sea, and somewhat resembles celery in taste The leaves are of a pale green; when blanched, the leaf stalks were formerly much used as a pot-herb and in salad, but it is nearly out of use.

Subsect. 8.—*Bladder Campion* (*Silene Inflata*).

2478. The young shoots of this, when boiled, are an agreeable flavoured vegetable, and are boiled like asparagus.

Sect. VIII.—acetarious vegetables.

2479. *By the term acetaria*, or *acetarious vegetables*, *is expressed* a numerous class of plants of various culture and habits, which are chiefly employed as *salads*, *pickles*, and other *condiments*. They are to be considered rather as articles of comparative luxury than as ordinary food, and are more desirable for their coolness or their agreeable flavour than for their nutritive powers.

2480. *Salads consist* of raw vegetables, of which lettuce is the most generally used with us; but several others are occasionally employed, as celery, cresses, onions, beetroot, &c. As raw vegetables are liable to ferment in the stomach, and as they give but little stimulus to that organ, they are generally dressed with some condiments, as vinegar, pepper, mustard, salt, and oil. Considerable difference of opinion exists among medical men respecting the use of these, and particularly oil, some condemning, others approving it.

Subsect. 1.—*Lettuce* (*Lactuca Sativa*, Linn.).

2481. *The botanical name of the lettuce, Lactuca, is derived* from the milky juice that exudes from its stalks when it is cut. This juice, when the plants are young, is of a mild and pleasant bitter, containing a small quantity of the narcotic principle; but this, in the old stems and foliage, and more especially in those plants which are fully exposed to the sun, becomes extremely bitter and notably sedative. A medicine (*extract of lettuce*) is extracted from it, which is said to have the good without the bad effects of opium. In the strongly-scented wild lettuce, which is uneatable, this is very abundant: the plant is cultivated in Forfarshire for this purpose.

2482. *The lettuce* came originally from the Grecian Archipelago, and the name of one kind, the *cos lettuce*, reminds one of the island of the same name. The soporific qualities of the lettuce were very early known, and a lettuce supper has been thought very conducive to repose.

2483. *There are two principal varieties, the cabbage* and the *cos* lettuce, the latter often vulgarly and improperly called *gauze* lettuce. The first is the earliest in season; the leaves are roundish, and the head flat, and close to the ground. The cos lettuce is more upright, and the head is of an oblong form. When very young, the leaves of both are open, and then the cabbage lettuce is preferred; but both have compact round heads when mature, the inner leaves being white, and then the cos lettuce has the finest flavour, and is most employed for salads, the cabbage lettuce being more used for soups. Blanching them prevents, in a great measure, the formation of the bitter acrid and narcotic principle, and renders them more wholesome.

Lettuces may be considered as a cooling summer vegetable, and useful rather as correcting or diluting animal food than as containing much nutriment of itself. It is generally eaten with some condiments, as vinegar, mustard, oil, &c.

Subsect. 2.—*Endive* (*Chicorium Endivia*, Linn.).

2484. The history of this plant is little known. It is supposed to have come originally from China and Japan, and to have been introduced into England about 1548. It is remarkable for its elegant leaves, which are much divided at the edges. When suffered to remain green by exposure to the light, they are harsh and bitter, but by tying them up with bass, and keeping them well earthed, they become blanched and succulent, and lose the greater part of their bitterness, retaining only enough to be agreeable. It is grown in abundance in the neighbourhood of London, and is much used as a winter salad, and likewise in soups and stews. The French consume a great quantity of it, raw in salads, boiled in ragouts, fried with roast meat, and as a pickle: they esteem it a wholesome esculent. By judicious culture it may be obtained through the winter, when other salads are not easily procured.

2485. *Chicory*, or *Succory*, called also *wild endive* (*Chicorium Intybus*, Linn.), is a native of this country, growing wild by the road-side; and, though little regarded here, it is much cultivated on the Continent. Its leaves, in the natural state, are bitter; but by steeping them some hours in water this bitterness is removed, and still more when blanched. They are used as endive in the Netherlands, and particularly the blanched leaves are sold in the markets as an early spring salad. The roots are scraped and boiled, and eaten with sauce and potatoes.

As chickory is very hardy, easily cultivated, and grows upon very poor land where scarcely anything will thrive, chiefly dry calcareous soils, its cultivation has been strongly recommended by Arthur Young and other writers on agriculture, as a food for cattle.

2486. *Mr. Loudon states that* an acre of chicory might be easily grown upon cheap land five or ten miles distant from the place of consumption. The roots may be brought together early in the autumn, and planted and packed close together in a few hundred feet of garden ground to defend them from the frost of winter; then, by laying on some earth and manure early in the spring, the leaves will push into it in a blanched state, and form a very crimp and early salad, the new leaves being derived from the stock of sap elaborated in the preceding year. The adoption of this plan of cultivating chicory may be recommended to many great towns in the north of England, where anything in the shape of a salad is rarely seen until the end of April, and then only tough green lettuces, far more bitter than this invitingly white chicory. Its growth is so rapid that it may be cut three or four times every year.

2487. Its roots may be laid up in a warm cellar, and, if kept from the frost, it will then soon send out a crop of blanched leaves, from which a salad may be obtained in the winter. This property is also taken advantage of on shipboard; the roots are put into a cask with sand, having the sides pierced with numerous holes (or a hamper will do), and the leaves make their way through the holes; this method of forcing is carried on extensively in France.

2488. But there is another use to which the roots of this plant have been applied. Dried and ground, they are employed to a great extent in Holland and Flanders, and likewise in France, as a substitute for coffee. See Chap. XI., Book VIII., "Coffee."

Subsect. 3.—*Celery* (*Apium Graviolens*, Linn.).

2489. Celery is also a native of Britain: the wild plant is known by the name of *smallage*, and grows on the side of ditches, and in the neighbourhood of the sea; but although it resembles the cultivated plant considerably, it has a rank, acrid, and disagreeable taste, and is even narcotic and unsafe; yet it has been converted by cultivation into the mild aromatic flavour of the garden celery.

2490. *The blanched foot-stalks of the leaves* are eaten raw, and great care is taken to have them in perfection on the table. The blanching of celery is a striking instance of the effect of the want of light in vegetation. All the colouring matter in plants is developed or assisted in its formation by the sun's rays; heat alone will not produce the same effect: it is light that causes the colour, and hence plants that grow in a dark place are always white: it may be observed that the part of the stem of all plants just below the surface of the ground is white, and that the green does not commence till above the surface. To procure the stalks of the celery as white as possible, they are kept almost entirely covered with earth while growing, and only the tops of the leaves suffered to appear above ground. This management also increases their crispness, and renders them milder flavoured. In Germany celery is boiled and served up as a dish, and the Italians use the green leaves in soup. With us the flavour of celery is employed in the culinary art; and when it is required, and neither the leaves nor stems can be had, the seeds bruised are sometimes employed as a substitute. In the neighbourhood of Manchester celery is grown of an enormous size.

2491. *Celeriac* is a variety of celery having the root of a turnip form, the only part that is eaten. It is much esteemed in Germany and other parts of the Continent, where they boil and eat it when cold, sliced with oil and vinegar as a salad, or employ it in various dishes. It is occasionally imported from Hamburgh, but is little cultivated in England, though very hardy.

2492. *Corn salad*, or *lamb lettuce*, (*Felix olitoria*, Willd.). This is a diminutive annual, common in cornfields and sandy soils. It is occasionally cultivated in gardens, rising to the height of a foot, and is used as a salad. It has long been a favourite plant in France.

Sect. IX.—small salad herbs.

2493. There are certain herbs which are used chiefly in the seed leaf, or when extremely young, for the purpose of procuring salads throughout the year, or at times and in situations where no other can be had. Some of these are also mixed with the larger salad plants to improve their flavours or wholesome qualities. The sorts mostly in use in this country are mustard, cresses, rape, turnip, radish, white cabbage, cabbage lettuce, &c. Some of these may be had at all times of the year, and are cut when not more than a week or ten days old. Being mostly of a warm relish, if suffered to grow too large, so as to run into the rough leaf, they become of a disagreeably strong, hot taste.

SUBSECT. 1.—*Mustard* (*Sinapis*, Linn.).

2494. *There are two varieties of mustard*, the black and the white, both natives of this country, and occasionally growing wild in the cornfields. The black is rather a larger plant than the white, and the leaves darker. The seeds of both, but chiefly the former, are ground to produce the well-known condiment, flour of mustard. It is principally cultivated in Durham.

2495. *Mustard contains* a mild fixed oil of a greenish yellow colour, procured by pressure. The mustard cake, after the expression of the bland oil, when distilled with water, yields an acrid, volatile oil, the principles of which reside in the seeds, but cannot be developed without the aid of water. The pungency of the mustard, when used as food, is developed from the action of the emulsion on a peculiar principle in the same manner as the hydrocyanic acid is developed by the action of water on the bitter almond.

2496. *Mustard is one of the best stimulants* employed to give energy to the digestive organs. It was in high favour with our forefathers. In the "Northumberland Household Book for 1512," p. 18, is an order for an annual supply of 160 gallons of mustard.

2497. *Mustard, in its present form, was not known at our tables previously to* 1729. At that time the seed was only coarsely pounded in a mortar, as coarsely separated from the integuments or skins, and in that rough state made up for use; sometimes it was brought to table whole, or boiled in vinegar. It then occurred to an old woman, of the name of Clements, resident at Durham, to grind the seed in a mill, and to pass the meal through the several processes which are resorted to in making flour from wheat. The secret she kept for many years to herself, and, in the period of her exclusive possession of it, supplied the principal parts of the kingdom, and, in particular, the metropolis, with this article. George I. stamped it with fashion by his approval. Mrs. Clements twice a year travelled to London, and to the principal towns throughout England, for orders, as regularly as any tradesman's rider of the present day; and the old lady contrived to pick up, not only a decent pittance, but what was then thought a tolerable competence. From this woman's residing at Durham, it acquired the name of Durham mustard.

2498. *Mustard is remarkable for the rapidity of its growth*, and, on this account, is frequently sown in the ground as a small salad, together with cress. The seeds strewed on wet flannel, and placed in a warm situation, even by the fireside, frequently shoot out their seed leaves in a day or two—sometimes even in a few hours—a circumstance which is frequently taken advantage of in long voyages. Ships going to the East Indies have boxes with earth placed on the deck, wherein they sow mustard and cress for the purpose of getting salad on the voyage; and the number of crops thus raised is surprising.

SUBSECT. 2.—*Garden Cress* (*Lapidium Sativum*, Linn.).

2499. This elegant small plant is not found wild in England, and is supposed to have been brought from Persia or Cyprus, about 1548. It is considered as the principal of the small salad herbs, and is much cultivated for this purpose, having a very warm, but agreeable aromatic flavour. By the assistance of a little artificial heat, it may be had fresh throughout the winter.

2500. *American cress* (*Barbarea præcox*).—This variety grows wild in Britain in moist or watery ground. It is aromatic and pungent, but rather bitter. It is sometimes cultivated for winter and early spring salad. It is also called *French cress*.

2501. *Winter cress* (*Barbarea vulgaris*).—This also is found wild in Britain in watery places and slow-running streams. In flavour and use it much resembles the last

SUBSECT. 3.—*Water-cress* (*Nasturtium Officinale*, Linn.).

2502. Water-cress has long been a favourite vegetable, and is found abundantly on the edges of running streams, preferring clean water to that which is muddy. It should be carefully distinguished from the water parsnip (*Sium nodiflorum*, Linn.), which is poisonous, and is often found growing with it.

2503. *The demand for water-cresses in London*, as an adjunct at the breakfast table, has been so great, that, since 1808, they have been cultivated extensively in various places; as at Springhead Valley, near Gravesend, West Hyde, near Rickmansworth, Hackney, Uxbridge, &c. On a gravelly or chalky bottom, shallow excavations are made, into which running water is introduced about a foot deep, and the cress is planted in regular rows, so that a constant succession of young and healthy green shoots, in great perfection, are provided for the market. It is supposed to possess antiscorbutic properties.

SUBSECT. 4.—*Burnet* (*Poterium Sanguisorba*, Linn.).

2504. This hardy perennial plant is indigenous in Britain, found in dry, upland, calcareous soils, and occasionally cultivated in gardens. The leaves are used in salads, put into soups, and form a favourite ingredient in cool tankards. When slightly bruised, they smell ike cucumber, and they have a somewhat warm taste. They continue green through the winter, but are now little in use.

SUBSECT. 5.—*Rape* (*Brassica Rapus*, Linn.)

2505. Rape, a native of Britain, is sometimes cultivated in gardens, the seed leaves being employed for salad, as mustard and cress. It is warm and aromatic. But the chief value of this plant is in the oil that is expressed abundantly from its seeds by a mill.

Sect. X.—Pot-herbs, or seasoning herbs.

2506. This title includes those vegetables which are not used alone as food, but are employed as additions to soups, stews, and various dishes, to increase their nutritious qualities, or to give them flavour. Many of them would prove actual poisons if eaten in quantity; but they owe their useful properties to their stimulating nature and powerful flavour, by which they render many kinds of food palatable that would otherwise be insipid: some are used medicinally. They are of very ancient use, and are to be found in every garden, from that of the mansion to that of the cottage.

Subsect. 1.—*Parsley* (*Apium Petroselinum*, Linn.).

2507. This herb, of extensive use in the culinary art, was known to the ancient Greeks, but the time of its introduction into Britain is not ascertained. Though not indigenous, it is so common, and so frequently sows itself, as to be frequently taken for a native.

2508. *There are several varieties:* 1. The *plain-leaved*, not much cultivated, though the only one used formerly. It is now nearly banished from the garden, because the curled varieties are much more elegant; but there is another reason for its being laid aside—its great resemblance to a poisonous British weed, the *fool's parsley*, or *lesser hemlock* (*Æthusa cynapium*). The leaves of the latter are of a darker green, and, when bruised, have a very disagreeable smell, quite different from that of the common parsley. When in flower, the fool's parsley is easily distinguished by what is called its beard, that is, by the three long pendant leaves of its involucrum. 2. The *curled-leaf parsley*, which may be safely used, being quite unlike the hemlock; it is the best, both for its flavour and appearance on the dish as a garnish. Sheep, hares, and rabbits are extremely fond of this herb, and it is said to impart to their flesh a fine flavour. It is useful to *know* that parsley is poison to parrots.

Naples parsley, or *celery parsley*, is a variety between parsley and celery, and is used as the latter.

Hamburgh parsley is a variety cultivated for the roots, which grow to the size of small parsnips; these boil exceedingly tender and palatable, are very wholesome, and may be used in soup or broth, or to eat with meat like carrots or parsnips.

2509. *Purslane* (*Portaluca oleracea*, Linn.).—This plant is a native of South America. The young shoots and succulent leaves were more used formerly than at present as a cooling ingredient in spring salads.

Subsect. 2.—*Tarragon* (*Artemisia Dracunculus*, Linn.).

2510. This herb, of a fragrant smell and aromatic taste, is used in France, on account of its pungency, to correct the coldness of salad herbs; an infusion in vinegar makes a good fish sauce, and it is also an ingredient in pickles, and in soups and other dishes particularly in French cookery. It is said to be originally a native of Siberia.

Subsect. 3.—*Fennel* (*Anethum Fœniculum*, Linn.).

2511. Fennel grows wild with us in chalky soils, particularly at Feversham, but has been long cultivated in the garden. The leaves, from their elegance, are often used as a garnish or ornament to various dishes. They are boiled in soups and fish sauces, and some use them as salads. They have too powerful taste in their natural state to be used, except as a flavouring ingredient. The French use it frequently in fish soups; but the Italians, by blanching the plant in their warm climate, where it grows rapidly and to a large size, obtain it in a state very like celery, with a strong thick stalk: the strong taste is then destroyed, and they eat it with oil, pepper, and vinegar

Subsect. 4.—*Dill* (*Anethum Graveolens*, Linn.).

2512. This plant resembles fennel considerably, but is smaller. It is used in pickles, particularly with cucumbers, and sometimes in soups and sauces, but chiefly for medicinal purposes. It is a native of Spain.

Subsect. 5.—*Horseradish* (*Cochlearia Armoracea*, Linn.).

2513. This well-known accompaniment of roast beef is a native of England, and a hardy plant, growing wild in wet ground, but it has been long cultivated in gardens also. It is occasionally used in sauces, and in winter salads. Its acrid taste depends upon an essential oil of great pungency, which may be obtained by mashing and distilling with water

2514. *The oil of horseradish*, which is frequently procured in Sweden, is extremely volatile, quickly evaporates, and fills the room with the peculiar flavour of the plant. On account of the great volatility of its oil, horseradish, when dried, loses its flavour, and becomes unfit for the purpose to which it is applied: hence it should never be preserved by drying, but by keeping moist and cold through burying in sand; and for this reason it is that, when scraped for the table, it almost immediately spoils by exposure to the air, the volatile oil evaporating.

SUBSECT. 6.—*Nasturtium* (*Tropæolum*, Linn.).

2515. This elegant plant, called sometimes *Indian cress*, is a native of Peru, but grows very well with us. Its young leaves and flowers being of a warm nature, are sometimes used in salads, as the cress; its fine yellow flowers are employed to garnish dishes; and its seeds, when pickled, form a good substitute for capers.

SUBSECT. 7.—*Chervil* (*Scandix Cerepolium*, Linn.)

2516. Chervil is a native of various parts of the Continent of Europe, and is sometimes observed naturalized in our gardens. The tender leaves are used in salads, and the curled variety for garnishing. There is a kind cultivated in the gardens of Paris (*Cerfeuil frisé*) with beautifully frizzled leaves. The roots are poisonous.

SUBSECT. 8.—*Pot-marigold* (*Calendula Officinalis*, Linn.).

2517. This is a native of France and Spain, and naturalized here since 1573. The flowers were formerly much used in broths and soups, and the plant is still frequently to be met with in cottage gardens.

SECT. XI.—SWEET HERBS.

2518. *Of sweet herbs some are cultivated for culinary purposes, and others for the perfumer and druggist.* Much of the natural fragrance of the fields is owing to the aroma of this class of plants, the *Labiatæ;* and many of them yield an aromatic essential oil by distillation. The most useful of this class are thyme, sage, mint, marjoram, savory, basil, rosemary, lavender, tansy, and balm. It is said that mint, and many other plants which yield an essential oil, afford it of a more penetrating odour in England than in the south of Europe, and that all strong-smelling plants lose their odour in a sandy soil.

SUBSECT. 1.—*Thyme* (*Thymus*, Linn.).

2519. We have two species of wild thyme in Britain, which differ from the common thyme cultivated in our gardens for culinary purposes.

Garden thyme (*Thymus vulgaris*, Linn.) is a native of the south of Europe; it is a shrubby evergreen about a foot in height, and is more delicate in its aromatic flavour than wild thyme; its young leaves and tops are used in stuffings, soups, and sauces.

Another smaller species, *lemon thyme* (*T. citriodorus*, Linn.), has a strong perfume, like the rind of lemons, and is used for some particular dishes.

A variety called *Frankincense thyme* is cultivated in Norfolk. Thyme was used by the Romans to flavour cheese.

SUBSECT. 2.—*Sage* (*Salvia Officinalis*, Linn.).

2520. Sage is originally a native of the south of Europe, but has been long an inhabitant of our gardens. There are several sorts, as the red, the green, the small-leaved, and the broad-leaved balsamic. Its chief use in cookery is in stuffings and sauces, to correct the too great lusciousness of strong meats, as goose, duck, or pork; its taste is warm, bitterish, and aromatic, qualities which depend upon an essential oil. The red has the most agreeable and fullest flavour for this purpose; the green is the next; the last two are used in medicine. Sage had great reputation formerly on account of its medicinal qualities; but at present these do not appear to be much regarded. It possesses, however, some aromatic and astringent powers; and a decoction, or sage tea, is found serviceable in debility of the stomach, and in nervous cases. The Chinese sometimes prefer it, it is said, to their own tea. It is useful as a gargle in sore throat, and it is grateful and cooling. The broad-leaved balsamic species is the most efficacious for its medical qualities, and as a tea herb. It is also introduced into cheese.

SUBSECT. 3.—*Mint* (*Mentha*, Linn.).

2521. *There are several species of mint* that grow wild in Britain, found chiefly in low, moist situations, and they are likewise cultivated. They are all distinguished by a well-known and peculiar aromatic flavour, and some are employed in culinary preparations; others yield a highly odoriferous and pungent essential oil by distillation. None of them are in the least poisonous; but they are very different both in appearance and their uses.

Spearmint (*Mentha viridis*, Linn.).—This is the common mint cultivated in our gardens, and employed in different processes of cookery, as having the most agreeable flavour; the leaves are sometimes boiled in certain dishes, and afterward withdrawn. They likewise form an ingredient in soups, and are sometimes used in spring salads. They are also dried for the winter, and in this manner lose none of their flavour. Mint is stomachic and antispasmodic, and is useful in flatulencies; these qualities probably led, independently of its agreeable flavour, to its universal use in pea soup, in which it is a valuable ingredient.

Peppermint (*M. piperita*, Linn.).—This is cultivated entirely for the essential oil distilled from it. Its taste is stronger, warmer, and more pungent than spearmint, and leaves a sort of coolness on the tongue after tasting it. It yields a little camphor, to which its taste is partly owing, and its medicinal uses are well known

Pennyroyal mint (*M. pulegium*, Linn.), has a warm, pungent flavour, but less agreea ble than common mint. It is employed in some particular dishes in cookery, and formerly chiefly for medical purposes, but is now little used.

SUBSECT. 4.—*Marjoram* (*Origanum*, Linn.).

2522. *There are several species of marjoram*, but that which is preferred for cookery, and which is cultivated in our gardens for this purpose, is the *sweet marjoram* (*O. marjorana*, Linn.), also called knotted marjoram. It is a native of Portugal, and the seeds seldom ripen here; they are brought from France. The leaves are dried as a seasoning herb, having an agreeable aromatic flavour. There is also a *winter sweet marjoram* (*O. Heracleoticum*, Linn.), a native of Greece, used for the same purposes. *Pot marjoram* (*O. onites*, Linn.) is another variety originally brought from Sicily, which does not ripen its seeds here. *Common* or *wild marjoram* (*O. vulgare*, Linn.) is found growing in our fields, chiefly among copse-wood on calcareous soils. This has nearly the same flavour, but is inferior, and is only used when the others are not at hand. All these are favourite ingredients in soups, stuffings, &c.

SUBSECT. 5.—*Savory* (*Satureja*, Linn.).

2523. Of this aromatic herb there are two varieties, the summer and winter savory, from the time of year when they may be gathered. They are natives of Italy, but are cultivated in our gardens for the use of the cook. The leaves are gathered and dried.

SUBSECT. 6.—*Basil* (*Ocymum*, Linn.).

2524. This plant is highly aromatic, its odour resembling that of cloves. There are two principal varieties, the *sweet* or *larger basil* (*O. basilicum*, Linn.), and the *bush* or *least basil* (*O. minimum*, Linn.), both natives of the East Indies. Though little employed in English cookery, they are favourite herbs with French cooks, on account of their flavour in highly seasoned dishes, and the leaves are used in small quantities in soups and salads. The Chinese, also, are said to flavour their dishes with basil.

2525. *Clary* (*Salvia selaria*, Linn.).—This is a native of Italy. Its leaves are sometimes used in soups, though some dislike its odour. A medicinal wine is made from its flowers.

SUBSECT. 7.—*Rosemary* (*Rosmarinus Officinalis*, Linn.).

2526. This is also a highly aromatic plant, a native of the south of Europe, and derives its name from its beautiful appearance when glittering with dew on the seashore. Its leaves have a fine aromatic fragrance like camphor, of which, indeed, its oil contains one fourth. From an old opinion that rosemary had the property of strengthening the memory, this plant has been made an emblem of remembrance or fidelity; which probably led to the custom in some parts of the west of England and Wales of wearing branches of it at weddings and funerals. Infusions of the leaves are put into some drinks; but its chief use is in the flowers giving their fragrance to Hungary water, used as a cosmetic. It also enters into the composition of Eau de Cologne, and four-thieves-vinegar.

SUBSECT. 8.—*Lavender* (*Lavandula Spica*, Linn.).

2527. Lavender is a highly odoriferous plant, scarcely used in cookery, but is extremely valuable on account of its agreeable perfume. The leaves and flowers are both aromatic, and when dried they are put among linen. From their flowers the well-known perfume, lavender water, is prepared. The ancients employed this plant to aromatize their baths, and to give a sweet scent to water in which they washed; hence their generic name, *Lavandula*. It grows spontaneously in the south of Europe, and has been cultivated in England since 1568: a great deal is grown near London, and sold to the druggists, perfumers, and distillers. The essential oil, when procured pure, is sometimes called *oil of spike*. Sixty ounces of flowers yield only an ounce of this oil; hence its high price and frequent adulteration.

SUBSECT. 9.—*Tansy* (*Tanacetum Vulgare*, Linn.).

2528. Tansy grows wild in Britain, and is cultivated in gardens. Its leaves, having a powerful aromatic bitter, are sometimes chopped or bruised to put into certain puddings, or the juice alone is so employed: its use is very ancient. There are three varieties: the *plain* and *curled leaved*, and the *variegated*.

SUBSECT. 10.—*Saffron*.

2529. This is the dried stigmata of a bulbous plant, the *Crocus sativus*, once much cultivated in England, and used in seasoning dishes in the time of Richard II. It is now chiefly employed as a colouring matter for cheese and butter. It is still cultivated near Glazenwood, in Cambridgeshire, and at Stapleford. When good, saffron has a beautiful yellow colour and an agreeable odour; it yields its active principle, an essential oil, to water and spirit. Dr. A. T. Thomson, in his Materia Medica, states that it excites the nerves of the stomach, and is in some degree narcotic; its incautious use has sometimes been attended with dangerous consequences. It is sometimes adulterated with safflower and marigolds; but the adulteration is easily detected, for the petals of these flowers will appear distinct from the stigmata of the crocus. Some saffron is imported from the Continent, but it is inferior to the English.

Subsect. 11.—*Laurel or Bay Leaves.*

2530. Bay leaves are often mentioned in the receipts for cookery. As there is some confusion with respect to the name, it is necessary to put this matter in a clear light. The name of *Bay* has been applied to two trees very different. The proper laurel-tree (*Laurus nobilis*, Linn.), the classical laurel, is commonly called the bay-tree, or sweet bay-tree; but its leaves, though slightly aromatic, are harmless, and are seldom, if ever, employed in cookery. A species of the genus Prunus (*Prunus laurus-cerasus*, Linn.), a kind of cherry-tree, has leaves much resembling those of the laurel, whence the name *lauro-cerasus*, or *cherry laurel;* this is also sometimes called bay, and is the sort employed for its flavour. The cherry laurel is an evergreen tree, cultivated in gardens; its leaves are large, thick, oblong, glossy, pointed at both ends, and slightly indented. These latter leaves have a bitter styptic taste, accompanied with a flavour resembling that of bitter almonds, or other kernels of the drupaceous fruits. This kernel-like flavour being agreeable, has occasioned them to be employed for culinary purposes, especially in custards, puddings, blanc mange, &c., and then, as the proportion of the sapid matter of the leaf is usually diluted in a large proportion of milk, bad effects have seldom or never ensued from its use. But as the Prussic acid developed by the action of water on laurel leaves is known to be a violent poison, it is necessary that the public should be cautioned with respect to its properties, lest too much should be used on some occasions; since in the process of making laurel water by distillation it is sufficiently powerful to occasion death, and persons have been poisoned bv drinking laurel water by mistake.

Sect. XII.—Plants used in tarts, confectionery, and domestic medicine.

2531. The list of this class of plants, as used formerly, was more considerable than at present, many of those employed by the ancient herbalist having given way to the abundance of foreign spicery and the more powerful medicines of the chemist. Those which we shall describe are still cultivated, and are all useful, particularly in retired situations in the country, where a druggist is not at hand.

Subsect. 1.—*Rhubarb* (*Rheum*, Linn.).

2532. This is one of the most useful and best of all the productions of the garden that are put into pies and puddings. It was comparatively little known till within the last twenty or thirty years, but it is now cultivated in almost every British garden. The part used is the footstalks of the leaves, which, peeled and cut into small pieces, are put into tarts, either mixed with apples or alone. When quite young, they are much better not peeled.

2533. *The culture of the tart rhubarb has increased very rapidly of late*, in consequence of the great demand for it, and, consequently, it is at present sold at a very cheap rate. It comes in season when apples are going out.

2534. There are several varieties of this plant: *common rhubarb* (*Rheum rhaponticum*, Linn.), called also *Monk's rhubarb*, is a native of Asia, but has been cultivated in England since 1573. It is much improved by blanching.

The Hybrid rhubarb (*Rheum hybridum*, Linn.) is also a native of Asia, but from a more northern part. It was first cultivated as a garden plant by Dr. Fothergill in 1778, and is now in general use, the leaves being much larger and more succulent than the common sort. *Elford rhubarb*, or *scarlet rhubarb* (*Rheum undulatum*), is considered by gardeners to have the finest flavour, and, when cooked, is of a bright scarlet; it is free from that peculiar taste which occasions common rhubard to be disliked by some persons. *Turkey rhubarb* (*Rheum palmatum*) is a most elegant plant, but its leaf stalks are small. It is the root of this which forms the well-known medicinal drug, but its virtues are not so well developed in this climate as in Tartary, from which the rhubarb of the druggist is brought to us by the way of Turkey, India, and Russia.

Subsect. 2.—*Gourd* (*Cucurbita*, Linn.)

2535. *The gourd constitutes a large family;* some varieties are very beautiful, and are cultivated for ornament; some grow to an immense size, and are kept more as matters of curiosity, and others are cooked in a variety of ways. In warm climates, and particularly when well manured, it grows luxuriantly in the open air, and is extremely ornamental. It is much employed as food on the Continent of Europe and in America. It is extensively used in soups, stews, and pies, and is also sent to table boiled and served with toast and melted butter, or fried with butter, the last being by far the best mode of cooking it. The tender shoots and young leaves are boiled as greens or spinach, and the flowers and young shoots make an excellent dish fried. It is only beginning to be appreciated in Britain, though one variety, the *pompion*, or *pumpkin* (*C. Peto*, Linn.), has long been eaten in England by the poorer classes, generally mixed with apples and baked in a pie: it is sometimes boiled with milk; this is, however, the most insipid of the gourds. A great many ways of dressing the different varieties of pumpkins may be seen in the French and Italian books on cooking, and in the Gardener's Magazine, vols. vii. and viii. There are many other varieties cultivated in Europe, as the *Turban pumpkin;* the *melon pumpkin,* or *squash; American gourd,* or *Mammoth gourd,* which grows sometimes to the enormous weight of two hundred pounds, and used in Paris boiled to eat with meat as a substitute for potatoes and carrots. In many of the French provinces, where it is extensively cultivated, cows, hogs, and other cattle are fed upon gourds, and from the seeds large quantities of oil are expressed, which is used both for food and burning in lamps.

2536. *The botanical name* (*Cucurbita*) *is derived* from the resemblance which many species bear to certain vessels employed by chemists. In various parts of the world the shell is converted into bowls and other domestic utensils for holding water. The bottle gourd has a long neck and capacious ball, like a flagon.

2537. *Vegetable Marrow* (*C. ovifera*).—This is a variety of gourd which has been lately introduced into Britain, and is already cultivated to a considerable extent. It appears to have been brought to us from Persia by one of our East India ships. In shape it nearly resembles the cucumber, but is yellow when ripe, and attains the length of about nine inches. When young, it is excellent fried in butter; when half grown, it may be dressed in several ways, and has a peculiarly soft and rich flavour. It is also dressed plain boiled, and eaten with butter, or stewed in slices with rich sauce; and it is made into pies. The tender tops may be used as substitutes for greens.

Subsect. 3.—*Angelica* (*Archangelica,* Linn.).

2538. This herb is sometimes found native in Scotland, but is more abundant in the most northern parts of Europe, as Lapland and Iceland. The whole plant is powerfully aromatic. The seeds are employed to flavour ardent spirits or the choicest liquors; and in Sweden, Norway, and Lapland, the leaf-stalks are peeled and eaten raw as a great delicacy, or boiled with meat and fish. In England and France they are candied by the confectioner. The root, as well as the leaves and seeds, are employed for medicinal purposes, and in Lapland is chewed like tobacco.

Subsect. 4.—*Anise and Cummin* (*Pimpinella Anisum,* Linn.).

2539. The seeds of the anise, which is a native of Egypt, have been long used in this country, in confectionery and for distillation: they are imported from China, and Alicant, in Spain. Anise is somtimes cultivated in our gardens, and its leaves are used, like fennel, as a garnish and for seasoning.

2540. *Cummin* (*Cumminus,* Linn.).—The seeds are used in the north of Europe as a warm and stimulating spice in ragouts and other dishes, and are also put into liquors.

Subsect. 5.—*Coriander* (*Coriandrum Sativum,* Linn.).

2541. This plant, of eastern origin, has been long cultivated in England for its seeds, which are highly aromatic, and form one of the less agreeable spices: they are employed by the distiller in flavouring spirits, by the confectioner for incrusting with sugar, and by the druggist in medicine. Its tender leaves are also sometimes used in soups and salads, and in Peru the seeds are employed in great excess to season their food.

Subsect. 6.—*Caraway* (*Carum Carisi,* Linn.).

2542. The caraway is a native of this country, and is found growing in meadows. It is likewise cultivated for its seeds, large quantities of which are produced in Essex. The seeds have a pleasant aromatic odour, and a sweetish, warm, pungent taste, depending upon an essential oil, which is easily extracted by rectified spirit, and partly so by water. They are employed in confectionery, in cakes, biscuits, &c.; in medicine as a carminative, and for flavouring spirituous liquors; and the young leaves are sometimes used in soups: formerly the roots were eaten as parsnips, and by some are thought to be not inferior.

Subsect. 7.—*Rue and Hyssop* (*Ruta Graveolens,* Linn.).

2543. Rue is a hardy evergreen shrub, cultivated time out of mind in our gardens, but supposed to be originally a native of the south of Europe. It has a strong, ungrateful odour, and a bitter, hot, and penetrating taste. It is employed only for its medicinal qualities.

2544. *Hyssop* (*Hyssopus officinalis,* Linn.).—This, like the last, is only used in medicine; the leaves and young shoots rarely as a pot-herb.

Subsect. 8.—*Chamomile* (*Anthemis Nobilis,* Linn.).

2545. This very useful and generally-used aromatic bitter grows wild in England. It is cultivated on account of its flowers, an infusion of which forms an excellent stomachic, known by the name of *chamomile tea.* Though the double sort is most raised by gardeners, the single is the best and strongest as a medicine. The flowers are kept dried in bags. The active principle of chamomile is a resinous substance called *piperina,* discovered by Dr. A. T. Thomson.

SUBSECT. 9.—*Elicampane* (*Inula Helenium*, Linn.).

2546. This aromatic plant was formerly in great repute in England for its medicinal virtues, and was to be found in every physic garden. It is still cultivated, and the root is candied as a stomachic. It is found wild in moist pastures in the south of England.

SUBSECT. 10.—*Liquorice* (*Glycyrrhiza Glabra*).

2547. This medicinal plant is a native of the south of Europe, but has been cultivated in this country since 1562, chiefly for the use of brewers and distillers. The liquorice of the shops is the juice of the roots obtained by expression, decoction, and inspissation, and is manufactured only in Sicily and Spain; hence the name Spanish juice. It grows so abundantly in these countries and in Languedoc, that it is considered as a weed like the horseradish here, and is looked upon as a great nuisance to the cultivator. Its roots penetrate to a great depth, and are difficult to eradicate.

SUBSECT. 11.—*Wormwood* (*Aremisia Absinthium*, Linn.).

2548. The intense bitter of this plant is so great as to render it proverbial. Its odour is strong, and, though fragrant, yet to many persons it is disagreeable and nauseous. It grows wild in England, but is likewise cultivated for several purposes, though less used than formerly. It has tonic properties, and is sometimes employed as a stomachic. The French beverage or liqueur, called *eau d'absinthe*, thought to create an appetite, is prepared from wormwood, by the addition of alcohol and subsequent distillation. The active part seems to be the extractive, for the essential oil which it contains is not in the least bitter. Before the use of hops was known, wormwood was much employed in the composition of beer or ale: for this purpose it was gathered when in seed, and dried; some prefer its flavour to that of the hop.

SUBSECT. 12.—*Balm* (*Melissa Officinalis*, Linn.).

2549. Balm, formerly much employed in medicine, is still found to make a very grateful and useful drink in fevers. The herb, in its natural state, has a weak aromatic taste, and a pleasant smell, somewhat of the lemon kind. It was originally brought from the south of France. The leaves may be kept dried in the sun or oven, and preserved for use.

SECT. XIII.—PLANTS USED ONLY IN PRESERVES AND PICKLES.

2550. Many of the plants already described, as well as many foreign plants and fruits, are made into preserves and pickles. The following are a few that are not employed in any other way.

SUBSECT. 1.—*Caper* (*Capperis Spinosa*, Linn.).

2551. Capers, so much employed in sauces, are the unopened buds of a low trailing shrub or bush that grows wild like brambles in the fissures of rocks in Greece and the north of Africa, and is cultivated in the south of Europe. They are pickled in salt and vinegar, and come to us from Italy, Sicily, and the south of France; the best are from Toulon.

SUBSECT. 2.—*Samphire* (*Crithmum Maritimum*, Linn.).

2552. Samphire is a native of Britain, and is found growing on rocky cliffs by the sea, and in dry stone walls. The danger incurred by gathering it is described by Shakspeare in a well-known passage in King Lear. It is not easily cultivated, but is chiefly gathered in its wild state for pickling, and as an addition to salads. It is crisp and aromatic. *Golden samphire* and *marsh samphire* are varieties likewise found upon the seashore, or in salt marshes, and applied to the same use.

SUBSECT. 3.—*Tomato, or Love-apple* (*Solanum Lycopersicum*).

2553. This is a native of South America, and *Tomato* is the Portuguese name. The fruit is about the size of a small apple, contains a very agreeable acid, and is now much used in gravies, soups, and sauces. It is also served at table boiled or roasted, and sometimes fried with eggs. When green, it makes a good pickle and catchup, and is found in our vegetable markets; even in its unripe state it makes an excellent sauce, like apples or gooseberries, for roast pork or goose: when fully ripe, it makes an excellent store sauce.

2554. *The egg plant* (*Solanum esculentum*, Linn.) is allied to the last, and, though not uncommon in our green-houses, is seldom employed in this country as an article of cookery: it has less flavour than the love-apple; but it is more employed on the Continent, and in warmer latitudes, where its growth is attended with less trouble; it enters into stews and soups, and it is eaten as fritters, sliced and fried with oil or butter; it then forms a pleasant variety of esculent.

SECT. XIV.—POISONOUS PLANTS THAT GROW WILD IN BRITAIN.

2555. Every gardener should be acquainted with the following plants, that he may point them out, and enable such persons as are in search of edible wild plants to avoid them:

Chelidonium majus
Cicuta virosa.
Colchicum autumnale.
Œnanthe crocata.
The leaves of Prunus lauro-cerasus, though the berries are used in puddings.
Aconitum Napellus.
Aconitum lycoctonum
Actæa spicata.
Rhus toxicodendron.
Æthusa cynapium.
Atropa belladonna
Datura stramonium.
Hyoscyamus niger.
Solanum dulcamara
Solanum nigrum.
Lactuca virosa.
Apium graveolens
(The last two plants, in a cultivated state, afford lettuce and celery; but wild, in hedges and ditches, they are poisonous.)
Conium maculatum.
Digitalis purpurea.
Helleborus fetidus.
Juniperus Sabina.
Scrophularia aquatica
Asclepias Syriaca.
Bryonia dioica.
Euphorbia Lathyrus.
Euphorbia amygdaloides.
Mercurialis perennis.
Mercurialis annua.
Periploca Græca.
Veratrum album.

Professor Burnett observes that, lately, seventeen convicts at Woolwich were poisoned by eating the roots of Œnanthe crocata, which grows wild near Woolwich, and four of them died. Other similar instances are recorded in the Reports of the Medico-Botanical Society. A variety of Œnanthe, though dangerous when wild, is innocuous when improved by cultivation, and is eaten at Angers, in France.

Sect. XV.—esculent fungi

2556. *Fungus is the botanical name* for a very numerous tribe of plants, which are distinguished from other vegetables, not only by their singular forms, but by their chemical composition, yielding, upon analysis, not only the usual components of the vegetable kingdom, carbon, oxygen, and hydrogen, but likewise a large proportion of nitrogen, by which they approach more nearly to the nature of animal flesh. Dr. Darwin observed, long ago, that all the mushrooms cooked at our tables, as well as those used for catchup, possessed an animal flavour; and soup enriched by mushrooms only has sometimes been supposed to contain meat.

2557. *In this numerous tribe, a large proportion are poisonous*, a few are wholesome, and a vast number are still unknown as to their action upon the human constitution. The poisonous and wholesome species are often very similar; and as it is difficult to distinguish between many of them, even by botanical characters, the use of wild mushrooms is very unsafe. The few that it is customary to eat and to cultivate are known to those who are in the habit of collecting them, and no one should venture upon eating a species they do not understand. It is a remarkable circumstance that certain species that are eaten as food in one country are rejected as poisonous in another, which seems to show that their deleterious properties are owing to climate, situation, or accidental circumstances, rather than any specific peculiarity. In some parts of Europe, as Russia, Poland, and parts of Germany, there are above thirty species growing wild that are used as food, and cooked or preserved in various ways, whereas in Britain only two are generally eaten.

2558. *The garden, or cultivated mushroom* (*Agaricus campestris*, Linn.).—This species, which is considered as the best, and is the most usually eaten in England, is cultivated in gardens; but it is also found abundantly springing up wild in rich open pastures. It is distinguished from the poisonous kinds called *toad stools* by its having pink or flesh-coloured gills or under side, and by its invariably having an agreeable smell. When young they are of a roundish form like a button, the stalk as well as the button being white, and the fleshy part being very white when broken, the gills within being livid. As they grow larger, they expand their heads by degrees into a flat form, and the gills underneath are at first of a pale flesh-colour, but as they stand long become blackish or brown. The poisonous kinds are mostly all brown, and generally have a rank, putrid smell. The edible mushrooms seldom grow in woods, but many of the poisonous sorts are to be found there. Mushrooms are stewed or boiled, and are employed in flavouring many dishes. They are also pickled and dried, and when reduced to powder, and kept in this state in close bottles, they are very useful in the season when they do not grow. The wild mushrooms of the same species are considered superior in point of flavour to those raised in the garden; but the latter are safer on account of the risk of gathering improper sorts. *Catsup*, or *catchup*, is made from mushrooms by mixing salt and spices with their juice. The young, when globular, called *buttons*, are best for pickling.

2559. *A. pratensis* is a much esteemed species, known by the name of *champignon:* the best grow in parks and dry pastures, where the turf has not been ploughed up for many years; they have a finer flavour than the garden mushroom; the gills are cream-coloured. These are much employed for catchup and in stews; but it is said that they are apt to be hard and leathery, in which state they are indigestible, and they are so like some poisonous kinds that they should be gathered with caution.

Besides these, however, there are several edible mushrooms in this country; and in particular districts, where the inhabitants are well acquainted with them, they are used; but, as we have before stated that there are many which are poisonous, we would advise those who are not very conversant with their characters to abstain from gathering them.

Mushrooms vary much in size: some are only an inch or two in diameter, others have been known to measure eight or ten inches across. Dr. Withering mentions a species on the seacoast of Cornwall which has the cap eighteen inches in diameter, and the stem as thick as a man's wrist; and one was gathered in a hot-bed in Birmingham that weighed fourteen pounds.

The manner of propagating the fungus tribe is remarkable and peculiar, and the properties of some of those which are found in other parts of the world are extraordinary. Besides those which are powerful poisons, some are medicinal; and one species in the northeast part of Asia is employed to produce intoxication.

All mushrooms require to be very well cooked, particularly those which are large.

CHAPTER IX.

DESCRIPTION OF THE FRUITS USED AS FOOD IN BRITAIN.

SECT. I.—GENERAL OBSERVATIONS.

2560. The most agreeable, if not the most useful, species of vegetable food consists of fruits. The hardy fruits, or such as grow without the aid of artificial heat, are valuable as food, independently of their employment in the dessert; and some of these, as the apple and the gooseberry, &c., are easily within the reach of the humbler classes.

2561. *The most important of our fruits were originally the produce of warm countries*, and have, by the art of cultivation, been gradually acclimated to temperate regions. Those enlightened nations of antiquity, the Greeks and Romans, introduced into Italy many fruits from countries which they subdued, and it was their constant practice to extend these advantages to their conquests. In this manner the fig, the orange, the peach, plum, cherry, apple, and pear, almonds, olives, and a great variety of others, mostly natives of Asia, have been spread over Europe; and thus war, productive of so many evils, has, in the early stages of society, contributed to diffuse the arts of civilization. Before the invasion of the Romans, Britain probably possessed no other than the wild fruits of Northern Europe, the crab, the sloe, the hazelnut, and the acorn. Much was due to the Anglo-Saxon monks, who, in their time, were probably the only gardeners, and who bestowed much care in the cultivation and improvement of some of our best fruits; their vineyards and orchards were in great perfection from the twelfth to the fifteenth century.

2562. *The Crusades*, unjust as they were, contributed to the improvement of European society; and the monastic gardens owed some of their choicest fruits to the ecclesiastics who had accompanied the expeditions to the Holy Land. In the same manner, the Spaniards introduced the European vegetables and fruits into America, as the English missionaries are now doing in the islands of the Pacific, and in Africa.

2563. *The discovery of the New World*, and the extension of commerce in the reign of Queen Elizabeth, added considerably to the number of our fruits and vegetables; and this princess herself set an example as a horticulturist. Under the Stuart family, gardening was greatly improved; and in each succeeding reign it made a steady progress.

2564. *At present* every part of the globe is examined by our botanists, and constant additions are being made to our knowledge of the vegetable kingdom. The modern improvements in science, and the art of gardening, have enabled us to add to our list numerous tropical plants, some of which, though at their first introduction they were kept entirely in stoves, are now planted out, and can bear the rigour of our ordinary winters; from which it may reasonably be expected that they may be so far acclimated here as to ripen in the open air. Already we find pineapples and melons, formerly so rare, now by no means uncommon in Covent Garden market, and sold at very moderate prices.

2565. *On this subject Sir Joseph Banks has observed:* "It does not require the gift of prophecy to foretell that ere long the aker and the avocado pear of the West Indies, the flat peach, the mandarin orange, and the litchi of China, the mango, the mangostan, and the durion of the East Indies, and possibly other valuable tropical fruits, will be frequent at the tables of opulent persons; and some of them, perhaps in less than half a century, be offered for sale every market-day in Covent Garden."

2566. *The extended introduction of inter-tropical fruits* begins much to interest the admirers of these natural productions, and trials may be made without much additional expense in our hot-houses, now fitted up in such perfection. The banana, or plantain, has been fruited in Britain nearly forty years ago, and frequently since. When the hothouse is lofty enough, it is a magnificent plant, and makes an appearance even surpassing what it exhibits in its native country, where its ample leaves are often torn in pieces by the winds. The mango has been also fruited, both in France and England; and if some of the best varieties were imported with care from Jamaica, there is little doubt that, with proper cultivation, they might be had on the table as easily as the pineapple.

But the orange trade displays in a singular manner the advantages which we derive from the present commercial system. Though these are fruits of climates much warmer than ours, yet we obtain them at a price little higher than that of our domestic fruits. Nor should we forget, while on this subject, that some of our wild fruits, as the berries, perhaps deserve to be made the subject of experiment how far they may be capable of improvement, and whether it may not be judicious to attempt their melioration.

2567. *Great advantage has been derived of late to the cultivation of fruits in general by the establishment of horticultural societies*, particularly the London and Caledonian, the

"Transactions" of which contain much valuable information on this interesting subject: great pains have been bestowed to select and disseminate the best varieties.

2568. *The fruits which we propose to describe* we shall divide, with Mr. Loudon, into,

1. *Kernel fruits*, or *pomes:* those having the seeds enclosed in membranous cells, including the apple, pear, quince, and medlar. These are also called fleshy fruits.
2. *Stone fruits:* having the seeds enclosed in hard nuts covered with flesh, or a sarcocarp, as the peach, nectarine, almond, apricot, plum, cherry, and olive.
3. *Pulpy fruits:* having the seeds lying among the pulp, as the pineapple, grape, melon, cucumber, fig, and tamarind.
4. *The orange tribe:* this contains a well-known group, the sweet orange, the bitter orange, lemon, citron, and shaddock.
5. *Berries:* a smaller kind of pulpy fruits, as the gooseberry, current, raspberry, strawberry, mulberry, elderberry, barberry, whortleberry, cranberry, blaeberry, blackberry, dewberry, juniper berry, and service berry.
6. *Exotic fruits:* occasionally imported, or but little known in England, as the pomegranate, plantain, banana, mango, mangostan, aker, bread-fruit, durion, guava, litchi, jujube, juvia, alligator, or avocado pear, anchovy pear, custard apple, and papaw.

2569. *No class of substances employed as food varies more in their dietetic qualities than fruits*, which, though extremely salubrious when used judiciously, are frequently injurious, particularly to the invalid. It is essential, in order to have a just view of this subject, to discriminate accurately between different species, the state of ripeness, the time and circumstances under which fruit is eaten, as well as the constitution of the consumer. There are three modes in which fruits may be used as food: in a crude state, dried, or prepared by the art of cookery. A very great change takes place as they advance towards maturity from the unripe state. In the latter, in general, acids and astringent matter abound, which is often converted into sugar when they ripen; hence the injurious properties of many unripe fruits which are perfectly wholesome when ripe. Similar changes in their constituent principles frequently take place during the operation of cooking; as, for instance, a portion of the acid of apples becomes sugar; and, in general, numerous fruits, very indigestible in their raw state, when boiled, roasted, or stewed, form excellent food. The acid of unripe fruits is usually objectionable, but that of fruits in their ripe state is often cooling and salutary, when sufficiently diluted. Those which, when ripe, have about an equal mixture of acid and sugar, as the strawberry, raspberry, grape, and orange, are particularly agreeable and wholesome in the warm part of the year, when they are in the most perfect condition. Of our natural fruits, the cherry and the nut tribe are the least wholesome.

2570. The drying of some fruits, as raisins, not only enables the inhabitants of cold countries, through the medium of commerce, to enjoy a species of food which their climate has not permitted them to cultivate, but, by this process, the watery and acid juices being in a great measure dissipated, they become less disposed to ferment in the stomach, and are, in general, safer than in a crude state.

2571. *With respect to the chemical analysis of fruits*, the small progress that has been made in the very difficult branch of vegetable chemistry precludes the possibility of giving the composition of all of them, very few having been subjected to rigid investigation. Many of them contain peculiar principles, and, in general, their composition is complicated. The usual principles in fruits are water, sugar, bitartrate of potash and of lime, malic acid, acetic acid, citric acid, binoxalate of potash, vegetable mucilage or extractive matter, tannin, the principle of flavour, and the colouring principle. The sugar of fruits is generally of the uncrystallizable kinds. The acids are chiefly the malic, acetic, and citric. In a few these are found free, but are most frequently combined with lime or potash. Malic acid is found in apples, currents, gooseberries, strawberries, raspberries, elderberries, and plums. Several acids are frequently found in one fruit.

Sect. II.—Kernel Fruits.

2572. These, *called also pomes*, from the Latin word signifying apple, have a pulp rather firm, so as to be termed fleshy by botanists, and they have their seeds not loose in the pulp, nor enclosed in a hard shell, but contained in cells formed of tough membranes.

Subsect. 1.—*Apple* (*Pyrus Malus*, Linn.).

2573. *No fruit in Britain is so abundant, and so generally useful, as the apple*, and none can be brought to such high perfection with so little trouble. It is employed at the dessert, in the kitchen, and for making cider. It is important from its hardiness and excellent flavour; and it has this striking advantage over all our other fruits, that it remains longest in season, and may be preserved with ease through the winter; whereas our stone fruits can only be kept in their natural state for a few days, and require extraordinary means to preserve them.

2574. *Homer describes the apple as one of the precious fruits of his time*, and it was cultivated and highly esteemed among the Romans, who brought it from the East, and set an extraordinary price upon fine bearing trees. The best varieties are natives of Asia, and have been introduced into Europe by grafting upon others. The only variety indigenous to Britain is the austere crab-apple of our hedges; but the cultivated kinds were introduced at an early period. During the Saxon heptarchy, Somersetshire and Devonshire were called the apple country, and there were large plantations near Glastonbury. Some apple-trees in Herefordshire now existing are said to be a thousand years old, and many varieties were undoubtedly brought over by the Normans in the time of William the Conqueror. The varieties of the apple have been prodigiously increased in this country, this fruit having a peculiar tendency to change by circumstances connected with its cultivation. Parkinson, in 1629, enumerates fifty-seven sorts. Evelyn, about thirty years afterward, states that "it was through the plain industry of one Harris, a fruiterer to Henry VIII., that the fields and environs of about thirty towns in Kent only were planted with fruit from Flanders, to the universal benefit and general improvement of the county." Hartlet, in 1650, speaks of "one who had 200 sorts of apples," and "verily believes there are nearly 500 sorts in this island." Since that time there has been a continual accession of sorts received from the Continent, as well as numerous varieties raised from seeds. The last catalogue of fruits, published by the Horticultural Society of London in 1831, enumerates 1400 sorts of apples, and those which have been acquired since that time would extend the list to 1500. Of no other fruits are there so many excellent varieties in general cultivation, suited to almost every soil which our island affords. Some sorts are ripe in the beginning of July; others ripen much later: those which ripen latest are the best.

2575. *Apple-trees will not grow in tropical countries*, but, like the oak, extend from the tropics to the latitude of 60°, and are not to be found in Lapland. The apple is, therefore, the growth of temperate and rather cold climates only.

It has been supposed, and the opinion was supported by Mr. Knight, that many of the oldest varieties of apples known to our ancestors are worn out, and others are now in a state of debility; thus the celebrated golden pippin, which was formerly the common cider apple of the Hereford orchards, is now preserved with difficulty in our gardens. This opinion, however, has been controverted.

Apples are divided into those which, from sweetness, are fit for eating, called *eating*, or *table apples;* those which are proper for pies, tarts, &c., termed *kitchen* or *baking* apples; and those for making cider, or *cider* apples. The best baking apples are the Colvilles, for early use; the rennets and pearmains, for autumn; the russets, and Padley's pippins, for winter and spring. For dessert apples, Margarets, for early use; Pomeroy, summer pearmain, and Kentish codlin, for summer use; golden, Dowton, and other pippins, especially the ribstone, with the nonpareil, and other small russets, for autumn, winter, and spring. Some apples are not eatable until kept some time.

2576. *All apples contain* sugar, malic acid, or the acid of apples, mucilage or gum, woody fibre, and water, together with some aroma, on which their peculiar flavour depends; and their different qualities may be traced to the different proportions of their principles. The hard, acid kinds are unwholesome if eaten raw; but by the process of cooking, a great deal of this acid is decomposed, and converted into sugar. The sweet and mellow kinds form a valuable addition to the dessert, and they are employed in the composition of marmalades, jellies, &c.; and from the juice is prepared a drink useful in fevers. A great part of the acid juice of the apple is converted into sugar as the fruit ripens, and even after it is gathered, by a natural process termed maturation, an account of which is given in the article "Preservation of Fruit." On the contrary, when apples decay, the sugar is changed into a bitter principle, and the mucilage becomes mouldy and offensive.

As in apples more than half consists of water, and as the rest of the ingredients are not of the most nutritive kind, this fruit cannot rank high as food; it is chiefly useful as an agreeable acid-sweet summer fruit. When cooked it is considered as slightly laxative, and therefore a useful adjunct to other food: this is probably the origin of apple sauce, so common with pork, ducks, and goose. The raw fruit is not advisable for dyspeptic persons. Old cheese has a remarkable effect in meliorating them when eaten; probably from the volatile alkali or ammonia of the cheese neutralizing their acid.

SUBSECT. 2.—*Pear (Pyrus Communis,* Linn.).

2577. The pear, like the apple, is indigenous to this country; but the wild pear is a very austere fruit. The best varieties were brought from the East by the Romans, who cultivated them with care, and probably introduced some of their best sorts into this island, to which others were added by the inhabitants of monasteries. The Dutch and Flemings, as well as the French, have excelled in the cultivation of the pear, and most of the late varieties introduced by the Horticultural Society are from France and Flanders.

The pear is a hardy tree, and a longer liver even than the apple; in a dry soil it exists for centuries. It will grow in almost any soil, and flourishes perfectly in our hedges.

2578. *Eating pears* were formerly divided into two sorts, viz., *proud pears*, which would not keep, and *woodens*, so called from their property of keeping. Pears however, have been wonderfully improved as a table fruit within the last twenty or thirty years, through French and Flemish botanists and horticulturists, by whose experiments our own gardeners have largely profited. The best sorts are delicious, and are preferred to the apple at the dessert. They should have a rich aromatic flavour, and be either of the melting kind (*buerré*, butter pears), or be firm and crisp, like the winter bergamots.

2579. *Above* 150 *varieties of pears are enumerated in late catalogues*, all differing from each other in their qualities, time of ripening, &c. For summer pears, some of the best are the Muscadelle, Windsor, Jargonelle, Bonchrêtein, &c. For winter, the St. Germain, Wilding, Rousselet, Bergamot, &c. For the kitchen, the Swan's Egg, Spanish red wooden, black Worcester, &c. Perhaps one of the most delicious sorts in Europe is that known throughout the north of Spain as the Pera de Mantiga, or "Butter Pear," and some of a very superior kind are grown in Guernsey and Jersey. The species grown in the neighbourhood of Guimaræns, in the north of Portugal, is equally celebrated.

2580. *Though perfectly wholesome when ripe, the pear is not so when green;* but in this state it is fit for stewing. The best kitchen pears for baking are rather austere than sweet: cooking converts part of the acid into sugar. They may be preserved in the same way as apples; but they are also pared and dried in an oven, by which means they will keep for years: this mode is much practised in France.

This fruit is likewise much employed for making perry, and the most austere varieties, unfit for eating, are best for this purpose. A mixture of the wild pear with the cultivated sort is thought to make peculiarly fine liquor.

2581. We do not find any good analysis of the pear, but it is evidently not very different in its composition from the apple, in some varieties containing more sugar.

Subsect. 3.—*Quince* (*Pyrus Cidonia*, Linn.).

2582. This tree is classed by botanists with the apple and pear, and the latter are generally grafted on quince stocks, proving their consanguinity. It is a native of Austria, and grows wild on the banks of the Danube. It is said to have been introduced here from the Isle of Candia, and grows easily in our hedges, but is not much used, the fruit, in its raw state, having a peculiar disagreeable smell and an austere taste. It is sometimes employed to give a flavour to apples in pies and tarts, and is occasionally made into a marmalade, which is much used in the south of France, where the quince is extensively cultivated. The juice, as a medicine, is cooling, astringent, and stomachic.

Subsect. 4.—*Medlar* (*Mespilus Germanica*, Linn.).

2583. This fruit, a native of the south of Europe, but long naturalized, somewhat resembles a small apple, and has a good deal of flavour, but which is seldom developed, even in its ripe state, on the tree. It is gathered and laid by till it begins to change or grow rotten, when only it is fit to be eaten.

Sect. III.—stone fruits.

2584. *Stone fruits are such as have their seeds enclosed in a hard nut or shell, and this covered by a fleshy pulp.* Those which are known among us belong to the natural order of *amygdaleæ*, and consist of the peach, nectarine, apricot, plum, and cherry. All these contain certain principles in their kernels, from which Prussic acid is developed by the action of water, though this acid does not exist in them ready formed. Some species of this tribe in other countries are highly poisonous: the Cerasus capricida kills the goats of Nepal which happen to eat them; and the Cerasus Virginia of North America is known to be dangerous. Notwithstanding, however, this poisonous principle in the kernels, the pulp of our fruits of this kind are perfectly harmless.

Subsect. 1.—*Peach and Nectarine* (*Amygdalus Persica*, Linn.).

2585. These, which are among the most delicious of our fruits, are considered as varieties of the same species produced by cultivation. The latter is characterized by a very delicate down, while the former is smooth; but as a proof of their identity as to species, trees have born peaches in one part and nectarines in another; and even a single fruit has had down on one side, and the other smooth. The trees are almost exactly alike, as well as the blossoms.

2586. Pliny states that the peach was originally brought from Persia, where it grows naturally, from which the name of Persica was bestowed upon it by the Romans; and some modern botanists apply this as the generic name, separating them from the Amygdalus, or almond, to which Linnæus had united them.

2587. Although they are not tropical, they require a great deal of warmth to bring them to perfection; hence they seldom ripen in this country in ordinary seasons without the use of walls or glass; consequently, they bear a high price.

2588. In a good peach, the flesh is firm, the skin thin, of a deep bright colour next the sun, and of a yellowish green next to the wall: the pulp is yellowish, full of highly flavoured juice, the fleshy part thick, and the stone small. Too much down is a sign of inferior quality. This fruit is much used at the dessert, and makes a delicious preserve.

2589. Both the peach and the nectarine are separated into, 1, the *free-stone*, or *melting peaches*, those in which the pulp or flesh separates easily from the stone; and, 2, the *cling-stone varieties*, in which the flesh clings or adheres to the stone; the first are generally the best flavoured. There are above two hundred varieties enumerated in the catalogue of the Horticultural Society.

2590. Peaches are often cultivated in large quantities. At Montreuil, a village near Paris, almost the whole population is employed in the growing of peaches, which has maintained the inhabitants for ages; and the consequence is, that they raise better peaches there than in any other parts of France. The best in Europe are Italian. In Maryland and Virginia, peaches grow nearly wild in extensive plantations or orchards resembling forests, but the fruit is of little value for the table, being employed only in fattening hogs, and for the distillation of peach brandy. On the east side of the Andes, peaches grow wild among the cornfields, and in the mountains, and are dried as an article of food.

2591. The young leaves of the peach are sometimes used in cookery from their agreeable flavour; and a liqueur resembling the fine noyeau of Martinique may be made by steeping them in brandy sweetened with sugar and fined with milk: gin may also be flavoured in a similar manner. The kernels of the fruit have the same flavour.

2592. *The nectarine is said to have received its name* from nectar, the particular drink of the gods. Though it is considered as the same species as the peach, it is not known which of the varieties came from the other: the nectarine is by some considered as the superior fruit.

SUBSECT. 2.—*Almond (Amygdalus).*

2593. *The almond-tree is a native* of warmer climates than Britain, and is indigenous to the northern parts of Africa and Asia; but it is now commonly cultivated in Italy, Spain, and the south of France. It is not usually grown in Britain, and the fruit seldom ripens in this country; it is much admired for the beauty of its blossoms. It strongly resembles the peach tree in the form of its leaves and blossoms, and is included in the same genus by botanists; but the fruit, instead of presenting a delicious pulp like the peach, shrivels up as it ripens, and becomes only a tough coriaceous covering to the stone enclosing the eatable kernel, which is surrounded by a thin bitter skin. It flowers early in the spring, and produces fruit in August.

2594. *There are two sorts of almonds, sweet and bitter*, but they are considered to be only varieties of the species; and though the qualities of the kernels are very different, they are not distinguishable by their appearance.

2595. *The sweet almond* (*A. communis*, Linn.) is much used at the dessert and in confectionery. The Valentia almond is sweet, large, and flat-pointed at one extremity, and compressed in the middle. The Italian almonds are not so sweet, smaller, and less depressed in the middle. The Syrian or Jordan almonds come from Malaga, and are the best sweet almonds brought to England. They are longer, flatter, less pointed at one end, and less round at the other, and have a paler cuticle than those just mentioned. Almonds are not considered to be very digestible. The brown skin easily comes off by pressing with the fingers when they are put into boiling water: they are then dried till they are brittle, and the interior part being white, they are then said to be *blanched*. This skin, or pellicle, sometimes disagrees with the stomach, and, on that account, almonds, when brought on the table as dessert, ought to be blanched.

2596. *When analyzed*, 91 parts of sweet almonds are found to consist of 54 parts of fixed oil, 3 of gum, 24 vegetable albumen, 6 saccharine matter, 4 woody fibre, 3 of water, and a trace of acetic acid.

2597. *The bitter almond* (*A. amarus*, Linn.) has, like the sweet, no smell when entire, but when bruised in a mortar it has the odour of the peach-blossom, and the taste is the pleasant one of the peach kernel, a property which occasions its use in flavouring many preparations.

2598. *Though bitter almonds do not contain prussic acid ready formed*, they contain two principles, amygdalin and emulsin, which, when acting on each other by means of water during distillation, produce prussic acid and a volatile oil, both violent poisons; and when bitter almonds are chewed, the moisture of the mouth and the emulsin of the seeds effect the decomposition of the amygdalin, and the consequent formation of prussic acid and volatile oil. Though the proportion of these poisons in a few of the almonds does not prove fatal, yet, when almonds have been eaten in large quantities, serious, and even fatal consequences, have been the result.

2599. *The volatile oil of bitter almonds* is sold in some shops under the name of *essence of bitter almonds*; and this is a most potent poison, being in general four times as powerful as the prussic acid kept in chemist's shops. A single drop of it will kill a cat in a few minutes. This preparation is sold to dealers in cordials, to make what they call "genuine noyeau," and it is used by some confectioners to flavour their preparations; but it is evident that so dangerous a substance should not be trusted in the hands of persons not thoroughly acquainted with its deleterious effects. See "Prussic Acid," Book VII., Chap. VII., Sect. 16.

2600. *Almonds contain a large proportion of fixed oil,* which is obtained by expression; his is mild and wholesome, and is much used in medicine as a pure oil. When almonds and water, with a little sugar, are triturated together in a mortar, a white liquor results, which is considered to be very nearly similar to animal milk, and is called *milk of almonds;* it is curdled by acids. Cream even separates from this milk, which may be converted into a species of butter. Several substances not mixible of themselves with water may, by trituration with almonds, be mixed with it, and thus fitted for medicinal use; such mixtures are called *emulsions.* Almond oil is used for making fine soap; and the almond cake, after pressing out the oil, is employed as a cosmetic.

Both sweet and bitter almonds contain the bland fixed oil obtained by expression, but it is chiefly procured from bitter almonds, which, after being blanched, are submitted to great pressure between two hot iron plates; the matter which remains, or the almond cake, is the source of the prussic acid, which is obtained by a subsequent process. When the cake is moistened with boiling water, the odour of the volatile oil, and of prussic acid, is immediately perceived.

2601. *The importation of almonds* into England amounts annually to about six hundred tons, of which about ninety-five are Jordan, the rest chiefly from Barbary and Spain. Bitter almonds come chiefly from Magadore.

SUBSECT. 3.—*Apricot* (*Prunus Armeniaca,* Linn.).

2602. *The genus Prunus includes the apricot, plum,* and *sloe.* The apricot was cultivated by the Romans, and is stated by Pliny to have been brought from Armenia, where it is found abundantly on the slopes of the mountains. Vast quantities grow in the oases of Africa, and are carried in a dried state to Egypt. It is the opinion of Mr. Royle, author of the "Botany of the Himalaya," that the Cabul Mountains are the source of the apricot, as well as many others of our fruit-trees. He states that the apricot grows wild at present in the hills between the Ganges and Jumna, as well as in Cashmere, together with the peach, nectarine, walnut, almond, plum, cherry, and also the apple, pear, quince, and pomegranate. It is also planted very abundantly round the villages, the fruit being eaten both fresh and dried, while a fine oil is expressed from the kernels. It is likewise plentiful in China and Japan.

2603. In the climate of England it is of less importance than many other fruits; its blossoms, in early seasons, are very subject to the effect of spring frosts, which renders its crops precarious. It is, however, much cultivated, and is used at the dessert, though inferior to the peach. The young fruit makes an excellent tart and preserve or jam, which is the use to which the apricot is best suited, possessing a moderate degree of acidity with a rich saccharine quality. The apricots produced upon standards, which are the best, do not appear north of Ipswich, and several of the sorts known in the south of Europe are too tender for England. It was first brought to this country by the gardener of Henry VIII.

SUBSECT. 4.—*Plum* (*Prunus Domestica,* Linn.).

2604. *The wild sloe is considered by Mr. Knight as the parent of the plum,* but the acclimated kinds come from the East. The cultivation of this fruit was probably attended to very early in England, as Gerard informs us that in 1597 he had in his garden in Holborn three score sorts.

2605. *The damson,* or Damascene plum, takes its name from Damascus, where it grows in great quantities, and from whence it was brought into Italy about 114 years B.C. The *Orleans plum* is from France. The *green gage* is called after the Gage family, who first brought it to England from the monastery of the Chartreuse, at Paris, where it still bears the name of *Reine Claude.* The *magnum bonum* is our largest plum, and greatly esteemed for preserves and culinary purposes. The best sorts of plums are agreeable at the dessert, and, when perfectly ripe, are wholesome; but some are too astringent. They lose much of their bad qualities by baking; and are extensively used, from their cheapness, in tarts and preserves, but they are not a very wholesome fruit, and should be eaten in moderation.

Dried plums are called prunes, of which several kinds are met with in the shops, and used at the dessert: the Brignolle plums, brought from Brignolle, in Provence, which is of a reddish-yellow colour, and has a grateful, sweet sub-acid taste; the common French prune, and the Damascene plum. Others come from the banks of the Rhine, by way of Holland, and others, again, are brought from Portugal. The *common medicinal prune* comes chiefly from Bordeaux.

2606. *The sloe* is a shrub common in our hedgerows, and belongs to the natural order Amygdaleæ. The fruit is about the size of a large pea, of a black colour, and covered with a bloom of a bright blue; it is one of the few indigenous to our island. The juice is extremely sharp and astringent, and was formerly employed as a medicine, where an astringent was necessary; it is employed in the manufacture of a red wine made to imitate port, and also for adulteration. The leaves have been employed to sophisticate tea. The fruit, when ripe, makes a good preserve.

2607. *The bird cherry* (*Prunus Padus,* Linn.) is a fruit little known, and nauseous to most palates, but when infused in gin or whiskey, it greatly improves these spirits, and the infusion is only surpassed by that of peach leaves.

SUBSECT. 5.—*Cherry* (*Cerasus Duracina*, Linn.).

2608. It is a question whether this beautiful fruit be indigenous in Britain. It is generally stated that the cherry was brought to Italy by the Roman general Lucullus from a town in Asia called Cerasus, and that we owe it to the Romans. This may be true of some varieties, but the cherry appears to be a native of most temperate countries of the northern hemisphere, and a small black wild cherry is found in Herefordshire, and even in the mountains of Scotland; this, when cultivated in Aberdeenshire, where it is known by the name of *Geans*, is a delicious fruit. At some of the ruins of our abbeys and baronial castles there are still existing some of these black cherry-trees that have attained the height of sixty or eighty feet, and which now produce vast quantities of fruit. All agree that the cherry has been a favourite fruit in England, and in general cultivation ever since the time of Henry VIII., when it was planted in Kent, where cherry orchards were formerly very extensive, and are still celebrated; but this fruit was probably introduced here at a much earlier period, for it is ascertained that in the fifteenth century it was hawked about the streets of London in the same manner as at present.

2609. *About two hundred varieties of cherries are enumerated*, some of which are in season, from the Kentish and May duke at the beginning of autumn, to the yellow Spanish and Morillo late in the winter. When perfectly ripe they are refreshing, and are excellent for pies and tarts. *A wine is made from the juice* resembling red Constantia. *A spirit is also distilled* on the Continent from the pulp fermented, called *Kirschevasser*. The liquor called *cherry brandy* is made by putting the best black varieties into brandy. *Noyeau* is a liquor flavoured by the kernels of the variety *Cerasus occidentalis*; and a large black cherry is employed in the *ratafia* of Grenoble. The *maraschino* of Zara is made from a particular species cultivated in Dalmatia.

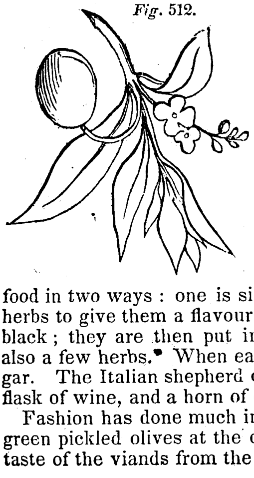
2610. *The cherry is, by some botanists, included in the same genus as the plum* (*Prunus*), and, like all this class of stone fruits, contains in its leaves and kernels some of the principles which are the source of the agreeable flavour resembling that of the peach-blossom. The poisonous liquid called *laurel water* is made by distilling the leaves of the *bird cherry*; those of the *Lauro-cerasus*, or cherry-laurel, as well as some other cherry leaves, afford a similar liquid, although the fruits are not poisonous.

SUBSECT. 6.—*Olive* (*Olea Europæa*, Linn.).

2611. The olive-tree is interesting from historical recollections. It was the leaf of this tree, brought into the ark by the dove, that gave the first evidence of the waters of the deluge having abated, since which time it has been employed as an emblem of peace. The olive was sacred to Minerva; it frequently appears in Grecian sculpture, and a wreath made of the leaves was a reward bestowed in the games of Athens. The mention in Scripture of the Mount of Olives near to Jerusalem proves it to have been a favourite tree in Palestine; and it is an interesting fact that wild olives still exist upon the spot. The olive is indigenous in Syria, Greece, and the north of Africa; and the beautiful plain of Athens seems almost covered with them.

2612. *The cultivated olive* (*fig.* 512) was introduced into Italy by the Romans: it now grows there in great abundance, as likewise in Spain and the south of France, but the fruit will not ripen in countries farther to the north. It will grow in England, but though an evergreen in warmer climates, with us it loses its leaves in winter, and the fruit does not ripen in the open air.

Fig. 512.



2613. *The fruit* is smooth and oval, about three quarters of an inch in length, and half an inch in diameter, being about the size of a small plum. When ripe it is of a deep violet colour, whitish and fleshy within; it is rather bitter, and to many nauseous, but has its pulp replete with a bland oil, and with an oblong, pointed, rough nut in the interior. In Greece, and also in Portugal, the fruit is eaten in its ripe state, but its taste is not agreeable. They are prepared for food in two ways: one is simply to cut and soak them in salt and water, adding a few herbs to give them a flavour; the other is to dry them in the sun, whereby they become black; they are then put into jars, with oil, salt, and pepper, or other spices, adding also a few herbs. When eaten, they are invariably flavoured with oil and a little vinegar. The Italian shepherd often takes nothing to the field with him but a little bread, a flask of wine, and a horn of olives; indeed, bread and olives form a nutritive diet.

Fashion has done much in this country to introduce and create an acquired taste for green pickled olives at the dessert. They are chiefly taken with a view to remove the taste of the viands from the mouth, previously to enjoying the flavour of wine.

Three kinds of olives come to London, Italian, French, and Spanish. The former are the best, and are from Lucca; the French are from Provence, and are also excellent; the Spanish are larger, but more bitter.

2614. *Olives are pickled in the following manner:* being gathered before they are ripe, they are suffered to steep in water for some days, and afterward are put into a lye of water and barilla, with the ashes of olive stones calcined, or with lime; and after remaining there a sufficient time, are bottled or barrelled with salt and water. They are thought to promote digestion and give appetite.

2615. *But olives are chiefly cultivated for the oil which they produce,* and which, in the countries where they grow, forms as necessary an article in the culinary art as butter with us. Olive oil, called also *salad oil,* is also largely used in Britain for the more delicate parts of our cookery, instead of butter, and is a useful addition to salads, preventing them from running into fermentation and producing flatulency. When the fruit is ripe, it is put into a bag of rushes, and the oil is forced out by gentle pressure. The first affords the virgin or best oil; a second quality is procured by a pressure sufficient to break the kernels. After the oil has been drawn, it deposites mucilage, and, when sufficiently clear, it is put into clean flasks, as we receive it. The greatest part of our best oil comes from Italy, and is known by the name of Florence, Lucca, and Gallipoli oil. Some is also brought from Spain and the Grecian islands. When quite fresh and pure, it has very little taste or smell, and is quite transparent, having only a pale greenish tint. It is sometimes adulterated with poppy oil.

SECT. IV.—ORANGE TRIBE.

2616. To the orange tribe or genus (*Citrus*) belong the *sweet orange*, the *Seville*, or *bitter orange*, the *lemon*, the *citron*, the *lime*, and the *shaddock*. They are all remarkable for containing much *citric acid* in their juice, and a very odoriferous and inflammable, acrid, essential oil in their outer rind. Besides these principles, they also contain the malic acid, and more or less of the saccharine and bitter principles. In the orange the sugar is prevalent, but in the Seville orange the bitter principle prevails.

The acid varieties are much used in medicine, and in the manufacture of cooling drinks; the sweet varieties are esteemed for the dessert, and the bitter as stomachics. The rind affords the essential oil of lemon and bergamot; and from the flowers a fragrant aromatic water is distilled. The unripe, or abortive fruits, called Curaçoa oranges, are used to flavour the delicious liqueur called *Curaçoa.* They are natives of the warmer parts of Asia, though they have been long introduced into the West Indies, the tropical parts of America, the Atlantic isles, and the warmer parts of Europe.

SUBSECT. 1.—*Sweet Orange* (*Citrus Aurantium*).

2617. This very useful and agreeable fruit gives us a striking instance of the advantages of commerce. Although the production only of countries much warmer than our own, we enjoy it nearly at the price of our ordinary fruits; and this is the more important, since it is perhaps the most refreshing and healthy of all fruits of warm countries. It is calculated that about 27,000,000 oranges are annually imported into England, and they are brought without any preparation farther than wrapping each separately in paper, and packing them in boxes.

Most of the oranges and lemons intended for exportation are gathered before they are quite ripe, for if they were mature, they would spoil in the carriage. The gathering of them for the British market usually occupies from the beginning of October to the end of December. They are not ripe till the spring. Though the name of China is attached to it, it is doubtful whether it was originally a Chinese fruit; and it has been supposed by some classical commentators that the golden apples of the Hesperides were the orange.

2618. *The best come from St. Michael's,* in the Azores, where they were introduced by the Portuguese; but very good ones are brought from Portugal, Spain, and Malta: some also grow in the south of France and Italy, but they are inferior.

The orange-tree may be mentioned as an instance of extraordinary fecundity: a single tree at St. Michael's has been known to bear in a season 20,000 oranges fit for packing, exclusive of those damaged and wasted, amounting to at least one third more. The delightful perfume of an orange-grove is such as to scent the air for miles, and the tree gives a succession of flowers during the whole summer.

Magnificent conservatories have been erected for them in countries where they do not bear the cold of winter. The first orange-trees were brought to England by Sir Walter Raleigh. At Hampton Court there are some said to be 300 years old; these, and also some at Windsor, are kept in green-houses during the winter, and are wheeled into the open air about the middle of June, when the perfume of their flowers is delicious. In point of age, these are far surpassed by those at Cordova, in Spain, the seat of ancient Moorish grandeur: some trees there are said to be six or seven hundred years old. In Devonshire and in other parts of England they have produced fine fruit when trained against walls and sheltered with mats. At Mr. Pugh's villa, at Rouen, there is a collection of a hundred orange-trees in boxes above seventeen feet high, and several centuries old; in winter they are kept under cover. In 1823 these produced 1400 lbs. of blossoms, which sell, on an average of years, at 2*s*. 4*d*. per pound, for the purpose of making orange-flower water.

2619. *The agreeable sub-acid of the orange* renders it one of the most agreeable, cooling, and wholesome of fruits; and the essential oil in the rind is serviceable to the cook in giving flavour to many dishes.

2620. *The varieties of the orange are numerous;* but the most important, as enumerated by Professor Burnett, are, 1, the common sweet orange; 2, the China; 3, the Majorca; 4, the Nice; 5, the Genoa; 6, the thick-rinded Portugal; 7, the tea-fruited; 8, the double-flowered; 9, the ribbed; 10, Malta, or blood-juiced; 11, the St. Michael's; and, 12, the Oporto, or pipless pot oranges.

2621. *It is observed in the Library of Entertaining Knowledge:* "The extraordinary consumption of a production which is brought here from very distant places is a natural consequence of certain qualities which fit the orange, in a remarkable degree, for being the universal fruit of commerce. If we would have foreign figs and grapes, they must be dried, for the undried grapes, which we bring even from the short distance of Portugal, are flat and vapid; the tamarind is a liquid preserve; the guava must be made into a jelly; the mango destined for us requires to be pulled before it is ripe, and is pickled; the date must be dried; and the cocoanut becomes, when here, consolidated and indigestible. With regard to the orange, man may have it fresh in every region of the world, and at almost every season of the year. The aromatic oil and the rind preserve it from the effects both of heat and cold; and the acridity of the former renders it proof against the attacks of insects. It is true that oranges rot, like other fruits; but that does not happen for a long time, if the rind is uninjured and they are kept from moisture, and so ventilated as not to ferment."

SUBSECT. 2.—*Seville Orange* (*Citrus Vulgaris*).

2622. This variety, called also the *bitter orange*, is of the same species as the sweet orange, and grows in great abundance on the banks of the Guadalquivir in Andalusia, from which they are chiefly obtained. In that part of Spain there are very extensive orchards of these oranges, which form the chief wealth of the monasteries. The pulp of the bitter orange is not eaten raw; in the yellow rind, separated from the white, spongy substance immediately below it, there is contained an essential oil, which is an agreeable warm aromatic, much superior for many purposes to that of the common orange. The best marmalade and the richest wine are made from this orange, and it is from the flowers of this that the best orange-flower water is distilled. They are also preserved whole as a sweetmeat.

SUBSECT. 3.—*Lemon* (*Citrus Limonum*).

2623. The lemon or citron tribe are natives of Asia, and appear to have been well known to the Romans: they are mentioned by Virgil and Pliny, but only as foreign fruit, and as antidotes against poison. It does not appear that they cultivated them. The citron is found wild in that part of India which is beyond the Ganges; also in Assyria and Persia, and was brought into Europe by the Arabians. It is now abundant in the south of France, Italy, Spain, and the West Indies.

The lemon is hardier than the orange. In some parts of Devonshire lemon-trees are trained to the walls, and require no more than a covering of straw or mats during the winter. Earl Paulet presented some of these lemons to George III. upward of fifty years ago, which grew in the garden of his sister, Lady Bridget Buttord. They were first cultivated in this country in the reign of James I., and are now not uncommon in our green-houses.

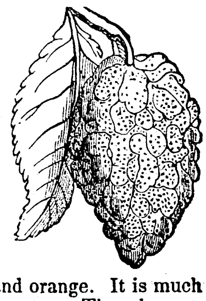
2624. The fruit in common use, however, is imported from Spain, Portugal, and the Azores, packed in paper, in the same manner as oranges. The Spanish are the most esteemed; those of St. Helena are extremely fine, growing larger and milder than the others. This fruit is not an article of mere luxury, but is almost an essential for culinary and many other purposes. The juice consists chiefly of the *citric acid*, which, besides its agreeable flavour, is particularly cooling and grateful. But the discovery of its antiscorbutic influence gives it a still higher value.

2625. *The scurvy, formerly so fatal in ships* making long voyages, is now *almost wholly unknown* in them: a result that is, in a great measure, to be attributed to the *regular allowance of lemon juice* served out to the men. The juice may be preserved in bottles for a considerable time by covering it with a thin stratum of oil; thus secured, great quantities of it are exported from Italy and Turkey to various parts of the world; it is also frequently administered as a medicine, and is extensively employed in the manufacture of punch. The citric acid is also prepared in a pure state, and crystallized, by which means it can be preserved in any climate, and for any length of time; but it is found that the crystallized acid is inferior to the recent juice. *Shrub* is made of lemon juice, sugar, and rum.

2626. *The outward rind or peel of the lemon contains* a highly odoriferous essential oil, and on that account it is a valuable and agreeable stomachic, and is used for flavouring a variety of dishes; it is warm, aromatic, and slightly bitter: it is also made into an excellent sweetmeat when cleared of the pulp and preserved by sugar, well known by the name of *candied lemon peel*. A liqueur is made by the inhabitants of Barbadoes from lemon peel, in a manner peculiar to themselves, called *Eau de Barbade*.

Subsect. 4.—*Citron* (*Citrus Medica*, Linn.).

Fig. 513.

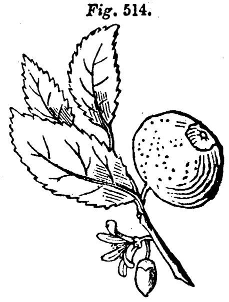


2627. This fruit (*fig.* 513) belongs to the same species as the lemon, being considered only as a variety, the distinction between them not being very great. It is larger and less succulent, but more acid; with a little artificial heat the citron comes to as great perfection in England as in Spain and Italy. The fruit is oblong, and about five or six inches in length. The tree is thorny. The juice forms an excellent lemonade with sugar and water. Its uses in punch, negus, and in medicine, are well known. The rind is very thick, and, when candied with sugar, forms an excellent sweetmeat. There are several varieties cultivated in England, one of which is termed the *forbidden fruit.*

Subsect. 5.—*Shaddock* (*Citrus Decumana*).

2628. This is also a variety of the same species as the lemon and orange. It is much larger than these, the fruit being from three to six inches in diameter. Though a native of China, it is cultivated largely in the West Indies, where it was first carried by Captain Shaddock. In its native country it is a sweet fruit, with little acidity; but in the West Indies, through neglect in its cultivation, it has degenerated into a sour fruit. It is handsome, and contains abundance of juice, which, diluted, is used as a beverage, and in making punch. Though less agreeable in its flavour than the orange, it keeps fresh and good longer at sea: hence it is valuable.

Fig. 514.



Subsect. 6.—*Lime* (*Citrus Acida*, Rox.).

2629. This (*fig.* 514) is also a variety of the lemon, but much smaller, being only about an inch or an inch and a half in diameter. It is not much cultivated in Europe, but, being more acid and cooling than the lemon, it is a great favourite in the West Indies, where lime punch is more esteemed than any other. The greatest part of our citric acid is prepared from its juice. There are several varieties.

Sect. V.—pulpy fruits.

2630. These have their seeds lying among the pulp, and are not enclosed in a nut or membrane like the grape.

Subsect. 1.—*Pineapple* (*Bromelia Ananas*, Linn.).

2631. It is the gardener's boast that this delicious fruit is produced in every part of Britain, by the employment of artificial heat, in greater perfection, both as to size and flavour, than in the West Indies, where the climate is natural to them. It grows wild in vast abundance in many parts of Africa and South America, and is cultivated in the hotter islands of the West Indies, where it requires but little attention to procure this elegant fruit in perfection and plenty. In Jamaica, pineapples have become so prolific that they are often used to flavour rum, and a wine is made from the fermented juice of the sweeter sorts nearly equal to malmsey.

2632. It has not been known in Europe above two hundred years, and has not been cultivated in England much above a century. It is stated that the first pine-apples raised in Europe were by M. la Cour, of Leyden, about the middle of the seventeenth century, and it is said to have been first cultivated in England by Sir Matthew Decker, of Richmond. In Kensington Palace there is a picture in which Charles II. is represented as receiving a pineapple from his gardener, Rose, who is presenting it on his knees.

2633. *At present, pineapples may be procured* any day of the year in London with more certainty than in their native countries, and of late their price has been very much reduced. It derives its name, probably, from the resemblance which the form of the fruit bears to that of the cone of the pine. This fruit is formed of many clustered tubercles, supporting crimson flowers: on the summit stands a crown of clustered leaves. While the fruit is growing, spines shoot out on all sides; but as it approaches maturity, these become dry and soft. It should be cut a little before it is quite ripe, and kept a few days. The largest pineapple ever grown in this kingdom was cut lately from the hot-house of John Edwards, Esq., of Rheda, Glamorganshire, and was presented to the king at Windsor. It weighed 14 lbs. 12 oz. avoirdupois, was 12½ inches high, exclusive of the crown, and 26 inches in circumference. It is the first of dessert fruits, and is, likewise, preserved in sugar, and made into marmalade. The malic and citric acids, which give to the juices, when fully ripe, their exquisite flavour, are abundant before maturity; the unripe juice is said even to have caustic properties, and at all times is so powerful as to corrode the knives with which the fruit is cut. In England, after the crown has been twisted off, the fruit is cut in horizontal slices; but in the West Indies it is cut obliquely, in the direction of the pips.

Subsect. 2.—*Grape* (*Vitis Vinifera*, Linn.).

2634. Next to the pineapple, grapes, when in perfection, have always been considered the most delicious fruit for the dessert.

2635. *The early history of the vine* is involved in the same obscurity as that of most of our vegetable productions. Its antiquity is unknown; but from the Scriptures we learn that its cultivation was of very early date. Bacchus was imagined to have taught its use in making wine, and was, in consequence, elevated to the rank of a god. Humboldt says that the vine now cultivated in Europe grows wild on the banks of the Caspian Sea, and in Armenia, which countries and Persia are probably its native place. From Asia it passed into Greece and Egypt, and thence into Italy and the rest of Europe. The Romans planted it on the banks of the Rhine; and France, now so remarkable for the excellence of its grapes, possessed none in the time of Strabo. It appears to have been brought into England towards the close of the Roman power, and in the time of the Anglo-Saxons it was cultivated in several parts of England; afterward, while the monasteries existed, few of them were without their vineyard.

It is a curious and interesting fact, which we shall enlarge upon in our account of wines, that in ancient times large quantities of wine were annually made in Britain. This has been supposed by some to indicate a change in our climate, an opinion, however, which is not sufficiently supported.

2636. *The grape vine has a limited range of latitude*, extending from the twenty-first to the fiftieth degree of N. latitude. Some varieties of it are found wild in America, particularly on the banks of the Ohio, where the French settlers have made tolerable wine from it. It is also cultivated in the same situation in the southern hemisphere, in South America, the Cape of Good Hope, and Australia.

2637. *Abundance of grapes ripen against walls in England* at present, but the best sorts are raised in vineries and hot-houses; the former are so common that there is scarcely a kitchen-garden worth notice without one; and, with the improvements of modern gardening, our hot-house grapes are not inferior in flavour to any produced in any part of the world.

2638. *The luxuriance and size of the vine in warm climates* is so great that it would scarcely be credited here, were it not well authenticated. Strabo relates that some bunches of grapes in Italy were a yard across. Bunches have been grown in Syria forty pounds in weight, but these are of a distinct species of grape. In England the bunches are usually from two to seven pounds, but they have been known to reach nineteen pounds.

The great vine at Hampton Court, planted in 1769, of the variety called black Hamburgh, occupies a space of 116 square yards, and has a stem thirteen inches in circumference; one branch is 114 feet long; it is a most productive bearer, having seldom fewer than 2000 bunches upon it every season, each weighing a pound on an average, or in all nearly a ton. Its parent, still existing in Valentine House in Essex, planted in 1758, is still larger, and nearly as productive.

2639. *The varieties of grapes are extremely numerous:* vine-growers enumerate in their catalogues nearly three hundred, of which between fifty and sixty are cultivated in Britain. These are classed according to the form and colour of the fruit, and are thus stated by Professor Burnett, in his "Outlines of Botany:" 1, the round black, or purple grapes; the grapes from which port wine is made belong to these; 2, the long black ones, to which belong the Hamburgh grapes; 3, the round white, or green grapes; 4, the long white and green ones; to the last two belong those brought from Portugal and Spain, packed in earthern jars; 5, the grapes of any other colours, such as red, roseate, blue, grayish, or variegated in stripes.

2640. *Of the round black grapes*, the most esteemed are the Damascus, the black Lisbon, the Muscat or purple Constantia, and the black Morocco. The claret grape is remarkable for its juicy pulp, being of a deep purple or blood colour, while in the others the dark tint is confined to the skin. The Ascalon, or black Corinth, when dried, constitutes the *currants* of commerce.

2641. *Of the long black grapes*, the best are Muscadel, the Burgundy, the purple Hamburgh, the black raisin, and the black Palestine.

2642. *Of the round white grapes*, the amber Muscadine, the malmsey Muscadine, the white Muscadine, the Pearl-drop, and the white Constantia are all excellent. The white Corinth or Ascalon is often without pips, and, when dried, is known as *Sultana* raisins.

2643. *Of the long white grapes*, the white Sokars, the white Muscat, the Morillon, or genuine Tokay, the white raisin, and others might be mentioned. The Verdelho, from which Madeira is made, is an excellent grape, but the stones should be rejected, as they are said to be deleterious when eaten.

2644. *Of the fancy grapes*, the red Muscat, the blue Tokay, the striped Aleppo, and the variegated Chasselas, are all worthy of cultivation.

2645. *Switzer informs us* that it is to Lord Capel and Sir William Temple we owe that collection of good grapes now so plentiful in England. The latter brought over the Chasselas and Frontignan, Amboyna, Burgundy, black Muscat, and grizzly Frontignan, and distributed them among the nurserymen, nobility, and gentry.

2646. *Grapes for the dessert* should be of a fine flavour, thin-skinned, sweet, and juicy. There is a superior richness in the black, blue, and red Frontignans, and there is a peculiar delicacy in the flesh of the white sweet water, which is also remarkably thin-skinned, with large berries. Grapes of the green and black sorts are imported from Portugal, and likewise from Malaga, and other parts of Spain, packed in large earthen jars having the interstices filled up with chaff, and the lids cemented down. They arrive here in little less than a week by the steam-packets. This method of preserving grapes was known to the Romans, and is described by Columella. Grapes are also brought from Hamburgh and Frankenthal, and sold at one shilling, and even eight pence per pound: arriving in less than twenty-four hours from Holland, they have all the plumpness and bloom of fresh-gathered fruit.

2647. *Used as food*, grapes are extremely nutritive in general, and very wholesome if quite ripe. They are better eaten with bread, as is the case in France, where they form a frequent breakfast for the working classes. Of the juice of unripe grapes, a pleasant cooling summer beverage is made; but the fruit should not be eaten in that state. The chemical composition of grape juice will be stated when treating of the mode of making grape wine.

2648. *Raisins* are grapes that have been allowed to shrivel and dry partly on the tree; they are then cut off and dried in the sun; hence they are sometimes called *sun raisins*, to distinguish them from others dried in ovens. They are also called *jar raisins*, because they come to us in jars. By drying they lose about two thirds of their weight, and become covered with a saccharine exudation. Some raisins come from Spain, Calabria, Smyrna, &c. The Malaga are the largest and most highly prized for the table, known here generally as *Muscatel*, and sell for double the price of any other. They are the produce of the provinces of Valentia and Grenada. On the hills round Malaga there are upward of 7000 vineyards. The first gathering of grapes for some raisins commences in June; from those gathered in September, *Xeres Secco*, or *sherry*, is made, the sack of Shakspeare; and a third, in October and November, produces the wine known on the Continent as *Malaga*, and in England as *mountain*. *Common raisins* are made from various kinds of grapes, better or worse; they have a slight degree of acidity, which renders them less agreeable than the best.

2649. *Dried currants*, so much used in Christmas pies and puddings, are a kind of little raisins, or dried grapes, that grow in, and are brought from, the Ionian Islands. The chief place from which they were formerly imported was the Morea, or the Isthmus of Corinth, whence the name, *corinths*, converted into *currants*.

2650. The island of Zante is the chief place from which currants are now brought; some are from Cephalonia and Ithaca. When they are collected in August from the vines, which grow quite low, they are spread out and dried in the sun, and then packed in casks quite close till they are wanted. They get thus so fixed together that they require to be dug out with an iron instrument. See, farther, on the subject of grapes, in Book VIII., Chap. IV., "On Wines."

Subsect. 3.—*Melon* (*Cucumis Melo*, Linn.).

2651. The flesh of this fruit is very delicious, being succulent, cool, and high-flavoured. With us it is used only at the dessert, and is generally eaten with sugar, ginger, or pepper; but in France it is likewise served up at dinner as a sauce for boiled meats. It grows wild in Tartary, and has been lately found in abundance on the sandy plains of Icypoor. It was brought originally from Asia by the Romans, and is said to have been common in England in the time of Edward III., though it is supposed that it was lost again, as well as the cucumber, during the wars of York and Lancaster.

The best kind, called the *Cantaloupe*, from the name of a place near Rome where it was first cultivated in Europe, is a native of Armenia, where it grows so plentifully that a horse load may be bought for a crown.

Melons require a high temperature to raise them in perfection; and though no country has a greater variety of them than England, yet they have a high price in our markets. In France they are grown in such abundance that whole villages are occupied exclusively with their cultivation; and, in consequence of the practice which the people have, their culture is well understood. While in France and England melons are grown as articles of luxury, in some parts of the East they are used as necessaries of life. Niebuhr informs us that in Africa melons are planted in the fields, and that they are used by all ranks of Arabians as common food.

2652. *But although the melon is a very delicious fruit, it is not one of the most wholesome*; and the coldness of its nature demands that it should be accompanied by warm and stimulating condiments. Large melons are too often preferred on account of their showy appearance; but the small ones, when ripe, are often the most highly flavoured. There are many varieties of this fruit of several degrees of excellence. When a melon is perfectly fine, it is full without any vacuity; this is known by knocking upon it; and when cut, the flesh should be dry, no water running out, only a little dew, which should be of a fine reddish colour.

2653. *The watermelon* requires a warm climate to bring it to perfection in the open air. Its sweet and succulent flesh, and gratefully cool juice, render it particularly agreeable in those countries where it grows abundantly. The juice is sucked out by a hole made in the rind. In Upper Egypt, whole districts on the banks of rivers are planted with watermelons; they grow in sand. The Egyptians eat them in such abundance that they would seem to be almost their only meat and drink, and they form their most common medicine in cases of ardent fever; but Hasselquist recommends caution in their use, "as they chilled his stomach like ice." The fruit often grows to a large size in this country; but in Senegal one has been known to weigh sixty pounds. In some parts of India, where rain does not fall for fifteen months, watermelons sometimes weigh from fifteen to seventy pounds. They were introduced into England with the common melon, but are seldom cultivated, as the juice, though useful in a warm climate, is insipid. One kind of watermelon is pickled like gherkins, and is much used by the French cooks in their fricassees; it is also sometimes baked in sweet wine.

SUBSECT. 4.—*Cucumber* (*Cucumis Sativus*, Linn.).

2654. *This fruit is allied to the melon*, though far inferior in point of flavour. It appears to have been cultivated at a very early period, for it is mentioned in the Mosaic history as one of the fruits which the Israelites enjoyed in Egypt, and of which they regretted the loss. We are informed by travellers that it, together with other fruits of this class, still forms a great part of the food of the people in Egypt. Bishop Heber saw them raised in India beyond the Ganges, and Burckhardt observed them in Palestine. Pliny mentions them as growing in great quantities in Africa. It was a very great favourite among the Romans, who raised them by artificial heat, and they were introduced into England together with the melon.

2655. *Cucumbers are chiefly used as salad with meat or fish*, and *young* ones are pickled under the name of *gherkins*. They are cold, and more difficult of digestion than most vegetables when eaten raw; and they are generally dressed with pepper, vinegar, and oil, chiefly with a view to correct their cold qualities. Cucumbers are now much less used in their natural state than formerly among wealthy families; but they are in request for stews and made dishes, and when preserved they are esteemed one of the most agreeable sweetmeats. They are excellent, and more wholesome when stewed with gravy. The expressed juice of the cucumber is employed as a cosmetic, giving a pleasant suppleness to the skin, and it enters into the composition of several French pomades.

SUBSECT. 5.—*Fig* (*Ficus Carica*).

2656. *The fig-tree is a native of Asia*, and was known to the Israelites, as we learn from the Scriptures. The fruit appears to have formed a principal article of food among the inhabitants of ancient Syria and Greece, and was so much esteemed for its nutritive qualities, that it was considered as an emblem of fruitfulness. Like the cerealia, it enjoys a considerable range of latitude.

Dried figs and barley-bread are a general food among the lower classes of Greece in the present day. In the northern parts of France there are many fig gardens; but it is not generally cultivated in England, except on walls, or in the hot-house, the climate being scarcely warm enough to admit of its flourishing as a standard in the open air; nevertheless, it will ripen its fruit in some open situations in the south part of England. There is an orchard of fig-trees at Tarring, near Worthing, where the fruit ripens nearly as well as in Spain, and the trees are exceedingly productive. There are also some fig-trees above thirty feet high in the gardens at Arundel Castle. Figs grow, likewise, in some other places, and there is no doubt that they could be easily raised for fruit on the coast of Sussex, if sufficient attention were paid to that object. It is generally supposed that the fig was not planted in England before the reign of Henry VIII., when the arts began to be encouraged, and noblemen's houses first put on the air of Italian magnificence. There are at present some fig-trees in the Episcopal Gardens at Lambeth, said to have been planted by Cardinal Pole; and at Oxford, in the Botanic Garden of the Regius Professor of Hebrew, there is a fig-tree which was brought from the East, and planted by Dr. Pococke in 1648.

2657. *The fig contains* a large portion of sugar, without acidity or oiliness, and is of easier digestion than any other of the sweet fruits. They are considered to be laxative.

2658. *The best dried kinds* come from Turkey, Italy, Provence, and Spain. Smyrna is a great mart; but the figs of the Grecian Archipelago are inferior to those of Europe. Figs are prepared by dipping the ripe fruit in a scalding hot lye made of the ashes of the fig-tree, and then dried in the sun, or in ovens, and packed very close in chests. In the Canaries, Portugal, and the Grecian islands they make a kind of brandy from them.

In medicine, figs are employed as emollient cataplasms and pectoral decoctions

SUBSECT. 6.—*Tamarind* (*Tamarindus Indica*).

2659. The tamarind is the fruit, or, rather, pod of a tree which is a native of the East and West Indies, and thrives also in Egypt, Palestine, and Arabia. In the countries where it is produced it forms occasionally an article of food, in the form of confectionery, and is esteemed on account of its pleasant acid and cooling qualities, so useful in a warm climate. The pod consists of two parts; the outer is fleshy, and the inner thin as the finest parchment: between these two there is a space of about a quarter of an inch, which is filled up with a soft, pulpy substance of a tart but agreeable taste; this, and the seeds which are enclosed in the inner pod, are fastened together by many slender fibres from the woody stalk which runs through the pod. The tree is common in Jamaica, is extremely beautiful, and grows to a great size, with large, spreading branches, and a thick and luxuriant foliage. The pods are gathered when ripe, freed from the shelly fragments, and placed in layers in a cask; boiling sirup is then poured over them till the cask is filled; the sirup pervades every part quite to the bottom, and when cool the heads of the casks are fixed down for sale. The more elegant method, however, is to clarify the juice of the fruit with the white of eggs, and form it with sugar into a clear, transparent sirup; this or the fruit supplies an agreeable and cooling beverage. The East India tamarinds are generally preserved by putting alternate layers of tamarinds and powdered sugar into a stone jar, by which means the fruit retains more of its natural taste and appearance. They are also sent from the East Indies in their natural state without sugar; but except these are kept in very close jars, they are apt to get musty.

2660. *According to Vauquelin, tamarinds contain* in the pulp, independent of the sugar used to preserve it, super-tartrate of potassa, gum, jelly, citric acid, tartaric acid, malic acid, and a feculent matter. The acid taste depends chiefly upon the citric acid, the quantity of that being the greatest.

Sect. VI.—nuts.

2661. *These are seeds or fruits rather dry*, and not fleshy or pulpy, enclosed in a hard woody shell or husk. Nuts of various kinds are spoken of as much employed for food in ancient times, and they still furnish in some countries a considerable source of aliment.

2662. *The edible part, or kernel, usually contains a good deal of oil*, and although they are nutritive, they are less digestible than most other vegetable substances. The principal fruits of this class used as food in England are the walnut, chestnut, and filbert, grown in England, to which we may add the acorn, the exotics, cocoanut, cashew nut, and pistachio nut.

Subsect. 1.—*Walnut* (*Juglans Regia*, Linn.).

2663. The walnut is a native of Persia, the Caucasus, and China, but was introduced to this kingdom from France.

2664. *The ripe kernel is brought to the dessert* on account of its agreeable flavour, and the fruit is also much used in the green state, before the stone hardens, as a pickle. In Spain grated walnuts are employed in tarts and other dishes. The walnut abounds in oil, which is expressed, and which, being of a highly drying nature, and very limpid, is much employed for delicate painting. This, on the Continent, is sometimes used as a substitute for olive oil in cooking, but is very apt to turn rancid. It is also manufactured into a kind of soap. The marc, or refuse matter after the oil is extracted, proves very nutritious for poultry or other domestic animals; in Switzerland this is eaten by poor people, under the name of *pain amer*.

2665. The sap of the walnut-tree is very saccharine, and sugar may be made from it by evaporation; it may also be fermented into a kind of wine. The leaves and green husks afford an extract, by maceration in warm water, that acts as a very permanent brown dye for staining hair, wool, and wood, and is said to be employed by the gipsies to give a dark colour to children whom they have stolen.

Subsect. 2.—*Chestnut* (*Fagus Castanea*, Linn.).

2666. The chestnut was known to the Romans, who called it Castanea, from a city of that name in Thessaly, whence they first procured it; and it was grown abundantly by the ancients, and much used as food. It is so common in Italy and France that it is often considered to be a native of these countries. The chestnut lives to a very great age, and forms some of the oldest trees in the world; as the celebrated one mentioned by Brydone on Mount Ætna, under which a hundred horsemen are said once to have taken shelter; that at Fortworth in Gloucestershire, and one at Marsham, calculated to be 1100 years old. This tree was probably introduced into England by the Romans. It grows commonly in the warmer parts of Britain; but the fruit seldom comes to maturity in Scotland.

2667. In the southern parts of the Continent, chestnuts form a very large portion of the food of the labouring classes, who, besides eating them both raw and roasted, make puddings of them, and polenta for pastry. Boiled chestnuts and milk form a common breakfast among the peasantry in the south of France; and in Corsica, as well as several districts of Spain, they are cooked in various ways. Mr. Phillips says (*Pomarium Brit.*, p. 95), "Chestnuts stewed with cream make a much admired dish, and many families prefer them to all other stuffings for turkeys: they make an excellent soup, and I have no doubt but that chestnuts might be advantageously used in cooking, so as to make many agreeable and wholesome dishes. I have had them stewed and brought to table with salt fish, when they have been much admired; but it is exceedingly difficult to introduce any article as food that has not been established by long custom; and it is not more strange than true that the difficulty increases if the object be economy."

2668. The chestnuts that grow commonly in this country are inferior in size and perfection to those which are imported from Spain, Portugal, and Italy: these are frequently kiln-dried to prevent germination in the passage. In Britain, little use is made of the chestnut except at the dessert, for which it is roasted, when it becomes farinaceous or mealy, like a sweet potato.

2669. It is, indeed, the most farinaceous and the least oily of all the nuts, and therefore it is the most easy of digestion; but raw chestnuts are not digestible by every one.

2670. *The tree called the horse-chestnut*, from the resemblance of its fruit to that of the chestnut, is very different. Its fruits are astringent and bitter, and unfit for human food; nevertheless, they contain so much farinaceous matter, that they are very nutritious to some animals, and horses and deer devour them greedily. They are likewise detergent, and have been used as a substitute for soap. A patent was taken out some years ago for preparing starch from them, by which much esculent grain might be saved.

Subsect. 3.—*Hazelnuts and Filberts* (*Corylus Avellana*, Linn.).

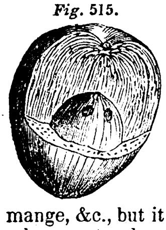
2671. *The common hazel is the wild, and the filbert the cultivated state of the same tree.* The hazel is found wild, not only in forests and hedges, in dingles and ravines, but occurs in extensive tracts in the more northern and mountainous parts of the country. It was formerly one of the most abundant of those trees which are indigenous in this island. It is seldom cultivated as a fruit tree, though, perhaps, its nuts are superior in flavour to the others. The *Spanish nuts* imported are a superior kind, but they are somewhat oily, and rather indigestible. *Filberts*, both the red and the white, and the cob-nut are supposed to be merely varieties of the common hazel, which have been produced, partly by the superiority of soil and climate, and partly by culture. They were originally brought out of Greece to Italy, from whence they have found their way to Holland, and from that to England. It is supposed that, within a few miles of Maidstone, in Kent, there are more filberts growing than in all England besides; and it is from that place that the London market is supplied. The filbert is longer than the common nut, though of the same thickness, and has a larger kernel. The cob-nut is a still larger variety, and is roundish. Filberts are more esteemed at the dessert than common nuts, and are generally eaten with salt. They are very free from oil, and disagree with few persons.

Subsect. 4.—*Cocoanut.*

2672. *This magnificent nut* is the produce of one of the palms (*Cocos nucifera*) which grows wild abundantly in the eastern parts of Asia and the islands of the Indian seas, from which it has been introduced into every part of the tropical regions, the property which the fruit has of not being destroyed by sea-water, favouring its transportation. The tree, like the rest of the palms, is tall and straight, being from thirty to sixty feet in height, and sometimes more, having the leaves only at the top, and the nuts hanging in bunches of about a dozen each, under the leaves: one tree, in a good soil, has sometimes a hundred cocoanuts annually. Some trees will bear blossoms every four or five weeks; hence there are generally fresh flowers and ripe nuts on the tree at the same time. The tree will continue to flourish for a century.

2673. The fruit is covered externally by a thin, tough rind, of a brownish-red colour.

Fig. 515.



Immediately within this is a quantity of tough fibres (*fig.* 515); and in the midst is enclosed the nut itself, which consists of a very hard shell, containing a kernel of a white substance, being itself hollow. The kernel, in its fresh state, is very nutritive, containing a good deal of fixed oil: it is eaten raw, or made into cakes or fritters when rasped; but, when it arrives in England, it is generally dry and indigestible. While the nut is green, the whole of the shell is filled with a juice called the milk, which is agreeably sweet and refreshing. When this can be procured, in its native country, it forms a delicious beverage; it is used as milk with coffee, and is employed for custards, blanc-mange, &c., but it is seldom found in any quantity in the cocoanuts brought to England: a large nut, when fresh, will give half a pint of milk. When it is very young, the pulp is so soft that it may be eaten with a spoon, and, with a little Madeira wine and lime juice, is excellent. When about a quarter ripe, the shell is thin, and so transparent that it is used to hold a light by way of a lantern: there are three holes in it, which give it somewhat the appearance of a monkey's head; from one of these the germe, or young plant, rises when the nut is planted in the ground. The oil obtained by pressure from the kernel is used for burning in lamps.

2674. *Perhaps no tree furnishes so many useful products as the cocoa*, and, where it exists in abundance, it seems to supply almost all the necessaries of life. The woody shell of the trunk, when of considerable age, is tough and durable, and is employed in building huts; it is sometimes so hard as even to be capable of receiving a very fine polish. The terminal leaf buds at the top of the tree are very tender and delicate, and, when boiled, resemble cabbage: they are pickled with vinegar; but they can be had only at the expense of the tree, which dies if they are cut off. The bases of the leaf-stalks afford a reticulated substance, like gauze, that is used by the Indians for coverings for cradles and for strainers. The leaves themselves are used for thatching houses, and ceilings are formed of them. Various articles are also manufactured from them, as baskets and wicker-work; also masks to protect the face from the sun: when young they are transparent, have a fine texture like satin, and are used for making lanterns; they are also employed for writing upon by scratching with a pointed iron instrument. Of the small leaves baskets for catching fish are made; also combs and brooms. They serve also for fuel, and for torches in travelling, and to keep off wild beasts; their ashes, which contain much alkali, are used for washing or making soap. The central rib of the leaf is employed for oars; and the end of it, well bruised, answers as a broom or a brush for whitewashing. The fibrous coverings of the blossoms are made into aprons or petticoats for women. The fibres in the nut afford a material of which ropes and strong cables are twisted, which endure in salt water much better than those of hemp, and are even employed in manufacturing course sail-cloth: they are likewise used for stuffing mattresses, cushions, &c. The marc, or refuse of the nut after the oil is expressed, serves as food for cattle; and the roots of the tree are sometimes chewed by the Indians instead of areca or betel nut. Of the shell of the nut a great variety of drinking-cups, ladles, spoons, and vessels of various kinds are made. From the sap of the tree, called toddy, arrack, a fermented liquor, is produced, superior to that from rice. When fresh toddy is boiled over a slow fire, it thickens into a sweet luscious substance, named *honey;* and, if this is farther boiled, it forms a coarse brown sugar, called *jaggery,* which is often dried into round cakes for keeping. In short, there is no part of the tree but is employed for some useful purpose, and it is certainly one of the most valuable gifts bestowed by Providence upon the inhabitants of tropical climates; and yet, with respect to fruit, the cocoanut tree is one of the least productive of the palm tribe. Another species of this class, the *Seje* palm, bears 8000 fruits at once; a single spathe of the date palm contains 12,000 flowers, each of which should afford one fruit; and in a third species, the *Alfonsia Amygdalina,* there is the enormous number of 207,000 flowers on each spathe.

2675. *The cacaonut,* pronounced, improperly, *cocoa,* from which our chocolate is made, is a very different fruit from that just described; and as it is not eaten as a fruit, we shall reserve our account of it to the description of "Cocoa used as a Beverage," Book VIII., Chap. XII.

SUBSECT. 5.—*Date* (*Phœnix Dactilifera,* Linn.).

2676. *This is the fruit of one of the palm tribe,* and forms a principal part of the food among the Arabs and inhabitants on the margin of the great sandy deserts in the north of Africa, where there is scarcely any other esculent vegetable. There this majestic monarch of the thirsty land, affording the only shade and food to be met with, is hailed by the traveller with greater pleasure than, perhaps, any tree in another situation. It shoots up a single straight stem to the height of fifty or sixty feet, and then throws out a magnificent crown of leaves, graceful and pinnated.

2677. The fruit, before it is ripe, is somewhat astringent, but when thoroughly mature it is excellent, being rich in sugar, gum, and other vegetable matter, with little acid; it is extremely agreeable and sweet, and affords wholesome nutriment. If required to be kept or transported, it must be dried in the sun. The Arabs reduce dates, when dried, to a kind of meal, which they preserve for food when they undertake long journeys across the deserts, and they will subsist for a considerable time upon date-bread.

2678. In Egypt an agreeable conserve is made of fresh ripe dates. They form a kind of solid paste or cake of them, by pressing them into baskets while soft, and in this state they are brought to market, and cut out in lumps, which are sold by weight for the daily food of the inhabitants. Mixed with water, they also compose a refreshing drink. The wood and leaves of the date-tree serve for many of the same uses to which the cocoanut palm is applied, above mentioned.

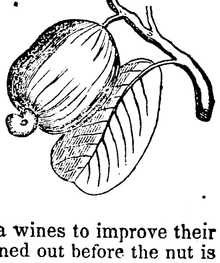
2679. *Dr. Clarke observes that a single date palm* will bear upward of a hundred weight, and sometimes between two and three hundred weight of dates in a season: they come into bearing at about six to ten years of age, and are fruitful for upward of two hundred years. The young shoots are good to eat, and resemble asparagus. The stem of the date-tree likewise affords an inferior kind of sago, and from its juice a fermented liquor is made.

2680. *Dates are imported into Britain in a dried state* from Barbary and Egypt, and, when in good condition, they are much esteemed. An inferior kind has lately become common, which are dried hard, and have little or no flavour. They should be chosen large, softish, not much wrinkled, of a reddish yellow colour on the outside, with a whitish membrane between the flesh and the stone.

SUBSECT. 6.—*Cashew Nut* (*Anacardium Occidentale,* Linn.).

2681. This is a tropical production. The nut (*fig.* 516), which a good deal resembles the walnut, grows at the end of the fleshy, pea-shaped receptacle called the apple. It has an agreeable sub-acid taste, and may be fermented into a kind of wine. The juice is also much used in the West Indies for making punch and other beverages.

Fig. 516.



2682. The eatable kernel is contained within two shells, and between these shells there is a thick rust-coloured liquor, extremely inflammable, and so caustic that it will blister the skin: this is used as an indelible marking ink for linen. The kernel is of a very fine flavour, preferable to the walnut, and employed in puddings and many other compositions of the cook, abounding in a delicious milky juice when fresh, and may be eaten raw, roasted, or pickled. Some also grind it with cacao in making chocolate, the flavour of which it is said to improve.

2683. The broken nuts are used for steeping in old Madeira wines to improve their flavour. The acrid inflammable oil of the shell should be burned out before the nut is eaten; for, if incautiously cracked by the hands or teeth, the caustic oil will blister the lips and excoriate the skin where it touches. It is said that the milky juice of the tree itself, obtained by tapping or incision, forms a black marking ink for linen that cannot be washed out. The nuts are eaten abundantly by the negroes in Brazil.

SUBSECT. 7.—*Pistachio Nuts* (*Pistachia Vera*).

2684. These nuts are brought to us from Sicily and Syria, where they grow upon a kind of turpentine-tree. They are oblong and pointed, about the size and shape of a filbert, including a kernel of a pale greenish-colour. Their taste is very agreeable, much resembling that of sweet almonds; but they are sweeter, have more flavour, and are more oily; hence they are liable to become rancid. On the Continent, in places where they are plentiful, they enter into the composition of ragouts and various dishes. A variety (*P. Atlantica*) is slightly acid, and is made, with dates, into cakes by the Arabs.

SUBSECT. 8.—*Brazil Nut.*

2685. These are also called *chestnuts of Brazil*, and are brought to us from Para. They are much esteemed, having a kernel resembling that of the almond, but larger, containing a great deal of oil, and tasting more like the hazelnut. The kernel, of a wedge-like form, is found within a very hard shell, as large as a child's head, which grows in clusters of fifteen or twenty. The tree which produces them is a Juvia, rising to the height of 100 or 120 feet, and abounding on the banks of the Oronoco.

SUBSECT. 9.—*Acorn.*

2686. The acorn, which is the well-known fruit or nut of the *oak-tree* (*Quercus*, Linn.), formed part of the food of man in the early ages, before the use of corn was known, and frequent allusion is made to this circumstance by the classic writers. They are seldom used at present, except for the fattening of hogs, deer, and poultry.

It is not certain that the acorn was ever employed as the common food of the inhabitants of this island, although they might have been among the ancient Britons. Oak forests in the time of the Saxons were much prized, chiefly for the fruit, which was useful for fattening hogs, the flesh of which was the principal food of the people at that time, a circumstance attributable to the great rapidity with which the hog multiplies his species, and the little preparation required for its maintenance.

2687. The fattening of hogs upon acorns was, among the Saxons, considered as an important part of domestic economy. Droves of swine were fed in the woods, particularly in the New Forest of Hampshire and the Wealds of Sussex. This right which the people enjoyed was called *pannage;* and the being deprived of it by William the Norman, who had a passion for converting all the forests into hunting-grounds, was one of the public grievances which was redressed by Magna Charta. The name is Saxon, *æcern* signifying corn of the oak.

2688. *The taste of common acorns is rough and disagreeable*, and they are astringent and difficult of digestion; even the hogs who feed upon them should go at large, and not be confined to the stye. Notwithstanding this objectionable quality, they have, in times of famine or great scarcity, been dried, ground into meal, and baked as bread in this country as well as in France, and it is said that they are still used in Norway and Sweden; but they are there first boiled in water, and mixed with one half or one third of corn flour, in which case they supply a nutritious food. Acorns are eaten at present in Spain, where they were long considered as a great delicacy, and even brought to the dessert. Cervantes often mentions them in his Don Quixote; but the Spanish acorns are sweeter than those of England. Some of the South American oaks produce acorns which are mild and nutritive. Acorns have been tried as a substitute for coffee, roasted, and having a little butter added to represent the oil in coffee; but they are not recommendable.

SECT. VII.—BERRIES.

2689. The name of berry (*Bacca*) is given to certain small fruits which consist of a pericarpium or skin full of juice or pulp, and seeds disposed throughout the pulp without any membranous capsule or covering. Almost all of those which we use as food grow upon shrubs cultivated in gardens, or are found wild on mountains or heaths. The most useful among them are the gooseberry, the currant, the raspberry, cranberry, and barberry, to which may be added the strawberry.

SUBSECT. 1.—*Gooseberry* (*Ribes Grossularia*, Linn.).

2690. This is perhaps the most useful of our fruits known by the name of berries. The best sorts form an excellent dessert fruit when ripe, and in their green or immature state they are employed in tarts, sauces, and creams. They are extremely useful when preserved, as they easily may be, throughout the winter. See Book X., Chap. IV., "Preservation of Food."

2691. The gooseberry is a native of cold climates, and is probably indigenous to these islands, or it has been long naturalized here, being found occasionally growing wild upon old walls, and in the woods and hedges in Cambridgeshire and Norfolk. It may be considered as peculiarly an English fruit, being produced in greater perfection here than in any part of the world. Foreigners are astonished at the size and flavour of this fruit among us. In Norway and Sweden the seasons are too rapid for its full development. The climate of Holland and some parts of Germany appear to suit it, and the pale kinds were first brought from Flanders in the time of Henry VIII. It grows wild in many parts of Europe, but the southern parts are too warm for it. Although it is found in Piedmont, the fruit is astringent and neglected. It is scarcely known in Italy and Spain, and in France it is little esteemed.

2692. *In its uncultivated state* it is a small berry, and it has been brought to its present state of perfection by the skill of English and Dutch gardeners; it may be easily raised in every cottage garden. The largest and finest in appearance are grown in Lancashire, where prizes are given for producing the largest; and the size of some shown upon these occasions is extraordinary, weighing an ounce or an ounce and a half. One gooseberry, exhibited in 1825, weighed 31 dwt. 16 grains; but the flavour of the very large sorts is inferior to that of the smaller kinds.

2693. *It would appear that the flavour improves with the coldness of the climate*, provided there be sufficient warmth to ripen them; for those grown in Scotland as far north as Aberdeen, and even Inverness, are of superior flavour.

2694. *There are numerous varieties of this fruit.* In vol. i., Series II., of the Transactions of the Horticultural Society, there is an account of seventy sorts, selected from those fruited in the Society's garden, and which were reckoned to have a good flavour, many of the large kinds having been rejected, their size not compensating for their coarseness. Some of the Lancashire growers enumerate above 300 sorts. The varieties are formed into four divisions, according to their colour when ripe, red, yellow, green, and white; and each of these again into hispid, downy, or smooth. The yellow gooseberries, in general, are sweeter, and have a more rich and vinous flavour than the white, which are often insipid. The green are sometimes extremely sweet, but generally inferior to the yellow, though sometimes very large. Of the red varieties, some are excellent, others rather acid; in short, every year produces new varieties, so that it is difficult to speak definitely of their characters. Some of them are early, and others late; of the latter, the variety called the *Pitmanston green-gage* is particularly deserving of notice, and in some seasons will hang till it shrivels, and almost candies on the tree. Gooseberries are not only very easily cultivated, but are, perhaps, the most wholesome of our fruits; and besides their use in the ordinary way, they are employed successfully for making excellent wine, which sparkles when the cork is drawn, and, when well made, is nearly equal to Champagne, and often passes for it. They are the earliest, as well as one of the best fruits for spring tarts, and are very easily preserved in the green state through the winter, so as to retain their natural flavour for tarts, cream, &c.; and when ripe, and preserved with sugar, they make excellent jams and jellies. From gooseberries being so useful for many purposes, both in a green and mature state, care is taken by the gardeners to have a succession of them through the summer months. The early sorts gathered green for tarts are to be had in April, or early in May, and until August. Some are ripe in June, and ripe gooseberries of a late sort are kept on the trees till September.

2695. *The pleasant acidulous flavour of the gooseberry is owing to the presence of malic and citric acid blended with sugar;* and upon the varied proportions in which these two principles are developed depends the fitness of the several varieties for dessert or kitchen use, for preserving, or for making wine.

Gooseberries and currants contain a large proportion of what has been named by chemists *pectic acid*, remarkable for forming the gelatinous coagulum when mixed with water, well known by the name of *jelly*.

2696. *The term gooseberry is supposed* to be a corruption of *grossberry*, the name among the ancient Latins being *grossulariæ*, from their resemblance to small unripe figs, or *grossi;* whence, also, the French *groseilles*.

2697. *The acid of gooseberries* may be procured in a separate form, the method of which is a late discovery by a French chemist. He ferments the gooseberry juice, distils off ardent spirit from it, which he reserves; the residual liquor he saturates with chalk, washes the insoluble powder thus produced, treats it with sulphuric acid, as in the process for extracting the crystallized lemons, filters off the liquor, and evaporates it, so that the crystals will form on cooling. By this mode 100 parts of gooseberries afford 10 of spirit, and 1 of crystallized acid, which is said to resemble citric acid.

Subsect. 2.—*Red and White Currants* (*Ribes Rubrum*, Linn.).

2698. Both these are considered to be varieties of the same species, since the berries in their wild state are all red, and it is cultivation that has produced the white and pale red varieties. There is little doubt that this elegant fruit is an improved native of Britain, being found wild (*Ribes sylvestre*) in many places. It has been supposed, however, that it has degenerated from the seedless grape of the Levant, still imported under the same name, currants. It is scarcely known in France, where it is distinguished from the gooseberry only by the name *groseilles en grappes*.

2699. *The white is preferred for the dessert*, being peculiarly juicy and cooling: they are best also for making wine. It is observed that all the white fruits of the berry kind are sweeter than the coloured, but other fruits that are coloured are generally sweeter than the white. Red currants are imported from Holland, and sold in Covent Garden market, after ours are out of season, at as low prices as our own. They are carefully packed in baskets of 15 or 20 lbs., and they consist only of large dry bunches, which keep better than ours. The red is used for tarts and in the preparation of jellies, and they are particularly useful, being easily preserved during the winter in bottles. Currants are not difficult to cultivate, and, being very hardy, they come within the attainment of every cottager who has a garden; when they are trained against the walls of the cottage they have an elegant appearance, not unlike that of the vine. Like gooseberries, they owe their pleasant flavour to the sugar and malic and pectic acids which they contain.

SUBSECT. 3.—*Black Currant* (*Ribes Nigrum*, Linn.).

2700. *The black currant is a distinct species*, is a native of most parts of Northern Europe, and is certainly indigenous in Britain, being found growing wild in woods, wet hedges, and other moist situations. The fruit, which has a peculiar flavour disliked by some, is occasionally, though seldom, brought to the dessert, but is eaten in puddings and tarts, and made into jelly, which is supposed to have a medicinal quality, and is used for hoarseness and sore throats. In Russia, where it grows in great abundance, and of a large size, they make a wine from it, and it is put into brandy, as cherries are in England: in Ireland it is put into whiskey. Cottagers in England, as in Siberia, sometimes mix the dried leaves of the tree with black tea, which gives nearly the flavour of a mixture with green tea; and it is suspected that tea is sometimes adulterated in this manner. When trained against a wall the berries grow to an extraordinary size. The varieties called the *black Naples* and the *black grape* are excellent for the dessert.

SUBSECT. 4.—*Raspberry* (*Rubus Idæus*, Linn.).

2701. This fruit derives its Linnæan appellation, "Idæus," from Mount Ida, where Pliny describes it to have grown. It was considered as a sort of bramble, though much improved by cultivation, and our name of raspberry is given to it from the rough spines with which the bush is covered.

2702. *There are two varieties*, the red and the white, both natives of Britain, and excellent for the dessert: the white is the sweetest. The flavour of the fruit is peculiar, but is very generally liked; it is, however, extremely volatile; even a few hours will diminish it, and, to be enjoyed in perfection, the fruit should be eaten off the bush. If kept for two or three days, the flavour will be almost entirely gone. The fruit is *sub-acid* and cooling, and the red is much used in tarts, and for jams, ices, &c. It also makes a delicious wine, and is employed for raspberry brandy and raspberry vinegar, a table spoonful of which in spring water makes a most refreshing beverage.

2703. Vast quantities are cultivated in the neighbourhood of Isleworth and Brentford, whence they are brought to Covent Garden market.

SUBSECT. 5.—*Strawberry* (*Fragaria Vesca*, Linn.).

2704. *The name of this favourite fruit* is said to be derived from an ancient custom of putting straw beneath the fruit when it began to ripen, which is now little attended to, but which is very useful to keep it moist and clean. The strawberry belongs to temperate and rather cold climates, and no fruit of these latitudes that ripens without the aid of artificial heat is at all comparable with it in point of flavour. The strawberry is widely diffused, being found in most parts of the world, particularly in Europe and America.

2705. The fruit has a delicious fragrance, and is universally esteemed for its agreeable flavour. It possesses a peculiar advantage of not creating acidity when taken into the stomach. It is nutritious, and very wholesome, and may be safely eaten by gouty and rheumatic patients who have been forbidden the use of other fruit. In addition to its grateful flavour, it is sub-acid and cooling, which renders it particularly agreeable in summer. Strawberries may be eaten alone, or with sugar and cream, and physicians consider them not only as wholesome, but rank them among their pleasant remedies, particularly in feverish habits.

2706. *The varieties are extremely numerous, but the principal strawberries*, as the *scarlet* and *Chili*, have been brought from America two hundred years ago: of these the *pine* is most esteemed, and the *hautboy*, though generally excellent, is the most variable.

2707. *Strawberries ripen* from June to August and September; but the main crop is over in July. One variety, a small red strawberry, grows wild in our woods, and is mentioned as an article of ordinary consumption in the time of Henry VI. The fine aromatic flavour of this fruit is not very durable, and a slight shower will sometimes almost entirely destroy it; on this account it should be gathered in dry weather, and the same day when it is to be sent to table. The strawberry is a kind of rock plant, and grows best on artificial banks, composed partly of broken fragments of rock.

SUBSECT. 6.—*Mulberry* (*Morus*, Linn.).

2708. The mulberry-tree is a native of Asia, and has been always a most valuable tree to the Chinese and Persians for feeding their silk worms. There are several species.

2709. The *white mulberry* (*Morus alba*) is a delicate tree, though it grows well in Spain, Italy, and the south of France; the berries are light-coloured and insipid, but its leaves are the best for feeding the silk-worm. It is seldom cultivated in this country.

2710. The *black mulberry* (*Morus nigra*) is a larger and more hardy tree, and is very commonly grown in England: the fruit is a blackish-red, and its juice stains the hands a deep colour: it is excellent for making a peculiar wine.

2711. *Mulberries are brought to the dessert*, and are esteemed for their highly aromatic flavour, and their sub-acid nature. They are considered as cooling, laxative, and generally wholesome. This fruit was very highly esteemed by the Romans, who appear to have preferred it to every other. The mulberry-tree is stated to have been introduced into this country in 1548, being first planted at Sion House, where the original trees still thrive. The planting of them was much encouraged by King James I., about 1605; and considerable attempts were made at the time to rear silk-worms on a large scale, for the purpose of making silk; but these endeavours have always failed, the climate being scarcely warm enough.

SUBSECT. 7.—*Elderberry.*

2712. *The common elder-tree* (*Sambucus nigra*, Linn.) is a native of this country, and is found near wet ditches and old walls. The wine made from elderberries is too well known by families in the country to require any encomium; it is almost the only wine that the cottager can procure, and, when well made, is a most excellent and wholesome beverage. That made from the white elderberry resembles some rich grape wine. The young tender shoots are much relished as a pickle; and if a sirup be made from ripe elderberries, with a few bitter almonds, and added to brandy, it has all the flavour of the very best cherry brandy.

2713. Professor Martin observes that this tree contains a whole magazine of physic to rustic practitioners. An excellent healing ointment is made from the green inner bark, and also with the leaves and flowers. Infusions of the flowers promote cuticular secretion, and form a powerful sudorific. The juice of the inner bark is one of the best hydragogues. No quadruped will eat the leaves of this tree, which also drive away all insects, except the peculiar ones that feed upon them.

SUBSECT. 8.—*Barberry* (*Berberis Vulgaris*, Linn.).

2714. The barberry is found in woods, coppices, and hedges in England, and is a native. The flowers are small and beautiful, and, when they first appear, have a perfume like cowslips, but which change to a putrid and most disagreeable smell, particularly towards the commencement and at the decay of the flowers. The fruit is extremely acid and astringent, but is cooling, and is thought to create appetite, though seldom eaten. Conserves and jellies made of it are refreshing and strengthening to the stomach. Barberries are employed as pickles and for sirups, which are considered as medicinal. There are several kinds; the fruit of some have stones, and others are without.

SUBSECT. 9.—*Whortleberry* (*Vaccinium Myrtillus*, Linn.).

2715. This is called also the *hartleberry* and *bilberry*. It grows wild abundantly upon our heathy commons and uncultivated hills. It is plentiful in the north of Europe. It is found on Leith Hill in Surrey, also in Devon. The fruit is seldom brought to the London market, although much relished by some persons in tarts or cream, or made into jellies. There are several varieties: the purple are rather larger than juniper-berries, and are covered with a fine blue or purple powder, like the bloom of plums. They are seldom cultivated.

SUBSECT. 10.—*Cranberry* (*Vaccinium Uliginosum*, Linn.).

2716. This berry is a red variety of the whortle, and is much esteemed in tarts or with cream. It is scarcely cultivated in gardens, but grows wild plentifully in peaty bogs and marshes, particularly in Lincolnshire, Sussex, Cumberland, and other similar places in Britain; also in Scotland. Considerable quantities of fine fruit are also imported from Russia and Germany, packed in casks. A large sort is brought from North America, and is used by the London pastry-cooks for tarts; but this kind is inferior to the English cranberries. Some have been brought from New-Holland, of a superior flavour.

2717. Cranberries are considerably astringent, and are thought to restore the appetite; they have a peculiar grateful flavour, something like black currants. They are easily preserved by drying them a little in the sun, and stopping them close in dry bottles. They are so plentiful in Cumberland that they are sold by the cart-load. The fruit is sometimes fermented into an intoxicating liquor, and is put into whiskey to disguise its peculiar flavour. It is said to possess narcotic powers, and is therefore also used in beer. It makes an excellent jelly, preferable to that from currants, for venison.

2718. *In the Transactions of the Horticultural Society, Mr. Milne recommends the cultivation of this berry*, which is now only collected in its wild state. He observes that, both the British and American species may be grown with much advantage in numberless situations in this island, with little trouble, and on soils where few other useful plants will grow to advantage. Cottagers and others living in the neighbourhood of moors and heaths covered with soil suitable to their growth, might cultivate them with considerable profit for the market; and if they could not be consumed or disposed of in the neighbourhood, they might be sent to a great distance without the hazard of being spoiled. The American would be the easiest managed, and most productive for general use; but, as many prefer the flavour of the English cranberry, there would be also a demand for it, though at a higher price.

SUBSECT. 11.—*Blackberry*, or *Brambleberry* (*Rubus Fruticosus*, Linn.)

2719. This is a species of raspberry; it is the most common of our native berries, and it is found in almost every hedge, being rather annoying with its long training stems and sharp thorns. In Wales it grows to a large size, and, in a fine summer, is really an excellent fruit. The berries are slightly astringent, and are made into a jam useful in sore throats. They are occasionally used in tarts. The juice, mixed with raisin wine before it is fermented, will give it the colour, and much of the flavour of claret.

SUBSECT. 12.—*Dewberry* (*Rubus Cæsius*).

2720. Phillips, in his *Pomarium Britannica*, p. 71, says that this is a variety of the blackberry; the protuberances are larger and fewer in number than those of the common blackberry. It is generally found trailing on the banks of hedgerows or in hazel copses, seldom growing above a foot high. He observes, "that it is a berry of excellent flavour, and well deserving a place in cultivated grounds, as it must be equally beneficial to society that our native fruits should be improved, as well as that new varieties should be imported from climates that can give but little hope of their thriving without the aid of artificial heat."

SUBSECT. 13.—*Juniper-berry* (*Juniperus Communis*, Linn.).

2721. This is the fruit of the common juniper, which grows wild on our hills. They are round, of a blackish-purple colour: when chewed, they have, at first, a warm, sweetish, and afterward a bitter taste. In Sweden they are made into a conserve, and eaten at breakfast. In some places they are roasted, and used as a substitute for coffee. A volatile oil is contained in cells in the shell of the nut, and not in the fleshy part of the fruit, that has a close resemblance to oil of turpentine, and which is used to flavour gin, but the juniper-berries employed for this purpose are imported.

SUBSECT. 14.—*Service Berries.*

2722. These are the fruit of the *wild service-tree* (*Pyrus torminalis*), very common in the hedges and fields, but, though at present little known, they were more in use formerly. The country people in some places gather the bunches of berries, and hang them up in the air till they undergo an incipient putrefaction, in which state they possess a peculiar acid, astringent taste, and are considered as having cathartic properties. When mellowed by frost they have been used as food. The service-tree is a native of England, but is now seldom seen except planted as ornamental trees.

SECT. VIII. — EXOTIC FRUITS WHICH DO NOT RIPEN IN THE OPEN AIR IN ENGLAND, AND WHICH ARE ONLY CULTIVATED IN THE HOT-HOUSE.

2723. It does not enter into our plan to describe the vast number of fruits that are found in various parts of the world: the following are occasionally imported in a preserved state, or are sometimes cultivated in this country by the aid of artificial heat.

SUBSECT. 1.—*Pomegranate* (*Punica Granatum*, Linn.).

2724. The pomegranate, which derives its name from "*pomum granatum*," a kernelled apple, possesses, independently of its valuable qualities, great historical interest. We find it often mentioned in the Bible, where it is included in the fruits of Palestine, with the vine, the fig, the olive, and other "pleasant fruits." It likewise grows wild in Barbary. Pliny states that the Romans brought it from Carthage in the time of Sylla; hence its name, Punica. It was likewise well known to the ancient Greeks, and held in great esteem by them: the story of Proserpine is well known, who, having been carried off by Pluto, was prevented from returning to the earth in consequence of having tasted of this fruit in the Elysian Fields. They are frequently represented in ancient sculpture.

2725. *The fruit of the pomegranate-tree* is about the size and shape of an orange. The rind is coriaceous, of a reddish-yellow colour, having a very styptic taste; but the pulp is succulent, contained in cells divided by membranes, and crowded with seeds; the juice is of a pleasant acid taste, and particularly grateful and cooling in warm climates. It is said to assuage thirst in a degree quite peculiar to it, from its acid, which is full of "pleasant sweetness." All the rest of the plant is highly astringent. The bark has so much tannin that it is employed in Germany and other countries for making an imitation of Morocco leather, and the rind of the fruit will do instead of nut-galls for ink: it was also employed medicinally in ancient times, as it is still in some places at present.

2726. The pomegranate flourishes in the open air in the south of Europe; but in England, though it blossoms readily in the southern counties, the fruit requires a greenhouse to bring it to perfection. It was first brought to this country in 1548, during the reign of Henry VIII., and it was among the trees that fruited in the orange-house of Charles I. The tree sometimes attains the height of twenty feet, and is highly prized as an ornament on account of its beautiful scarlet blossoms, which are extremely fragrant. In the West Indies, where it has been planted, the fruit grows larger and finer-flavoured than in Europe. Its singular and beautiful appearance adds to the variety at the dessert.

SUBSECT. 2.—*Banana* (*Musa Sapientum*, Linn.).

2727. This fruit is very generally diffused over the torrid zone of the New World, and an immense portion of mankind subsist chiefly upon it, answering to them instead of the wheat, barley, and rye in Europe and Western Asia, and rice in India. The banana is not known in an uncultivated state: among the wildest tribes in South America, as well as in other places, it is propagated by suckers.

2728. *No individual plant in the vegetable kingdom produces so much nutriment in the same* *space of ground.* The fruit is from five to seven or eight inches long, and sometimes a foot in circumference. Each plant will produce from 160 to 180 fruit, which grow in a bunch, and each bunch weighs from 60 to 80 pounds. Humboldt has observed that a European is surprised to see the smallness of the plantation of bananas round an Indian hut, which is found sufficient to maintain the family. A cultivated space of only 1000 square feet will admit of 30 to 40 bananas, which, together, will annually produce 4000 pounds weight of fruit: a produce 133 times greater than could be obtained from the same space if covered with wheat, and 44 times greater than if occupied by potatoes.

2729. *The form of the fruit* is somewhat like that of the cucumber, but of a highly grateful flavour, less luscious than the plantain, and composing an extremely nutritive and healthy aliment: the stalks are marked with purple spots, whereas that of the plantain is entirely green.

The plantain is relished by all ranks of people in the West Indies, and is considered as preferable to bread in hot climates. Dr. Wright observes that no species of provision could supply its place; even wheaten bread would be less agreeable, and less capable of supporting the laborious negro, and enabling him to preserve his health. In America it is the custom to plant banana walks, which they extend as their family increases. Some or other of the plants are in bearing the whole year round. It is eaten raw, roasted, or boiled, and is made into fritters, preserves, and marmalades; and it is dried in the sun and preserved like figs. Meal is extracted from it by pounding. Sometimes, after making it into a paste, they squeeze it through a sieve, form the mass into loaves, which are dried in the sun, or baked in hot ashes, after having been previously wrapped up in leaves. The fermented juice also affords an excellent wine.

2730. Bananas have been fruited in England in a hot-house. When the building is lofty enough they form a magnificent appearance, equal, if not superior, to what they present in their native climes.

Fig. 517.

Perfectly ripe bananas were produced in the hot-houses of the Royal Caledonian Horticultural Society, in Edinburgh, and were sent up to the Lord Mayor of London for the banquet given to the present queen at Guildhall, but, from some cause or other, were neglected to be mentioned in the published report, although certainly the rarest dish on that occasion.

2731. *Plantain* (*Musa Paradisiaca*, Linn.).—This fruit (*fig.* 517) is allied to the banana, but is a native of the Old World, growing in India and Africa, from whence it was carried to the West Indies.

2732. The fruit of the plantain is about the size of ordinary cucumbers. When ripe, it turns yellow, is sweet, of a mealy substance, tasting something like the melon, luscious, and dissolving in the mouth. It is brought to table as dessert, raw, fried, or roasted. It is used also in tarts, or dried, or preserved as a sweetmeat, and is considered as the most wholesome of all confectionery. The fruit grows in clusters on the tree, which is of the palm tribe, rising with a single stem to the height of fifteen or twenty feet, and having leaves only at top, each of which is about six feet long and two feet broad. The whole spike and fruit often weigh forty or fifty pounds.

SUBSECT. 3.—*Mango* (*Mangifera Indica*, Linn.).

2733. The mango (*fig* 518) is one of the most grateful to Europeans of all the tropical fruits. It resembles a short, thick cucumber in form, and grows upon trees forty or fifty feet high: it has a thin skin, and, on removing this, the interior consists of a pulp which melts in the mouth with a cooling sweetness, and a delicious, aromatic, and sub-acidulous taste. It is sometimes cut into slices and eaten with wine, or is candied to preserve it. In the heart is a small stone. The mangoes of Asia are said to excel those of America.

Fig. 518.

2734. In India they are constantly at the dessert in the hot months, and no fruit is held in such high estimation; it is extremely wholesome and nutritious. The green fruit is made into jellies, conserves, tarts, &c. The ripe is very perishable, and cannot be brought to this country except pickled, from which no idea can be formed of their exquisite flavour: altogether, they are considered as one of the chief dainties of the vegetable world, and are, consequently, cultivated wherever the climate admits of it and the arts of civilization have penetrated. There are many varieties, some of which are ill-flavoured.

2735. By the Hindoos the wood of the tree is consecrated to the service of the dead, and used for coffins and funeral piles. From the flour of the dried kernels several kinds of food are prepared, and the stalks are employed with the betel nut.

2736. The mango has been fruited both in France and England. If a few *worked plants* could be had from Jamaica, and a stove fitted up for them, there is little doubt, according to Mr. Knight, that the fruit might be had upon the table as easily as the pineapple.

SUBSECT. 4.—*Mangostan* (*Garcinia Mangostana*).

2737. This (*fig.* 519) is one of the most delicious fruits in the world, and grows in Sumatra, Java, and other islands of the Indian Ocean. The fruit is about the size and shape of the orange, surrounded by a thin shell. The pulp is juicy, and of an exquisite flavour, partaking of that of the pineapple and strawberry, though some have compared it to other combinations of the best fruits. It is also very wholesome, and is almost the only fruit allowed to some invalids, being cooling, and a happy mixture of the tart and the sweet. The tree is about twenty feet high, and extremely beautiful.

Fig. 519.

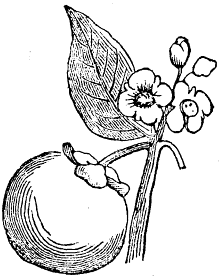
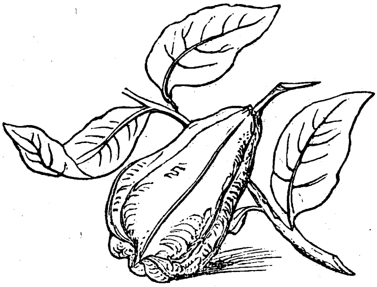


Fig. 520.



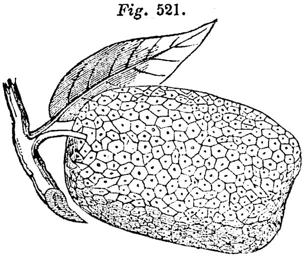
SUBSECT. 5.—*Aku* (*Blighia Sapida*, H. R.).

2738. This fruit (*fig.* 520) is so named because it was carried by Capt. Bligh, in 1793, from Guinea, its native country, to Jamaica, where it now grows well, and is much esteemed. The fruit is a pome, about the size of a goose's egg, having a grateful subacid flavour, and being very wholesome and nutritive. It has been planted in this country, and, it is thought, may, in a few years, produce fruit as easily as the orange.

SUBSECT. 6.—*Bread Fruit* (*Artocarpus*, Linn.).

2739. This very important fruit was originally found in the southeast parts of Asia, and the islands of the Pacific. There are two species of bread fruit, the *Artocarpus integrifolia*, with the leaves entire, which grows chiefly on the continent of Asia; and *A. incisa*, with the leaves deeply notched, which grows chiefly in the islands, and is the proper bread fruit (*fig.* 521). The first is called *Jaca*, and the fruit grows to an enormous size, often to more than 30 pounds. It is eaten, but it is not very palatable. The last, the proper bread fruit tree of the South Sea, was found originally in the islands of the Indian Ocean and Southern Pacific by Dampier, in 1688: it grows to the size of a middling oak, and the fruit is about eight or nine inches long, of a yellowish-green colour, and is covered with hexagonal warts. It grows in clusters of five or six. The pulp is white, and is partly farinaceous and partly fibrous: when quite ripe it becomes yellow and juicy.

Fig. 521.



2740. *It is dressed in various ways.* When roasted or baked, they scrape off the second rind, and the interior is eaten as bread; it has no seed nor stone. Its taste is agreeably sweet, between that of wheat bread and roasted chestnuts. It is extremely nutritive, but must be eaten new, for in twenty-four hours it becomes harsh and unpalatable. When boiled it much resembles potatoes; some think it more like the Jerusalem artichoke, and others the chestnut. It is also beaten up with cocoanut and milk. The fruit is gathered before it is fully ripe, for when mature it quickly runs into decay. The bread fruit continues in season above eight months in the year; and so productive is it, that two or three trees are sufficient for the yearly support of one person: during the remaining months they make of it a sourish paste, which they keep for store.

2741. *At the expense of this government, and through the well-known exertions of Captain Bligh,* the bread fruit has been brought to the West Indies in consequence of the great expectations that had been formed of its utility; but, though it is easily cultivated, it does not appear to excel the banana. From experiments made in the West Indies, it appears that it could be converted into flour, from which cakes were made extremely well flavoured. It is scarcely necessary to say that in this country it can only be raised in the hot-house.

SUBSECT. 7.—*The Durion* (*Durio Zibithinus*, Linn.).

2742. This is an Asiatic fruit which grows upon a lofty tree; and, though of an agreeable taste, has an unpleasant strong odour. Some of the fruits are as large as a man's head, and are covered with a kind of pointed scales. It must be eaten fresh, as it putrefies in twenty-four hours. The part which is eaten is a thick pulpy juice of the consistence of thick cream, which has the flavour of a delicate animal substance mixed with a cool vegetable acid. This singular flavour cannot be imitated by any process of cookery; and the substance is extremely nutritious. It is a costly fruit even in its native country, and is highly prized.

SUBSECT. 8.—*Guava* (*Psidium*).

2743. There are various species of the guava, some of which are natives of Asia, some of America, and some common to both. The best of these is the white guava (*Psidium pyriferum*), which is plentiful in the West Indies. The fruit is rather bigger than a hen's egg, yellow, smooth, and of a peculiar smell. The pulp is of a very agreeable taste, sweet, aromatic, and flesh-coloured. It is used at the dessert, and preserved. Guava jelly is considered as one of the finest conserves which we have from the West Indies.

SUBSECT. 9.—*The Mamma* (*Mammea Americana*).

2744. This is a native of the West Indies, where the tree grows to the height of seventy feet. The fruit is yellow, and somewhat resembling a russet apple in size and shape. The pulp is yellow, and is very fragrant and delicious, like the finest apricot.

SUBSECT. 10.—*The Litchi* (*Dimocarpus Litchi*).

2745. This is a Chinese fruit, round, and about two inches and a half in diameter. It is covered with a tough leathery coat, within which is the pulp, colourless, semi-transparent, slightly sweet, and of a very agreeable taste. It is often brought to this country in a dried state, in which, though the pulp be much diminished in size, it retains a considerable portion of its original flavour. It is not unlikely but it may become common in this country as a hot-house fruit.

SUBSECT. 11.—*Jujube* (*Zizyphus Vulgaris, Z. Jujuba*).

2746. This is a favourite dessert fruit in Italy and Spain, either fresh, or dried as a sweetmeat; and a pleasant pectoral lozenge is made of it by the French apothecaries. The fruit is to be seen in abundance in the markets of Constantinople and the southern parts of Europe: the Turks plant the trees round their coffee-houses, that they may enjoy both their shade and their fruit. It is found in greatest perfection in China, where there are upward of sixty species.

SUBSECT. 12.—*The Juvia* (*Bertholletia Excelsa*).

2747. This fruit is described by Humboldt as that which encloses the triangular grains imported under the name of *Brazil nuts*. The fruit itself is as large as a child's head, being covered by a shell, and growing upon a tree fifty or sixty feet high; the force of their fall is so great as to be fatal to one who might be struck with them; hence the Indians never enter the woods where they grow, in the season of fall, without covering their heads by a buckler.

SUBSECT. 13.—*Papau* (*Carica Papaya*).

2748. The papau, which resembles a gourd, about the size of an ordinary melon, grows on a branchless tree in the East and West Indies. It is cultivated, and is eaten both raw and cooked. It is wholesome, but not very palatable. It is usually gathered when half grown, and soaked in water to withdraw an acrid milk like mangoes, for which it sometimes forms a substitute. The milk of this fruit is a singular substance, for it contains a large proportion of a species of fibrin, very like that of animal flesh, and that of fungi, a circumstance which is uncommon among vegetables; and the exhalations from the leaves of the tree have so powerful an effect, that newly-killed meat suspended on the tree in a few hours becomes quite tender; and the flesh of old hogs and poultry fed upon the leaves are said to be as tender as that of young pigs and pullets.

SUBSECT. 14.—*The Alligator, or Avocado Pear* (*Laurus Persica*).

2749. This is another West Indian fruit, about the size of an apple. It is considered as one of the most delicious of fruits. It consists of a kernel enclosed in a soft rind, and the yellow pulp has the firmness and delicate flavour of the peach, but much superior.

SUBSECT. 15.—*The Anchovy Pear* (*Grias Cauliflora*).

2750. It is, likewise, one of the fruits of the West Indian islands. It much resembles the mango in taste, and when green is sometimes pickled. It might be raised in England like the pineapple.

CHAPTER X.

SPICES.

SECT. I.—GENERAL REMARKS.

2751. *All the substances classed as spices are the produce of tropical climates only*; none of our native plants, and no plants that come to maturity in the open air in this climate, possess sufficient aromatic flavour to be reckoned among the spices. The most valuable of these natural productions were originally found in the islands situated in the Indian Ocean, called the Spice Islands, or Moluccas, and were probably conveyed from them in the most distant ages. The spices which Queen Sheba presented to Solomon were unknown in Palestine, and probably came from Ceylon or some of the islands to the east.

The delicious aromatics of tropical regions were highly prized by the ancient nations; and, besides spices, we read of frankincense and myrrh, from the East, as ranking among their most esteemed luxuries. The wealthy Romans indulged in these to an extravagant degree; as navigation and the means of intercourse between distant nations improved, from the facility of transport, they found their way, as articles of traffic, to countries very remote from the places of their production; and the inhabitants even of the northern parts of Europe shared in the advantages of this commercial spirit.

2752. *On the use of foreign spices*, we may quote Dr. Paris in his work "On Diet." "These were not," he observes, "intended by nature for the inhabitants of temperate climes: they are heating and highly stimulant. I am, however, not anxious to give more weight to this objection than it deserves. Man is no longer the child of nature, nor the passive inhabitant of any particular region: he ranges over every part of the globe, and elicits nourishment from the productions of every climate. It may be, therefore, necessary that he should accompany the ingestion of foreign aliment with foreign condiment. Nature is very kind in favouring the growth of those productions which are most likely to answer our local wants. Those climates, for instance, which engender endemic diseases are, in general, congenial to the growth of the plants that operate as antidotes to them. But if we go to the East for tea, there is no reason why we should not go to the West for sugar. The dyspeptic invalid, however, should be cautious in their use; they may afford temporary benefit at the expense of permanent mischief. It has been well said that the best quality of spices is to stimulate the appetite, and their worst to destroy, by insensible degrees, the tone of the stomach. The intrinsic goodness of meats should always be suspected when they require spicy seasoning to compensate for their natural want of sapidity."

Sect. II.—pepper (*Piper*, Linn.).

2753. This is a well-known spice of an aromatic odour, and an extremely pungent and acrid taste.

2754. *Black Pepper* (*Piper nigrum*, Linn.) is the fruit of a species of climbing vine, a native of the East Indies, and found on the slopes of mountains in the southern parts of both peninsulas; it is also cultivated extensively in Malabar, and the eastern islands, Sumatra, Java, Borneo, and those which are near. It was formerly known only as the growth of these countries, the whole globe being supplied from them; but it has been lately introduced into Cayenne. The berries grow in spikes of from twenty to thirty, are at first green, and when ripe they are of a bright red colour. After being gathered, which they are while green, they are spread out on mats, with their skins on, and dried in the sun: thus they become black, and more or less shrivelled. Those which are least ripe, and in the fittest state for gathering, shrivel the least; but when they are more ripe, they often shrivel up entirely, or contain nothing but dust. The goodness of pepper is tried by rubbing it between the hands, and what is easily reduced to powder is unsound and bad.

2755. *White Pepper* is not the produce of a separate plant, as was once supposed, but is made from the black, by steeping it in lime and water and rubbing it between the hands till the coats come off, the powerful acrid oil residing chiefly in the skins. As it is only the best grain that will bear this operation, the white pepper is the superior kind, and fetches a higher price; it is, of course, milder than the black, and is much prized in China, but little of it is brought to England. Pepper is sometimes sold in the shops ground, and then it is often sophisticated, the black with burned bread, and the white with rice flour.

2756. Pepper is very generally employed as a condiment, and, from its promoting the secretion of the gastric juice, it aids the digestive powers of the stomach, sometimes rendered necessary in our artificial mode of living; but, even in small quantities, it is hurtful in inflammatory habits. The quantity of pepper imported into Europe is quite enormous.

2757. According to the analysis of Pelletier, pepper contains a peculiar substance called *piperina*, a concrete acrid oil, a volatile oil, starch, malic and uric acids, and lignin. The oil of pepper is too pungent to be tasted; applied to the skin, it reddens and inflames it: from which we may comprehend the effect upon the palate and stomach.

2758. *Long Pepper* is produced by a different plant (*Piper longum*), growing in the same countries. It is less aromatic than the black, but the oil is still more pungent.

2759. *Cayenne Pepper* is a very different substance, and is the most heating and stimulating spice with which we are acquainted, being extremely pungent and acrid, setting the mouth, as it were, on fire. It is powder prepared from several varieties of the capsicum, which are annual plants, natives of both the Indies, where they are used in large quantities both with vegetable and animal food, and from these countries we have borrowed their use.

There are three varieties of capsicum, all natives of tropical climates, but which have been so far naturalized in this country as to bear in the open air in summer. *Guinea pepper* (*C. annum*) was introduced into England from India so early as 1548. The plant rises about two feet, and has white flowers succeeded by pods, which, when ripe, are yellow or red. *Cherry pepper* (*C. cerasiforme*) was brought from the West Indies in 1759. It is very like the last, only its pods are generally round, like cherries. *Bell pepper* (*C. grossum*) produces the largest pods, and is, therefore, generally preferred. The pods of all these, when ripe, are extremely hot in their taste; and when in their green state they are used as a pickle, and called *chillies* with us. When ripe, they are ground into the condiment called *Cayenne pepper;* but the best of this we have from the West Indies ready prepared, and it is made from the *C. baccatum*, or *bird pepper*, so called because much eaten by birds, as hens and turkeys, which are extremely fond of it. The East Indian Cayenne is prepared in a very careless manner, and has often a dirty brown colour. To improve the colour, by making it red, a colouring substance is sometimes added, and Accum has stated that he had detected red-lead, which is a poison. With us, capsicums, or chillies, are ripe in September or October, and the pods are easily pounded in a mortar, after being dried before the fire. They may be purchased in Covent Garden market. About one fourth their weight of salt is mixed with them in the mortar to prevent the dust getting to the eyes. Dr. Kitchener states that this is the only way to have genuine Cayenne, and that the English has a finer flavour than the foreign, though not half the heat.

2760. *This powerful spice has become a necessary article at table*, and is much esteemed for its flavour, and the quality which it is supposed to possess of promoting the digestion of fish and other kinds of food. But it may be doubtful if the practice is conducive to health; for, though Cayenne pepper, like highly-flavoured Indian soys, may occasionally assist digestion, it would, perhaps, be better that invalids should abstain from food requiring a vigorous stomach, than to employ artificial stimulants.

2761. The dish called *Man-dran* in the West Indies, which is resorted to for exciting an appetite, and which is said to be sure to do so in the most languid state of the digestive organs, is a mixture of bird pepper, shallots or onions cut small, a little lime juice, Madeira wine, and sliced cucumbers.

Sect. III.—cinnamon (*Laurus Cinnamomum*, Linn.).

2762. This is the inner bark of a tree, a native of Ceylon, and several countries in the East, as China, Borneo, &c., but it is now cultivated in the West Indies and South America. It has also been lately planted in Egypt, and appears to succeed. The cinnamon-tree grows to the height of twenty feet; but when cultivated for the sake of the spice it is not allowed to attain its full size, but is lopped close to the ground when about ten feet high, with a stem one or two inches in diameter. New branches shoot up from the roots, and these shoots are cut when from half an inch to three quarters of an inch in thickness, and in length from two to three feet. The fragrant bark is protected by a tasteless cuticle, and after this is stripped off the bark is dried, which makes it shrivel up and assume the quill form in which it is imported, and the smaller pieces are put within the larger. The best is scarcely thicker than paper, and in long pieces, of a light yellow, bordering upon fawn brown, a dark colour being a mark of inferiority. Its odour is very fragrant; its taste is agreeable and highly aromatic, hot, but not too pungent to be borne upon the tongue, and without any bitterness.

2763. Cinnamon easily communicates its agreeable flavour to any other substance, and hence it is much employed in the most delicate preparations of the cook and confectioner.

2764. An essential oil is distilled from it in the countries where it grows; but very little of this is contained in the bark as we have it. This oil is very pungent, and is heavier than water; it is extremely dear. The best cinnamon comes from Ceylon, where a greater quantity grows than in any other part of the world; and the property of all the cinnamon-trees there is retained by our government, though the regulations by which the preparation of their produce for market was limited and restricted are now relaxed: some of the Chinese is also very good, but generally it is inferior; the Cayenne is thicker, but not so good; that from Brazil is the worst.

2765. *Cassia is a bark* brought chiefly from China and Ceylon, possessed of the usual properties of cinnamon, and was once supposed to be the produce of another tree; but it is now certain, from the observations of Mr. Marshall, that it is only the bark from the trunk and larger branches of the cinnamon-tree: it is of a flat shape, much thicker, and has the mucous integument of the bark remaining, which is cleared off from the proper cinnamon. It has the same qualities of cinnamon, only in an inferior degree. According to Vauquelin, cinnamon contains volatile oil, tannin, mucilage, a vegeto-animal colouring matter, an acid, and woody fibre. The oil of cinnamon is prepared chiefly from cassia and from the chips of cinnamon: eighty pounds yield about two ounces and a half of the oil, worth in England a guinea per ounce.

Sect. IV.—cloves (*Eugenia Caryophillata*).

2766. Cloves are the fruit, or, rather, the calyx of the unexpanded flowers of the clove-tree. Their name in French is *clou*, a nail, from their resemblance to one, and hence our term "clove."

2767. The tree is a native of the Malacca Islands, where they were originally found by the Portuguese in 1511, the date of their introduction into Europe. The Dutch, on gaining possession of the Spice Islands, endeavoured to secure a monopoly of cloves; and with the view of confining the cultivation of the tree to Amboyna, the seat of their power, they bribed the surrounding chiefs to cut down all the clove-trees in the other islands. As these contracts still exist, a military officer with a party of soldiers annually visit every place with axes to destroy the young trees, which spring up in astonishing abundance. Sir Stamford Raffles describes the clove as a tree of noble height, somewhat like the bay, and composing, by the beauty of their form, the luxuriance of their foliage, and the spicy fragrance with which they perfume the air, some of the most delightful objects in the world. The best variety of the Amboyna clove, called the *royal clove*, is scarce. It is smaller and blacker than the other kinds.

2768. But, notwithstanding this conduct of the Dutch, cloves are now cultivated in other parts of the world. The French introduced them at Mauritius, Bourbon, Cayenne, and Martinique, and they have since been carried to St. Kitt's, St. Vincent's, and Trinidad. The trees live twenty-four years, and bear from six to twenty years. After the cloves are collected in the green state, they are dried quickly by exposure to heat and smoke, until they appear of a deep brown colour; after which the drying is completed in the sun. Those dried wholly in the sun are the best.

2769. *Cloves form one of the most agreeable of all the spices*, and are much employed in flavouring many dishes, preserves, liqueurs, &c. They contain a considerable quantity of essential oil of a very pungent quality, in which their efficiency consists, and this is procured by distillation; it is said that the Dutch sometimes extract part of this oil, and then mix the deteriorated cloves with fresh ones, from which they imbibe some of what they contain. Cloves are also very liable to imbibe water, which increases their weight.

2770. *Cloves are employed* more for their flavour than for their medicinal qualities; but they are likewise very powerful stimulants of the stomach, and are used, but with caution, in conjunction with bitters. They yield their medicinal and other qualities to water and to alcohol.

2771. *According to Tromsdorff, 1000 parts of cloves contain* 180 of volatile oil; 40 extract scarcely soluble; 130 gum; 60 resin; 280 woody fibre; and 180 water. The volatile oil of cloves might be advantageously employed instead of the dried clove in culinary processes.

Sect. V.—nutmeg (*Myristica Moschata*).

2772. This is also a native of the Spice Islands, the Moluccas, and the monopolizing spirit of the Dutch was long enabled to keep the cultivation of it to themselves by extirpating it from all the islands except Banda, where it is chifly grown, the whole of the plantations being in the possession of their government. But while the English had possession of the Spice Islands, plants were carried to Penang and Bencoolen, where they now flourish, and produce a considerable quantity of nutmegs. Sir Stamford Raffles states that they are also largely cultivated in Sumatra. Attempts have likewise been made to introduce them into the West Indies, not altogether without success. The tree is not unlike the pear. It bears fruit all the year round.

2773. *The exterior part of the fruit is a pulpy substance*, sometimes brought to table in India as a preserve; within this is a thin shining black shell surrounded by membranous layers, which constitute another of our spices, the *Mace*, and within the shell is the nutmeg. To prepare them, the pulp is cleared off, and the mace separated by a knife; the nuts are then dried in the sun, and afterward by the fire; by this the shell becomes brittle, and the kernel within shrinks, which admits of the nuts being broken without injuring the nutmeg. They are then soaked in sea water, and impregnated with lime to destroy the vegetating power and keep away insects; but Mr. Crawford observes that the natives, if left to themselves, transport them in the shell, which is by far the best mode.

2774. *There are two sorts of nutmeg;* one wild, which is long or oval-shaped, and much inferior: the cultivated nutmeg is nearly round: the best are firm, hard, and of an unctuous consistence, the odour strong, aromatic, and agreeable; taste hot and acrid. When cut across, they appear full of dark veins, which contain much volatile oil.

2775. *This oil is yielded by distillation*, and it possesses the flavour of the nutmeg in perfection, two drops being nearly equal to a pound of the powder; this is made from the broken kernels; and it is said that the nutmegs are sometimes punctured and boiled for the purpose of extracting the oil, the holes being filled up with sassafras: *it is* one of the few oils of tropical climates that are lighter than water. It is employed in medicine.

2776. *The nutmeg is much used as a condiment;* but Dr. A. Thomson observes that, if taken in large quantity, it is found to have narcotic effects, and to produce symptoms indicating great determination to the head, on which account it should be cautiously used in apoplectic and paralytic habits.

2777. *The analysis of M. Bonastre shows nutmeg to contain*, in 100 parts, 24 of an insoluble white matter (stearin); 7·6 of an insoluble coloured butter (elain); 6·2 of a volatile oil; 0·6 of an acid; 2·4 of fecula; 1·2 of gum; and 58·0 of ligneous matter.

Sect. VI.—mace.

2778. ***Mace is the reddish membrane surrounding the shell which contains the nutmeg.*** It is dried previous to packing tight in bags. Its general qualities are the same as those of nutmeg; it has an agreeable aromatic odour, and a hot, biting taste. According to Mr. Henry, it contains a small quantity of volatile oil; a large quantity of a yellow, odorous, fixed oil, soluble in ether, but insoluble even in boiling achohol; a nearly equal quantity of a red, odorous, fixed oil, soluble both in ether and alcohol; a gummy matter forming nearly a third of the weight of the mace; and a small quantity of woody matter.

Sect. VII.—ginger (*Zingiber Officinale*, Linn.).

2779. Ginger is the tuber, or, rather, the rhizome, of a plant which is a native of the mountain of Gingi in Hindostan, whence the name. It was carried from India to Cayenne and the West Indies, where the greatest part of the ginger of Europe is cultivated. There are two kinds of ginger, but the difference consists chiefly in the mode of preparing it. *White* ginger consists of the best pieces, of which the outer skin has been scraped off; they are then well washed and dried in the sun: it breaks with a fibrous fracture, and is the strongest and best flavoured: good ginger should be compact and heavy. *Black* ginger is the inferior kind, which has only been scalded before it was dried.

2780. Ginger is one of the most agreeable and wholesome spices: it is much used in culinary operations, and likewise in beer and other beverages. It is stimulating to the digestive organs, and is less hurtful than pepper; but, like all excitants, it should be used with great moderation. The constant use of any kind of spices is, as we have stated, to lessen in time the nervous irritability and weaken the digestive function; for this reason, gingerbread, which contains a great deal of ginger, is very injurious to the stomachs of children. As a medicine it is occasionally highly useful; and an essence or essential oil of ginger is prepared as a more convenient mode of applying it.

2781. *Preserved ginger* comes to us from the West Indies. It is made by scalding the roots when they are green and full of sap; then peeling them in cold water, and putting them into jars with a rich sirup, in which state we receive them. It should be chosen of a bright yellow colour, with a little transparency: what is dark-coloured, fibrous, and stringy is not good.

Ginger roots, fit for preserving, and in size equal to West Indian, have been produced in the Royal Caledonian Horticultural Garden in Edinburgh.

When analyzed, ginger is found to consist chiefly of starch; besides which it contains a resin soluble in ether, another insoluble, a volatile oil, a vegeto-amimal matter, acetic acid, potash, gum, sulphur, and lignin. The pungency consists in the oleo-resin combined with the starch.

Sect. VIII.—allspice, pimento, or jamaica pepper (*Eugenia Pimenta*, Linn.).

2782. This well-known and useful spice is the berry of a handsome tree that grows to the height of twenty feet in the West Indies and South America. It belongs to the natural order of the Myrtaceæ, and as it grows spontaneously in Jamaica, the seeds are supposed to be sown by birds. The fruit is not suffered to ripen, but is gathered while yet green; when dried in the sun it becomes black. It is less expensive than the Oriental spices, and, as it combines the flavour of cinnamon, nutmeg, and cloves, it is known here popularly by the name of *allspice*. It is a very agreeable aromatic, and is considered as the most mild and innocent of the common spices; hence it is much employed for domestic purposes.

Its active principle resides in an essential oil, which it gives out readily to water and spirit. The essential oil, or essence of allspice, is of a deep reddish-brown colour, and extremely pungent; a few drops is sufficient to give a flavour to gravy, or to mulled wine.

The best pimento is from Jamaica; an inferior and larger kind grows in Tobago.

It may be proper to observe that it is the practice of London shops to sell what they call *mixed spice*, which consists of a portion of all the above-mentioned spices ground together; this is much used about Christmas time, and is convenient for many purposes.

Sect. IX.—lemon and orange peel.

2783. *Among the aromatic condiments may likewise be reckoned the rinds of the lemon and orange*, called lemon and orange peel, which owe their high flavour to the essential oil they contain, which is extracted and sold as the essence of lemons and oranges; a few drops of this essential oil is equally efficacious with the peel itself, and has the advantage of being easily preserved, whereas the peel, when dried, loses most of its flavour in time, from the essential oil escaping.

BOOK VIII.

ON THE VARIOUS BEVERAGES USED IN THE BRITISH ISLES

CHAPTER I.

WATER.

SECT. I—INTRODUCTORY OBSERVATIONS.

2784. In the following account of water, we propose to confine ourselves chiefly to the consideration of those properties which relate to its use as a beverage, either alone, or as an ingredient in the preparation of the various kinds of drink which we shall describe; and to its employment in the culinary art.

2785. *As a beverage, the qualities of water differ materially;* every one is sensible of the great difference between that of a soft and clear spring, and that of a stagnant pool; and persons much accustomed to this simple beverage can distinguish flavours in it which are not sensible to others. The value of purity in water is universally admitted, but it requires to be explained in what that purity consists; for it can be shown that water absolutely pure is not the fittest for many purposes. All water, in a natural state, is impregnated with a certain proportion of air, which is highly useful; and of many other substances found more or less in water, some are harmless, while others are extremely prejudicial.

2786. *The most general distinction of water is into hard and soft,* and both the cook and the laundress may practically be good judges of these properties; yet we do not consider it sufficient to possess this merely practical knowledge; we shall therefore enter more minutely into the natural history and details respecting a liquid in such universal use, and of such serious importance to the health and comfort of families.

2787. With this view, we propose first to inquire into the chemical nature of water as a liquid body, and we will afterward examine the properties of the several kinds which are obtained from different sources, and which are found in various situations in the earth; to which will be added instructions as to the best modes of supplying and preserving it.

SECT. II.—OF THE COMPOSITION AND GENERAL PROPERTIES OF WATER.

2788. In order to have a clear idea of the nature of water, we must take a view of its *chemical constitution.*

2789. *Water was long considered as one of the natural elements,* and, consequently, was supposed to be simple, and incapable of being decomposed, or separated into other substances. The discoveries of chemistry, however, have proved that this fluid is, in fact, a chemical combination of two kinds of gas, or air, which, of themselves, are invisible. The nature of these gases has been mentioned in Book III., "On Ventilation;" but as a certain degree of repetition is unavoidable in a work like the present, it will be proper to speak of them again as the elements of water.

2790. *The two gases of which water is composed are oxygen and hydrogen.* Oxygen is that gas which we formerly stated to enter into the composition of the atmosphere which we breathe, and without which, indeed, life could not be supported; hydrogen is an inflammable body, and is the basis of the gas now so much employed in lighting our streets. But water is *not a mere mechanical mixture* of these two kinds of air, for if a portion of each of them be merely introduced into one vessel, water will not be the result. In order to produce the fluid we are treating of, these gases must be *united* in what is termed a *chemical* mode, that is, by a particular and intimate union very different from simple mixture. There is no doubt that water is thus formed daily by many natural processes, some of which are connected with meteorological phenomena. The fact of the composition of water was first shown by Mr. Cavendish, who demonstrated it by *burning* oxygen and hydrogen gases in a dry glass vessel, by which a quantity of pure water was generated exactly equal in weight to that of the gases which had disappeared.

2791. *By ingenious experiments, water can be separated into its elementary constituents,* oxygen and hydrogen; and by another process these very constituents can be made to re-unite, and form the same quantity of water as was decomposed. There is, therefore, no opinion in natural philosophy better established than that water is a compound body, and, consequently, that it cannot be ranked among the elements.

When we speak of the general properties of water as a body, we allude only to water which is absolutely pure, and unmixed with any other matter whatever.

2792. *Although pure water is composed of two gaseous bodies, yet there is no variety in its composition;* that is, a given quantity of water has not at one time more oxygen, and at another more hydrogen, but the proportion of these constituents is always precisely the same, namely, eight parts, by weight, of oxygen, and one of hydrogen. Neither is pure water, in itself, liable to any change whatever; when its elements have once fairly united to form a liquid, they cannot be separated or altered in any manner without the liquid entirely losing all its properties; in short, by no longer existing as water. Why, then, it may be asked, do we hear of different kinds of water? If water be unchangeable, what distinctions can be made, or how can various specimens of water have different qualities, as hard, soft, and so on? The answer to these questions will form the subject of the following pages. And first we shall describe the properties of water as a body, independently of every kind of mixture with any other substance, or contaminations of any kind.

2793. *Water is volatile*, that is, it is capable of being converted into vapour. If a vessel containing water be exposed to the air, the water gradually lessens in quantity, and, at length, disappears altogether. This, in familiar language, is said to be the *drying up* of the water; but the fact is, the water has insensibly been converted into invisible vapour, which has mingled with the atmosphere. This is called *evaporation;* not a particle of the water is lost, but the whole has dissolved in the air, to return one day in the form of rain.

2794. *We have already shown* (in Chap. I., Book I., "On Heat") that water boils, or is converted into steam, when it is heated to 212° in the ordinary pressure of the atmosphere, that is, when the barometer stands at 30 inches; water cannot be made any hotter in open vessels, because the steam carries off the heat. If salt be added to water, it is capable of being heated to a degree higher than 212°, in proportion to the strength of the brine.

2795. *But water may be heated to a much higher degree in closed vessels*, where the steam is confined so as to exert a great pressure upon the surface of the water; or the steam may thus be prevented from forming; but in that case it is requisite that the vessels should be extremely strong, or have a safety-valve, otherwise there is danger of their bursting. The digesters for dissolving meat and bones are made upon this principle.

2796. We may here refer the reader to what we have said in Chap. I., Book I., "On Heat," for many details connected with the heating of water.

2797. *Steam is condensed again into water by cold:* if deprived of the heat which made it steam, it returns to its former liquid state. On these two processes, the conversion of liquids into the elastic form, and condensing them by means of cold into the liquid form again, the *art of distilling* depends.

2798. *Water is so bad a conductor of heat* that it was supposed by Count Rumford to be absolutely a *non-conductor*. And although late experiments have shown that this is not actually the case, yet water conducts heat so imperfectly that the count's conclusion may be taken as true for practice in the greater number of ordinary cases. A vessel of water, when put upon the fire, is heated by the lower stratum of water expanding, and becoming specifically lighter; hence it ascends through the rest to the top, causing another layer to take its place; this becomes heated in its turn, and so the various particles of water *transport* or *carry* the heat upward by their motion.

2799. *Water becomes solid, or is converted into ice*, when it is cooled down to 32°, and the ice begins to be formed by appearing like needles crossing each other. In freezing, the air contained in water is excluded, but the bulk of the ice being greater than that of the water which has been frozen, ice is specifically lighter than water, and swims upon it. The specific gravity of ice is about 0·94; that is, it is $\frac{6}{100}$ lighter than water.

2800. *Water, in freezing, and increasing in bulk, expands with great force;* and hence it frequently bursts very strong vessels in which it may be contained: to this cause must be attributed the rupture of pipes in frosty weather. The expansive force of ice in freezing is well shown in an experiment made by Major Williams. A bomb-shell, thirteen inches in diameter, and more than two inches thick, was filled with water, and the fuse-hole plugged up with an iron bolt: thus charged, it was exposed to the cold of a severe frost, and the consequence was that the bomb burst by the congelation of the water. This expansive power of water in freezing is of infinite importance in the preparation of soils by the disintegration of rocks, and the pulverization of the ground after it has been turned up.

2801. *Water assumes the solid form*, not only when it becomes ice, but likewise in many cases where it combines chemically with other bodies; for instance, when salts crystallize from their solutions in water, a certain portion of this fluid becomes fixed, and is called *the water of crystallization:* a familiar example of this may be given in the slacking of lime, where the water becomes united to the lime, and a dry powder, called *slacked lime*, is the result, and which always contains some water in a state of solidity: this kind of union of a substance with water is called by chemists a *hydrate*.

2802. *That all water which has been exposed to the atmosphere contains a portion of air*, which it has absorbed, may be shown by placing this fluid under the receiver of an air-pump and exhausting it; the air will be seen coming out of the water in numerous bubbles. But this air may also be driven out by boiling; for this purpose the water should be boiled for two hours, and if such boiled water be again exposed it will absorb air as before. About 100 cubical inches of spring water afforded two cubical inches of air, which consisted of ten per cent. of carbonic acid, and the rest atmospheric air, that is oxygen and nitrogen; but different springs vary considerably in the quantity of air which they contain.

Rain water contains usually 3·5 per cent. of air, and 1 per cent. of carbonic acid gas. Snow water, when fresh, has no air.

2803. *Water absorbs various gases in different proportions.* Of some of the acid gases it takes up several times its own volume.

2804. *Water is susceptible of compression,* though in a very small degree. It was formerly thought to be absolutely incompressible; and it may be still considered so for all practical purposes; but it was shown long ago by Mr. Canton, and more lately by Mr. Perkins, that it can be compressed in a small degree by applying a very great force: it has been calculated that, by a pressure equal to 2000 atmospheres, it may be diminished $\frac{1}{12}$ part of its bulk, though Œrsted considers this estimate as somewhat too great.

2805. *Water is the most convenient material to serve as a standard for comparing the weights of other substances,* and their weight, compared with an equal bulk of water, is termed their *specific gravity;* therefore, in making tables of the specific gravity of various substances, water stands as 1·000. As water expands with heat, and contracts with cold, the weight of a cubic foot, or any other measure of water, must be somewhat less in warm weather than in cold; and on this account, when it is spoken of as a standard, it is always supposed to be of a certain fixed temperature. By very accurate experiments made lately, in consequence of the act of Parliament to regulate weights and measures, it has been ascertained that a cubic inch of distilled water at the temperature of 62°, barometer 30 inches, weighs 252·458 grains. An imperial pint, at the same temperature and state of the barometer, weighs twenty ounces avoirdupois. Any water heavier than this must contain some other substances, and, consequently, be less *pure.* Water is 816 times heavier than atmospheric air.

2806. *Water is a very powerful solvent;* hence it is very important, both as a natural agent, and in a great number of processes. Substances are remarkably distinguished as they are soluble, or not, in water. Frequent mention of the solubility or insolubility of substances in water will be found throughout this work.

2807. *Water absolutely pure is, perhaps, never found in nature.* It is nearly so in many instances; but in consequence of its being a powerful solvent, it soon becomes contaminated, more or less, by foreign substances. The purest water that can be found in a natural state is obtained by melting snow that has just fallen in a clean vessel at a distance from buildings, or by collecting rain water in very clean vessels at a distance from houses. But the chemist finds that, even then, the water is not absolutely pure; it has received, although in a very minute quantity, some adventitious matter in falling through the atmosphere; and it contains a portion of air, which may be separated by the air-pump. All the varieties of water which are found on the surface of the earth, or rising in the form of springs, are, as we might expect, still more impure, containing various substances which the water has dissolved. It is by art alone that we can obtain the purest water: to procure it we must employ distillation.

2808. *Distilled water is the purest state in which we know this fluid.* When heat is applied, the pure water alone rises in the form of steam, and the salts, and all other substances, dissolved in it, sometimes in very minute quantity, will not rise with the vapour, but remain behind; and thus distillation enables us to free water from any contamination by other matters which it may contain.

The process of distillation effects no change whatever in the water itself; it merely separates the pure fluid from its impurities. Water, when distilled, is quite colourless, beautifully transparent, entirely void of taste and smell, and it is lighter than any other water. It is perfectly soft; soap dissolves in it completely, presenting an opaline appearance.

2809. *Distilled water is absolutely unchangeable.* Time has no effect upon it, if kept ever so long. Notwithstanding its purity, however, it is little used except for medical purposes, or in experiments, partly on account of the trouble of preparing it, and partly because the process of distillation deprives it of the air which water always has in a natural state, and which is essential to its being an agreeable beverage: for want of this air, the taste of distilled water is vapid, although it is stated by some physicians to be an excellent solvent of the food.

In places where no water can be procured but which contains too much salts to be proper for drink, recourse may be had to distillation; but then it will be proper to suffer the distilled water to be exposed to the air for several days before it is used, and to agitate it by pouring it several times from one vessel to another, to facilitate the absorption of common air, and restore its usual taste.

The purest distilled water is obtained from rain water, and when it is required to have it absolutely pure for pharmacy, or very nice experiments, it is usual to employ glass or silver vessels for the distillation. But this nicety is not necessary for ordinary occasions: any tin kettle fitted up as a still will do sufficiently well, and any one at all acquainted with the subject may easily contrive a method of having a constant supply of distilled water sufficiently pure by means of the common kitchen fire. This would be extremely easy in a kitchen where a boiler is attached to a range or grate; for it would only require to have a pipe from the top of the boiler leading to a worm placed in any convenient situation, and passing through a tub or cask of cold water, which must be removed when it gets too warm.

Distilled water is absolutely necessary in the composition of medicines, since impurities which might be of no detriment to water for ordinary purposes might destroy or injure the properties of certain materials in pharmaceutical preparations: hence, in the "Pharmacopœia," apothecaries are requested to use only distilled water. When the water to be distilled contains carbonic acid, if the temperature be low, a small portion of this gas passes over with the steam, and is found in the water when condensed, a circumstance which would be injurious in medicines: for instance, if distilled water were used, as it always ought, for diluting solutions of subacetate of lead, or, as it is called, sugar of lead, a cloudy precipitate would be seen, owing to the formation of carbonate of lead, which would render this preparation less effective as a lotion; but if distilled water, perfectly pure, be employed, no such precipitate occurs. This is the reason why the apothecary throws away the first tenth of the product in distillation; but for the purposes of drink, this very minute portion of carbonic acid would be no detriment whatever. The distillation should not be carried on till all the water in the still be driven off, because, when it is reduced to within about four tenths, a decomposition of the substances left is apt to take place, and a disagreeable taste communicated to the product, which would defeat the desired object.

2810. *Water, in the ordinary state, contains*, besides common air, a small quantity of another gas, the carbonic acid gas, which we also mentioned under "Ventilation," and which we shall again have occasion to speak of under "Fermentation." This gas, which assists in giving a brisk taste to spring water, distillation drives off; and this is likewise restored by exposure for a short time.

Sect. III.—Rain Water.

2811. *Rain water is the next in purity to distilled water*: and it is the purest, and, of course, the softest, of any natural water.

2812. *The origin of rain* is water which is evaporated from the sea and land. By the heat of the sun this liquid rises in vapour, and after ascending to the higher regions of the atmosphere, where constant cold prevails, it is condensed into mist, which appears to us as clouds; these float in the air as long as the temperature remains the same, but when they enter currents of colder wind, or are affected by electricity, they are farther condensed into minute drops of water, which ultimately unite together and descend as rain. One might expect that rain water, falling immediately from the clouds, should be absolutely pure, and entirely free from all other matter. This, however, is not exactly the case. It always contains a certain proportion of common air and of carbonic acid gas, which, however, are useful, and, as we have stated above, are the cause of its agreeable taste. But rain water, even when collected with the utmost care, is said by chemists sometimes also to exhibit traces, though very slight, of muriatic and nitric acids, together with carbonate of ammonia.

A small quantity of carbonic acid being a component of the atmosphere, its absorption by rain is easily conceived; but it is not so easy to account for the existence in it of the other acids. Rain, also, falling through the atmosphere of a smoky town, collects in its descent some impregnation from the impurities in the air above the houses. The quantity, however, of all these deteriorating matters is exceedingly small when it has been properly corrected; they can only be detected by the most delicate chemical tests, and are too insignificant to be regarded in employing rain water for the ordinary purposes of life, when used fresh; yet they are often sufficient to render it liable to spontaneous change when long kept.

From the great purity of rain water, its solvent powers are greater than those of any other natural water; hence it soon becomes impregnated with whatever matter it meets with that is at all soluble in it. In hot climates it is apt to become full of animalculæ, and at last to acquire a strong putrid smell from the decay of the animal and vegetable substances contained in it. If properly collected in this climate, however, it keeps a long time.

2813. *To obtain rain water in a state of complete purity for the purpose of examining it*, it should be collected in wide vessels perfectly clean, placed in some open space as far as possible from the smoke of towns, where they can receive the rain immediately from the clouds without its being suffered to fall upon or touch any other substance. Whatever is collected from ordinary roofs is more or less contaminated with whatever happens to be loose, and there is generally some soot from the smoke of chimneys, and fragments of loose mortar, together with a variety of matters that have been blown there by the wind. These materials, however, are not of such a nature as to make the water hard; and provided the roofs are kept clean, it will be perfectly soft, and, if suffered to settle, and filtered, will be nearly as pure as that which is collected immediately from the atmosphere. In countries or districts where water cannot be had from springs or any other source, large roofs are constructed purposely for collecting it. But the substance of which roofs consist is important to consider in collecting water from them; those which consist of lead, copper, or zinc are altogether improper, as the water would certainly be impregnated with the oxydes of these metals, and rain water in particular is found to exert a solvent power on metallic lead. In tiled roofs, where there is a great deal of mortar, the water from them frequently has some impregnation of lime, not, however, sufficient to deteriorate it to any considerable degree, except while the roof is new: wood is also improper. Slate is quite insoluble in water, and, in that case, there being generally no mortar, the water will receive no impregnation, except what may arise from smoke and dust, or what may be produced by the lead gutters and pipes, if there are any. Dripping eaves, and earthen-ware pipes placed below them, are most to be recommended where it is wished to collect water from roofs; and cisterns or tanks formed of slate, stone, or brick, covered with cement or stucco, are better to keep it than wood; lead is particularly improper. It would be very easy to construct cisterns with filters so contrived that rain water might at all times be drawn from them in a state of great purity; and in this manner almost every house, at least in the country, might be supplied with the very best and purest soft water. It has been calculated that the average quantity of water which falls in a square yard of surface in Britain, in the course of a year, is 126 gallons. If, therefore, there be 100 square yards of roofing, it will give 12,600 gallons, which would be an ample supply for all the purposes of a small family.

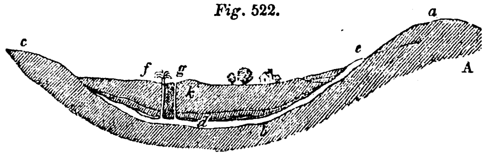
2814. *Rain water, carefully collected and filtered, is extremely agreeable to the palate, and perfectly wholesome.* From its great softness, it is also particularly fitted for the purposes of the laundress. For the mode of preserving it, see Section 10, "Filtration," and Section 12, "Cisterns and Tanks."

Sect. IV.—SPRING WATER.

2815. *The original source of all spring water is rain,* which, falling upon high ground, filters through the soil and the strata of the earth so long as they are porous, until it is stopped by some impervious substance, as rock, or tough clay; it will then find its way along the surface of this bed, until it arrive at some crevice or opening, through which it forces its way out on the surface. From this description of springs, it is obvious that the water which they afford would be equally pure with rain water, provided it does not meet with any substances in its passage through the earth which it can dissolve.

2816. *This will be rendered more clear if we consider the accompanying diagram.* Suppose A to be high ground, perhaps rocky, or, at least, impervious to water, and let *a b c* (*fig.* 522) represent the surface of this *impervious* stratum, having a stratum of sand, or some *pervious* substance, *d*, lying upon it; and over this let another *impervious* bed, *k*, cover the last. The rain which falls on the surface of the high ground at *a* will run down the slope of the hill until it comes to the sandy stratum at *e*, and it will sink down into the sand, and make its way to the lowest part of the sandy stratum. If there should happen to be fissures at *f* and *g* in the upper impervious stratum *k*, the water which entered at *e*, and went down to *d*, will be forced up through these fissures, because *e* is at a higher level; and it will issue out on the surface of the ground at *f* and *g* in the shape of springs. This is the origin of springs in general; they are the openings through which water is forced that has come originally from some higher ground, and made its way through the soft strata as it would through pipes; and very often the sources of springs lie at a very great distance. But if the rain water was ever so pure at first, in passing through various parts beneath the surface of the earth, where a variety of soluble salts occur, it must frequently dissolve some of them in its passage, and issue more or less impregnated; and the kind of salts and quantity of the impregnation must vary in every locality. Accordingly, spring water is never perfectly pure, nor entirely free from substances dissolved in it, though sometimes the quantity of dissolved matter may be very small, and not so much as sensibly to deteriorate its qualities with reference to domestic purposes.

Fig. 522.



2817. *The salts most frequently found in the water of springs* are sulphate of lime and carbonate of lime; but, besides these, there occur occasionally sulphate of magnesia, or Epsom salt, sulphate of soda, or Glauber's salt, muriate of soda, or common salt, now called chloride of sodium. Alum is sometimes found, though much more rarely; and salts of iron are extremely common, besides occasionally other substances.

2818. *The chief practical distinction in water is its being what is called hard and soft,* qualities which are pointed out by its action on soap. In water perfectly soft, soap dissolves without curdling, and washes with a lather; hard water curdles the soap, instead of dissolving it, and will not do for washing. This distinction is practically so important that it is necessary to explain it clearly.

2819. *What is called the hardness of water*, exhibited in its curdling soap, is owing to its containing a small quantity of certain neutral salts in solution, which have been derived from the passage of the water through the earth, for rain water is quite free from them. These salts, as has been stated, vary in their nature and proportions according to the nature of the earth through which the water has passed; but all these salts which have been just enumerated consist of an *acid* united to some other substance. Sulphate of lime consists of sulphuric acid and lime; carbonate of lime, of carbonic acid and lime; sulphate of magnesia, of sulphuric acid and magnesia; sulphate of soda, of sulphuric acid and soda; muriate of soda, of muriatic acid and soda, &c.

2820. *Now the reason why water that contains these salts curdles soap is this:* Soap consists of alkali, and oil or tallow, and it is the alkali which is the effective material in washing; but the acid of the salts dissolved in the water *decomposes the soap* by having a stronger attraction for its alkali than for the substance with which this alkali is already united, and thus the soap is rendered quite useless and ineffective. *But to make this still more plain*, we shall take a particular salt, and examine in detail what effect it actually produced upon the soap. Sulphate of lime is by far the most general cause of the hardness of ordinary spring water, except it be brackish, and then the salt would be muriate of soda. Sulphate of lime, we have said, consists of sulphuric acid and lime; and soap, we have stated, consists of alkali, either soda or potash, and oil or fat; these two, the alkali and fat, unite to form soap, which is soluble in water, although fat, one of its ingredients, is insoluble. Now, when sulphate of lime dissolved in water comes in contact with soap, the sulphuric acid, having a stronger attraction for the alkali of the soap than it has for its own lime, lets go the lime, and seizes upon the alkali; in consequence of which the fat of the soap is set at liberty. The soap is thus evidently separated into its original constituents, fat and alkali, and is, therefore, no longer soap. The soda of the soap joins to the sulphuric acid, and forms sulphate of soda, and the lime and the fat unite as an insoluble compound, appearing like a curd; in consequence of this the peculiar action of the soap is totally prevented. *And to understand this clearly, let us examine what is this peculiar action of soap.*

2821. *The action of soap is detersive*, that is, it destroys grease, which is only another term for oil or fat of some kind; and the following is the manner in which it takes away or discharges grease: the alkali of the soap unites with the grease, and makes more soap, which, being soluble in water, is thus carried off. But it may be asked, if the alkali of the soap be already united to oil or grease, why should it unite to the grease which it is intended to destroy? The fact is, that if there was a sufficient quantity of oil in the soap to *saturate* it *completely*, it would not act in this manner, and would not be detersive; but in the manufacture of soap, care is taken to have a little less oil than would be sufficient for that purpose, and therefore the alkali can still take up a small additional quantity of oil, which is just what happens in its removing grease in washing. Another question will now naturally occur to one who reflects: if the alkali of the soap be the only effective material, *why not use it by itself?* why make it into soap at all? This is done merely for convenience; if the alkali alone was rubbed upon the linen, it would, as every laundress well knows, burn and corrode it, and it would also corrode the skin of the hands: uniting it to fat, therefore, in making it up into soap, is for the purpose of moderating its strength, and enabling it to be applied for a greater length of time to the desired parts, instead of being, as it would be in the state of soda only, soon lost in the water. It follows from this explanation that the strongest soap has the greatest quantity of alkali.

We must observe that water never contains so much sulphate of lime as to be perfectly hard, or to destroy altogether the action of soap; therefore we find water *more or less* hard; and to a certain extent it may do for washing, though badly.

2822. *Carbonate of lime is another substance very commonly dissolved in water*, and which occasions hardness, as well as being otherwise inconvenient and prejudicial. Carbonate of lime is composed of lime united to carbonic acid, which has been described when treating of "Combustion," Book II., Chap. II.

2823. Common carbonate of lime *not being soluble* in water, it is natural that one should inquire how it can be occasionally held in solution in that fluid? That the carbonate of lime in hard water is dissolved is evident, since water of this kind is perfectly transparent, and not cloudy, as if chalk were mixed with it. It is not possible to account for this circumstance, nor to explain distinctly the mode of remedying this defect in water by depriving it of its carbonate of lime, without entering into the following details, which, although a chemical subject, we shall endeavour to render very simple, at the same time recommending every one to cultivate chemistry so far, at least, as to be able to understand explanations of this nature: a task which is far from being difficult, and perfectly within the easy attainment of every person who has had the advantage of a liberal, or even an ordinary education.

2824. Every kind of limestone or carbonate of lime, of which chalk is one, is *insoluble* in pure water; therefore pure water, running over chalk or other limestone rocks, cannot be impregnated with lime. Were not this the case, we should have no water free from this earth, as it is so abundant in nature; nor should we have springs of water issuing so pure as they do frequently from chalk rocks. But springs of natural water are often impregnated with carbonic acid, which they receive in the earth by means not well understood; the fact, however, is certain; and when such water is exposed to the air, but still more when boiled, the acid gas flies off, and leaves the water free. Now, common carbonate of lime, as, for instance, chalk, is, as we observed, united to carbonic acid, but to a certain determinate proportion only of this acid; it cannot take up any more as common carbonate: no chalk or limestone contains more than this fixed quantity; and we have said that in this condition it is not soluble in water. But, if common carbonate of lime should meet with water holding carbonic acid without lime, the lime of the carbonate will then receive an additional quantity of the acid gas, and thus become *doubly carbonated*, or what is called a *bi-carbonate*, or, as some say, a *super-carbonate;* and this *bi-carbonate of lime is soluble in water.*

2825. Upon these facts the explanation of the phenomenon in question depends. In order that water should have carbonate of lime in solution, it must first have been impregnated, by some means or other, with carbonic acid: how that has happened we cannot always say: we know that this gas issues in abundance from the interior of the earth, as in the case of the famous *Grotte del Cane*, and numberless other instances. Water greedily absorbs this gas, and by its means, in the way just mentioned, it is rendered capable of holding abundance of lime in solution. But what will be the natural consequence of exposing such water, now impregnated with lime, to the air, and, still more, of boiling it? We have said that the carbonic acid will be driven off by exposure; that is, *so much* carbonic acid as was sufficient to convert the common carbonate of lime into bi-carbonate of lime, *but no more.* By boiling, therefore, the bi-carbonate is reduced to common carbonate. Now, what must follow? Bi-carbonate of lime is a soluble substance, and the solution of it i water is transparent; but common carbonate is not soluble, that is, water cannot retain it in solution; consequently, the newly-formed carbonate falls down as a cloudy precipitate. Every one knows that if a common carbonate of lime, as powdered chalk, or limestone of any kind reduced to the state of a powder, be mixed with water, they will not dissolve; but, after causing at first the fluid to be turbid, will, after some time, settle to the bottom as a powdery or pasty mass, leaving the water quite free. This is exactly what happens in the case we have mentioned, with this difference, that the precipitated carbonate does not fall down in the state of a loose powder or soft pasty substance, but forms a hard crust; and it is this crust which we call *furr*, and which lines the insides of our tea-kettles. All waters that deposite furr in kettles or boilers must have had in solution *bi-carbonate of lime*, which has been thrown down in the state of *common carbonate*, in consequence of the boiling of the water sending off and dissipating part of the carbonic acid.

2826. *From this explanation, the remedy for water having carbonate of lime in it will be easily understood.* Boil the water for some time, and the carbonate will separate and fall down. Some waters clog the kettles and boilers much faster than others, owing to their having a very large portion of carbonate of lime. It is well known that this is a serious inconvenience in steam boilers; and when tea-kettles become much furred they do not boil water so readily.

The remedy just mentioned, of precipitating the carbonate of lime by boiling, is tedious, and can only be effected on a small scale: another method has been suggested, which answers immediately, and on any scale whatever, rendering the water soft as far as that depends upon freeing it from the carbonate. Add to the water some quicklime, formed into the consistence of cream, with water. Diffuse this through the water to be purified: the quicklime attracts the excess of carbonic acid in the water, and becomes common carbonate of lime, which is insoluble, while, at the same time, the bi-carbonate, previously held in solution, being deprived of its excess of carbonic acid, also becomes common insoluble carbonate, and both fall to the bottom, leaving the water pure. It is to be observed, however, that though this process will effectually render the water soft, if the hardness be owing to carbonate of lime, and that such water will no longer curdle soap, and may be used for washing, yet there will be danger of more lime being used than is necessary for the purpose, and the superabundance will remain in solution in the water, which is then, in some degree, lime-water; indeed, it will scarcely be possible to proportion the lime so as to avoid this. Quicklime, which is caustic, has been employed with this view by laundresses, and the consequence has been that, using too much, the linen has been corroded and injured. Nor would it be advisable to employ this method with water used as a constant beverage; but for many purposes the method may be valuable.

But, though these methods will free the water from carbonate of lime, the sulphate of lime, another source of hardness, must be treated by a different process. The sulphuric acid, not being volatile, cannot be driven off by boiling; but the sulphate of lime must be decomposed by adding some alkali for which the acid of the sulphate has a stronger attraction than for the lime. This may be either soda or potash. The sulphuric acid will seize the alkali and let go the lime; at the same time the sulphuric acid, being now saturated with the added alkali, can no longer act upon that of the soap. This is one of the reasons why soda is found so useful in washing in some of the waters round London, besides its immediate action as a detergent. In these waters there is generally more or less sulphate of lime, which causes a degree of hardness, and this hardness is destroyed by the soda.

This remedy is sufficient if the water be employed only for washing; but, as the addition of soda to sulphate of lime would convert it into sulphate of soda, or Glauber's salt, it would be a matter for consideration with the physician how far a minute portion of this newly-formed salt would be injurious to the constitution in using the water as a beverage. It is very generally stated that hard water is prejudicial if taken long as a beverage. It is apt to cause a sensation of weight, particularly in that weak condition of the stomach which exists in dyspepsia. The water of Paris contains some sulphate of lime, and occasions uncomfortable feelings to strangers who drink of it for the first time.

2827. Sulphate and carbonate of lime being properly insipid substances, they do not impair the taste of the water nor injure its transparency, while the agreeable coolness of water brought up from a considerable depth in the earth renders it frequently very agreeable; but, though a very minute quantity of these salts may not be prejudicial, there is little doubt that waters very hard are unwholesome if used for a length of time. It has been said that they give rise to calculous complaints; but it is not an easy matter to prove this, since, "with the exception of lime, the substances found in hard waters do not enter into the composition of calculi; their operation, therefore, must be rather of a predisposing nature, and is probably exerted upon the organs of digestion, which are well known to be intimately connected with the kidneys."

Late observations, indeed, have given another view of this subject: the formation of calculi appears to be owing to an undue secretion of lithic acid occasioned by indigestion, generally indicated by acidity in the stomach; and it is now said that hard water, containing an impregnation of carbonate of lime, so far from increasing the disease, acts as a remedy by neutralizing the acid in the stomach, and is, in fact, a useful beverage to this class of invalids. In this respect there may be essential difference between an impregnation of sulphate and of carbonate of lime; and it is only the latter which can be advantageous, acting in the same manner as chalk.

Dr. Paris observes that "animals are more sensible of the impurities of water than man. Horses, by an instinctive sagacity, always prefer soft water; and when, by necessity or inattention, they are confined to the use of that which is hard, their coats become rough and ill-conditioned, and they are frequently attacked with the gripes. Pigeons are also known to refuse hard, after they have been accustomed to soft, water. Hard water has also a tendency to produce disease in the spleen of certain animals, especially sheep."

2828. *The proportion of salts varies considerably* in waters that are considered as hard, and we have stated that no natural water is absolutely free from them. But it is not necessary for the ordinary purposes of life that water shall be as pure as when it has been distilled: when water is transparent, colourless, entirely tasteless, and without smell, and will answer for the purpose of washing, it may be considered as pure and good water; but the salts should not be in such quantity as to stimulate the bowels to increased action, nor should the water refuse to unite with soap.

2829. *Brackish spring water* contains common salt, muriate of magnesia, and muriate of lime, all of which exist in sea water; and the springs must owe these either to some communication with the sea, or to the proximity of some bed of rock salt through which the springs pass. *Brine springs* contain so much salt that it is procured from them by boiling and evaporation; several of these occur in Cheshire and Worcestershire.

[Brine springs, or salines, as they have been called, are very numerous in various parts of the United States, especially in the western section of New-York, where, as on the borders of Onondaga Lake, the brine is of such strength that, from some of the wells or springs, thirty to forty gallons will yield a bushel of excellent salt. The manufacture of salt from the springs of Onondaga county employs many thousands of labourers; and, while it is productive to the proprietors, constitutes a fruitful source of revenue to the state, nearly four millions of bushels being annually inspected at these works. As the improvements in the works, though yearly increasing, are not yet perfect, there is still an immense waste of brine, which might be obviated by greater skill in the process, and improved machinery. Experiments are in progress under the patronage of the state, and these objects, it is hoped, will ere long be secured.

Three modes of manufacturing salt are pursued at the Onondaga springs, viz., 1, solar evaporation; 2, evaporation by artificial heat; and, 3, rapid boiling in kettles.]

2830. *What are called petrifying springs* are intimately connected with this subject, and we cannot introduce their explanation in a better place, as it will throw still farther light on what we have been discussing. The vulgar notion of a petrifying water or spring is, that it will convert into stone any substance thrown into it. This is, however, altogether an erroneous idea; there is probably no such water or spring, in this sense of the term. No water in any country, *as far as is known*, has *now* the property of converting wood into stone. Petrified wood is frequently found imbedded in ancient rocks; but the date of such petrifactions is entirely unknown, and is probably of incalculable antiquity. Modern waters said to have a petrifying quality do not convert the substance of wood into stony matter, but only incrust the wood with a deposition of carbonate of lime, precisely analogous to the furr of a tea-kettle; and the piece of wood so incrusted will be found within this incrustation perfectly unchanged. Several springs of this kind are well known in various parts of England, particularly at Matlock in Derbyshire, where many substances, as birds' nests with eggs, branches and leaves of trees, &c., or, in short, any objects thrown into them, are petrified, as it is improperly called. These springs hold carbonate of lime in solution, in the manner we have stated above; and when the water issues from the ground, and is exposed to the atmosphere, the excess of carbonic acid flies off, without boiling, and the bi-carbonate, thus reduced to the state of common carbonate, is precipitated as a crust over any substances at the bottom. Such objects are, therefore, merely *incrusted with carbonate of lime*, and are properly *incrustations, not petrifactions*, the latter term being applied only to the effect of very ancient and unknown operations, by which every particle of the original body has been removed, and stony matter *substituted* in its place. If a piece of really petrified wood, for example, be broken across, no wood will be perceived in the interior; the whole will be mineral matter. Science is yet unable to explain satisfactorily this effect, as well as many others in the natural history of the earth, and the cause has never been seen in operation.

[Petrifying springs are not infrequent in America, and in Western New-York they are numerous, so that specimens of the most delicate parts of vegetables, replaced by carbonate of lime or silica, without any alteration in their form, are found in great variety. And these are not merely incrustations, as in the formation of stalactites, calcareous tufa, or travertin, but are often true petrifactions, in which the conversion of the wood into stone is proven by analysis, not a trace of vegetable matter being discoverable, the petrifactions consisting wholly of lime in the form of carbonate, with minute portions of silica, alumina, and oxyde of iron.]

2831. *Soft spring water* is nearly the same as rain water; it is, indeed, only the latter which has passed through the earth without meeting with any soluble substances to alter its purity: it is very seldom quite so pure as rain water. Some waters of this kind are so pure as to possess even a medicinal celebrity. The waters of Malvern and of St. Winifred's Well in Flintshire are very pure waters, having no mineral impregnation; and it is thought that their salubrity is owing to the great solvent power which water has when in a very pure state. The sweetness of water is a term that merely expresses its purity.

Although hard water is improper for many domestic purposes, yet there are many cases in which the *hardness is no detriment*, and there are several in which *it is even advantageous*. Soft and pure water has, as we have stated, a much greater solvent power than hard; therefore in culinary operations, where the object is to soften the texture of animal or vegetable matter, or to extract from it and present in a liquid form some of its soluble parts, soft water is the most effective, and to be preferred. In brewing, boiling, or stewing meat, making soup, or any extract whatever, soft water is best.

2832. *But if we consider the cooking of vegetables*, we shall find that in some instances hard water is better than soft; and this the cook knows practically at least, by throwing salt into the water, which makes it hard. Soft water without salt has too powerful a dissolving effect upon green vegetables; it makes too tender, destroying that firmness essential to the preservation of their juices, which are thus dissolved and extracted, and the vegetables consequently rendered insipid, at least to English palates. Together with the juices the green colour is extracted, and the vegetables rendered pale, and even yellowish.

2833. *In boiling fish, likewise*, the contrary to boiling meat, it is not required merely to render the fish soft, but to preserve a certain degree of its firmness. Salt is, therefore, put into the water in boiling fish; hence it is evident that, in this case, hard water is at least as good, if not better, than soft.

2834. *It may therefore be laid down as a rule in domestic economy*, that when the object is to dissolve substances, to render them soft, or to extract the virtues of anything, as in soups, broths, stews, &c., then soft water is the best; but when the object is to cook the food by preserving the juices as much as possible in the substances, hard water is preferable. This, it is to be remarked, although correct, is not the prevailing opinion acquired from books on cookery.

2835. *It should be observed that the terms hard and soft, as applied to water, are only relative:* but water which contains as much as five grains in the pint of saline matter is generally regarded as too hard for washing, and many other economical and manufacturing processes.

2836. *The temperature of springs is uniformly the same all the year round;* hence in summer the water is considerably cooler than any other water: that coming to the surface is more easily affected by the change of season.

2837. *Some springs are, however, naturally warm, and some are hot, and even boiling hot.* When they are warmer than ordinary, they are called *thermal springs*. When a spring is warmer than usual, but still below the temperature of the human body, it is said to be *tepid;* a good example of which is the waters at Buxton, which are always at a temperature of 82°; it is perfectly transparent and colourless, and only differs in its temperature from any ordinary spring. When the spring is warmer than the heat of the body, but not so warm but that the hand may be borne in them, they are called *warm springs*, as those of Bath, which are about 116°; above that point, and to the boiling point, they are *hot springs*. Of the latter there are none in Britain. Thermal waters are generally pure, seldom saline; occasionally, however, they are so, as at Carlsbad in Bohemia, where they have the temperature of 165°. In Iceland, there are several large springs which issue from the ground boiling hot, the most remarkable of which is that called the Geyser.

Sect. V.—well water.

2838. *The water of wells*, sometimes called *pump water*, when the wells are of great depth, is derived from springs; therefore it is essentially the same as spring water, and, like that, must vary with every locality, being hard or soft, according to the various impregnations it has received.

2839. *We stated, when treating of the choice of the situation* for a house, the importance of having an abundant supply of good water. Frequently, to procure this, a well is to be dug, and upon the success of this experiment sometimes the decision on the situation depends.

2840. *The probability of finding water in any spot* depends upon the geological structure of the surrounding district; and as this varies in different places, no rules followed by well-diggers in one district will apply to another. The experience of the well-digger is generally limited to a certain district, and he too often thinks that the observations which he has made in one spot will apply to all the world; and this is very apt to mislead.

2841. *The study of geology furnishes the only true guide* in the search after the proper spots to sink wells in; therefore the geological examination of the surrounding country should precede every other step to be taken with respect to sinking for water.

2842. Wells are always sunk till they penetrate some loose stratum which is charged with water, and which is placed between two other strata impenetrable by it.

2843. Wells are of two kinds: 1, common shallow wells, which are often only reservoirs; 2. Artesian wells, or constantly flowing wells depending upon a high source.

Shallow wells often penetrate a thin stratum or two, *a*, *a*, *fig.* 523, and enter another of sand or some porous substance, *b*, *b*, in which water is contained. When this stratum is pierced, water appears, and is called a spring. Should this not communicate with any higher source, the water that drains into the well sunk down to *c* will not rise upward, and therefore it is necessary to sink this well deeper, so as to form a reservoir for the water that runs into it from the stratum *b*. In some cases, the well is a mere tank into which the water may ooze from the gravel on the surface. This is the case with most of the *shallow wells* round London. The water of such wells of no great depth are very apt to be contaminated by the various substances in the soil, as iron, lime, and even putrid matters; the first two would give them inconvenient properties, but the latter would render the water highly prejudicial. Many instances have occurred of disease being produced from bad water, and particularly in cases where churchyards have been suffered to contaminate the sources from which wells have been supplied, a circumstance which does not appear to excite so much alarm as it ought to do in the English metropolis.

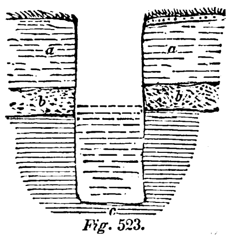


Fig. 523.

2844. *An Artesian well* is a deep well sunk down as at *f*, *fig.* 522, to some stratum fed by a high source. When the stratum with water is arrived at and pierced, the water suddenly rises in the well as high as the source of the spring, *e*, which may even be higher than the ground where the well is sunk, and then the water will pour out as a fountain, or flow over. The *deep wells* in London are of this kind, and the water in them is remarkably pure. The name Artesian is derived from the province of Artois in France, where, it is said, they were first executed. Wells of this kind are now become extremely common, since the operation of boring is often found sufficient.

Sect. VI.—river water.

2845. *River water is composed partly of spring water and partly of rain water.* The principal source of the water of rivers is mist and rain. The former, consisting of the masses of vapour called clouds, are condensed upon mountains, whence a thousand rills of transparent soft water, which unite together into streams and rivulets, either flow into lakes, or, by their union, compose great rivers. Since rivers wind through various regions of the earth, their waters will necessarily vary considerably in the substances which they contain, the nature of which will depend upon the season of the year, and whether they have been increased by snow and floods, or whether, from the heat of the summer, they are more or less impregnated with animal and vegetable matter. Another source of the supply of rivers, but one much less considerable, is derived from springs, which, consisting of water that has long filtered through different strata, is sometimes extremely pure, and in other places highly charged with mineral salts. The proportion of these last, however, being comparatively small, river water is in general remarkably soft, and next in purity to rain water.

2846. *After storms rivers become muddy* from the earthy and boggy matter through which they pass, and which they sweep away as they swell above their ordinary channel. It is evident, also, from what has been said, that the water of rivers must be purer the more we advance towards their sources; and that the greatest quantity of contaminating matter will be found where they nearly reach the sea, the water in their mouths being brackish.

2847. *Some streams that flow over a rocky or pebbly bed,* particularly those in a mountainous country, as in Wales and Switzerland, are remarkably pure and transparent, having been filtered by the clean siliceous pebbles and sand through which they pass; rivers that wind through plains composed of soft strata are often extremely muddy, though they may be free from saline contents.

2848. It is here important to notice and explain the difference between impurities being *mechanically suspended* in water and *being dissolved* in that fluid. If fine sand or clay be agitated in a glass of clean water, a turbid mixture will be produced; but if the water be suffered to rest quietly for a day or two, all the sand and clay will settle to the bottom, and the water will remain perfectly clear as at first. The particles of the sand and clay were merely suspended for a time in the water, in consequence of the motion given to it, their extreme minuteness rendering them easily disturbed; but when that motion has ceased, these particles being specifically heavier than water, that is, fragments of substances that would sink in water, they fall to the bottom, or subside by their superior gravity: rest, therefore, for a certain time, is alone sufficient to separate such substances. But the case is very different with what is actually dissolved in water. Take, as an example, some common salt. This, in dissolving, disappears entirely: it does not cause the water to be muddy, and if the fluid stand quiet ever so long, not a particle will fall to the bottom. The salt is here chemically united to the water, and no rest can have any effect upon it so as to separate it. This is the case with all the salts which are held in water; and, likewise, with some other substances, as mucilage and gelatin, or gum and glue, which will dissolve in the same manner, and will not fall down in consequence of rest.

2849. *Though the water of rivers is produced from the union of that of springs with rain water,* and hence must contain the salts of the former, together with a variety of matters collected by the rivulets and streams which flow over the surface of the earth, yet in general, as we said before, it possesses considerable purity. Much of the carbonate of lime is deposited during its passage through the water, being exposed to the air; and the greater part of the animal and vegetable substances carried down into it is held merely in a state of mechanical suspension, and is not dissolved; for while the water is in constant motion, the putrefaction of these matters does not take place, or in a small degree; hence the greater part may be separated by subsidence when the water is suffered to be at rest, or by filtration.

2850. *But it should be remarked that though river water, even when originally extremely foul, may be purified* by means of filtration to a very considerable degree, yet it can scarcely be expected that it can thus be deprived entirely of all impurities, since, notwithstanding all possible care, some small portion will escape the best filters. If the filters, however, are good, the quantity of these will be extremely small; but the *impurities* which have been dissolved in the water cannot be separated by ordinary filtration. See, farther, Sect. X., "Filtration."

2851. *River water is almost always soft,* because the principal portion of it has been collected from rain water that has never passed through the strata, but flowed only upon the surface, and because the greater part of the earthy salts have had time to be deposited; but from the most noxious impregnations consisting of animal and vegetable matters which have been carried into it, or which have been generated in the rivers themselves, by various aquatic insects and plants, and which have been partly mechanically suspended, and partly dissolved in the water, it is never quite pure. If such river water be suffered to rest, part of this matter will subside, but some will still remain; and though putrefaction did not take place while the water was in motion, yet this effect will happen whenever the water becomes stagnant.

2852. *For this reason it is very desirable that artificial pieces of water* employed to ornament pleasure grounds should, if possible, have some motion, to prevent the bad effects always produced by stagnant water.

What has been said of artificial lakes and ponds applies, likewise, to reservoirs of every kind.

2853. *Rivers which issue from lakes* are generally very pure and transparent, because all the sediment has been deposited in the still water, and the stream that issues is free from the mechanically suspended impurities that were brought into the lake. The Rhone coming out of the Lake of Geneva furnishes a good example of this fact.

2854. *In countries where bogs and peaty marshes abound,* the rivers are often tinged with a brownish colour extracted from the peat, and which does not easily separate from the water.

2855. *The taste of river water* is more vapid, and less agreeable, than that of spring water, because the former has lost all its carbonic acid in consequence of long exposure to the atmosphere; and it is this which renders spring water so pleasant as a beverage.

2856. *Many capital cities are supplied with river water,* as London with the water of the Thames, Paris with that of the Seine.

The Thames water is of itself remarkable for its softness and purity, although in passing through London it receives a great deal of impurities from sewers, and various other local causes. Most of the foulness with which it is in this way contaminated is only suspended, and not dissolved, in the water, and, therefore, mere rest causes much of it to subside, and the greater part of the remainder of what is merely suspended might be separated by filtration: the same may be said of the New River water.

The water of the Seine has been carefully examined by Parmentier, and appears to be of great purity, notwithstanding the numerous manufactories, as dyers, tanners, hatters, &c., which crowd on its banks, but it contains more lime than Thames water.

SECT. VII.—ICE AND SNOW WATER.

2857. *The water from melted ice is nearly pure,* as almost all saline substances are separated by the freezing of the water; even the ice of salt water is nearly fresh, and is used in some places for brewing: but the air contained in the water is likewise separated by this process. Ice water is therefore similar to what has been boiled, in consequence of which fish will not live in it except it be afterward exposed to the air for some time. It has a vapid taste, and does not appear to quench the thirst, nor to act as a solvent in the digestive process so well as rain water. Water from melted snow agrees in its properties with that from ice.

2858. It has been supposed that ice and snow water are unwholesome, and that they give rise to the unseemly disease, the bronchocele, or *goître*, which disfigures so many persons in the Alpine valleys who are obliged to drink snow water for a great part of the year; but this opinion is no longer admitted by physicians, who observe that the "same affection prevails in Sumatra, where ice and snow are never seen; and, on the contrary, that this complaint is unknown in Chili and Thibet, although the rivers of these countries are derived from the melting of the snow with which the mountains are covered." Captain Cook, and other navigators, have proved the wholesomeness of ice and snow water, which they have been obliged to depend upon entirely in high latitudes; and in the polar regions, thawed snow and ice forms the constant drink of the inhabitants during winter, and of the mariners who visit them.

This kind of water is perfectly soft, dissolves soap readily, and will keep good for many years.

SECT. VIII.—SEA WATER.

2859. *The saltness of the sea is, no doubt, one of the wise arrangements of Providence* to prevent the evils which we perceive in stagnant fresh water. The saline impregnation prevents the putrefaction of the animal and vegetable remains with which it abounds.

2860. *According to Dr. Murray's analysis,* a pint of sea water on our coast contains, lime, 2·9 grains; magnesia, 14·8; soda, 96·3; sulphuric acid, 14·4; muriatic acid, 97·7; total, 226·0; or, if we consider these substances as combined in the water, it will be, muriate of soda, or common salt, 159·3 grains; muriate of magnesia, 35·5; muriate of lime, 5·7; sulphate of soda, 25·6; total, 226·0, or 1 of saline contents to about 30 of water. It is the muriates of magnesia and lime that give the bitterness which we taste in water of the sea. This water will not do for washing, on account of the salts which it contains; nor, for the same reason, is it proper for preparing food.

2861. *The steam which rises on the boiling of salt water is* nearly quite fresh, scarcely any of the salt rising with it; hence it might appear that we have an easy method of obtaining fresh water from the sea, since, for this purpose, it is only necessary to subject salt water to the common process of distillation, and the water formed by the condensation of the steam in the usual way will be fresh, the salt remaining behind in the still, or any vessel employed for distilling. Yet simple and obvious as is this process, it does not appear to have occurred to the early navigators, who were often distressed for want of fresh water, when they might have supplied themselves by this method. The ancient Greeks, indeed, who were acquainted with the art of distillation, are said to have procured fresh water at sea by suspending large sponges in the mouths of brazen vessels in which salt water was boiled; when the sponges were saturated, they squeezed out the fresh water. This certainly may be regarded as the infant state of distillation; but the quantity of water procured in this manner must have been very small. The discovery of the process of distilling by the moderns put mankind in possession of a new power.

The first account we have of the obtaining fresh water at sea by distillation is in the reign of Queen Elizabeth, when it was put in practice by Sir R. Hawkins. Experiments were afterward made by Hales, Lister, and various philosophers, and the practicability of the method established. M. de Bougainville, in his voyage round the world, derived great assistance from it; and Dr. Irving received, in 1770, a parliamentary reward of £5000 for introducing it into the British navy. Lord Mulgrave tried it with success in 1773, in his voyage to the North Pole, since which time it has been perfectly understood.

The method practised by Dr. Irving was this: the ship's kettle was divided into two parts by a vertical partition; in one of these divisions was the soup or meat to be cooked, and in the other, sea water to be distilled. The same fire boiled both, and therefore, at the same time that provisions were dressing, fresh water was distilling. Three fourths only of the sea water was distilled off, since, when the brine became strong, the distilled water had a disagreeable taste from a partial decomposition of the brine. The farther distillation was also found to injure the boilers.

This construction has, since that time, been varied in many ways, but the general principle must always be the same. All that is necessary is some method of condensing the steam which is raised by the boiling of salt water, in the manner of a still; and the particular form and construction of the apparatus may be varied to suit the place where it is used. On board ship, advantage is generally taken of the kettles for cooking, and the steam from these is condensed with little expense and trouble. In long voyages, and even where there has been no particular scarcity of water, it has been thought prudent to employ apparatus of various construc tions for this purpose, to lessen the quantity of water taken in, and to provide against accidents.

2862. *But it is to be observed that, although distilled sea water is all but fresh,* and will answer for washing or cooking, yet it is not completely so. It contains a little muriatic acid, and is not very fit for drinking. A little chalk or alkali added neutralizes the acid; still, it is not found so good as to supersede the necessity of having fresh water from the land.

Sect. IX.—stagnant water.

2863. By the term *stagnant* we should understand water simply *in a state of perfect rest,* or altogether without any current, whether it be a lake or a small pond, and whether the water be clean and pure, or very foul. We mention this the more particularly, because many persons mistake the meaning of the term, and suppose that the word stagnant applies only to water that has already been rendered foul by remaining in that condition. Strictly speaking, it is the *state of rest,* and not its quality, that constitutes the stagnation of water.

2864. *But stagnant water exposed to the air, if ever so pure at first, will not long remain so;* for it soon becomes inhabited by myriads of animalculæ, and aquatic insects of a great number of species, many of which pass some of the stages of their lives beneath its surface, and their exuviæ, or remains, become putrefied, and contaminate the fluid. The vegetable kingdom also here extends its influence. There are a great number of plants, many of which, called *conferva,* are so minute as to be scarcely observable by the unassisted eye, which propagate in still water, and often serve as food to the insect tribes.

Thus stagnant water, like every portion of the superficial part of the earth, teems with life; and the accumulation of the dead remains of animals and vegetables communicate to it properties highly deleterious. We stated that water perfectly pure is incapable of change by itself, whether in rest or motion; but no water, however pure at first, if kept perfectly stagnant and exposed to the atmosphere, can continue long in a wholesome state, or fit to be employed in preparing food, from the causes just stated. Boiling and filtration may, indeed, correct much of these bad qualities; still, it can never be so safely used as running water. These observations apply to reservoirs of all kinds when employed in arrangements for supplying water, if freely exposed to the air and light.

2865. *Stagnant water has often a greenish colour,* which is derived from an infinity of minute plants that can only be seen by the microscope: much of this will be retained by the filter, but some will also pass through, as well as part of the mucilaginous juices of plants and animal fluids, and thus the results of putrefaction will probably remain, notwithstanding every care bestowed in filtering; but to what extent it is not easy to say. The transparency alone of filtered water, therefore, will not form a complete test of its purity. See "Filtration," Sect. X.

2866. *The water of lakes and ponds is, properly, stagnant;* but these may vary exceedingly, according to circumstances. Lakes are generally supplied from streams and brooks, which flow into them, some of which have been produced by rain, and others have risen from springs. Here much will depend upon the size of these pieces of water, and the nature of the bottom. The water of deep lakes is agitated by the wind, and is not so liable to have vegetables growing in it. The water of large lakes is generally very pure; but some contain so much salt as to be called salt lakes. It is in shallow water that the numerous confervæ, and other minute species of plants, grow, and which render the water so deleterious; and hence the brownish-green, slimy substances so often seen in shallow ponds.

2867. *The water of marshes is the worst of all.* Marshes are places where the stagnant water is very shallow, and where the greatest quantity of plants of various kinds, and likewise numerous tribes of insects are produced, and, consequently, where their dead remains are the most abundant. The putrefaction of these substances gives rise to poisonous effluvia, which contaminate the air, and often occasion fatal diseases. Such water should be carefully avoided; nor should it be employed in any way whatever for human sustenance if other water can be obtained.

2868. *But the water of a peat bog,* though stagnant, is of a very different quality from that of a marsh. This, indeed, from some property in the peat itself, instead of containing putrid matter, is remarkable for resisting putrefaction; and therefore the same unhealthy gases are not disengaged from the water of a peat bog as from common marshes. This fact is of great importance, and it is observed that the vast peat bogs in Holland, Ireland, North of England, and parts of Scotland, are not at all unhealthy, but the contrary; and the same may be said of those stagnant ponds of water occasioned by the rain filling those cavities from whence peat has been cut. If the swampy surface of bog land in general, and the water contained in these ponds, were equally liable to putrefaction as marshes, the districts containing them would be uninhabitable.

SECT. X.—MINERAL WATERS.

2869. *There are several other salts which occasionally occur in water;* but they are much less frequent than the sulphate and carbonate of lime which we have mentioned. When others occur, they are sometimes in too minute quantity to be perceived by the taste, and can only be discovered by chemical tests. Occasionally, however, they exist in much greater proportion, so as to be discoverable by the palate, and then the water is said to be *mineral*, and is altogether unfit for most domestic purposes. Sulphate of lime and carbonate of lime are generally found together; we rarely have one without the other. *Chlorides of calcium* and of *magnesia* give great bitterness to waters when they occur in them. They are found in the waters of the Dead Sea in Palestine, and in many mineral springs. *Sulphate of magnesia*, or *Epsom salts*, so called because first noticed in the springs at Epsom, where they still exist, is not unfrequent. *Sulphate of alumina* is found sometimes, though rarely.

2870. *When salts of iron are found in water*, it forms what is called a *chalybeate*, and is known by its austere, astringent taste. But the iron sometimes exists in smaller quantity than is sufficient to warrant the appellation of a mineral water. Iron is usually found in water in one or other of two states: either joined to sulphuric acid, constituting sulphate of iron, or what is vulgarly called copperas; or as a bi-carbonate of iron, that is, iron joined to carbonic acid. When the iron is in the state of bi-carbonate, it deposites an ochrey sediment on being exposed to the air for some time, and still more on being boiled; but when it is a sulphate there is no sediment.

2871. *Iron, in whatever mode it exists in water, may be discovered* by its striking a black, or deep violet colour, with tincture of galls, or any substance containing the gallic acid, or tannin (tannic acid); consequently, it would be totally unfit for making tea, as it would convert it into a kind of ink; and it stains black all wearing apparel which have been dyed with tan. Iron is far from being deleterious in small quantity in water, but in a considerable proportion becomes medicinal. The mineral springs at Tunbridge Wells contain bi-carbonate of iron, and that of Sandrock, Isle of Wight, sulphate of iron.

2872. *Chalybeate waters are extremely common:* the most noted in Britain are those of Tunbridge and Cheltenham; but there are several round London, particularly at Hampstead, which were much resorted to formerly.

2873. *Besides the earthy, alkaline, and metallic salts* we have mentioned, mineral springs have considerable quantities of *several gases*. Sometimes there is free carbonic acid gas, and then the water has an acidulous taste. Sulphuretted hydrogen gives it a smell and taste resembling that of rotten eggs, as is the case with the Harrowgate water.

2874. *Accordingly, mineral waters are divided, from their contents*, into acidulous, saline, alkaline, chalybeate, and sulphurous. It would be foreign to our object to go farther into the subject of mineral waters, as they do not come into the list of beverages.

[The mineral springs of the United States are numerous, and found in almost every part of our country, many of which are more valuable as medicinal agents than any in the Old World, as shown by analysis, and, what is still more conclusive, by their curative effects and direct physical action upon the human organism.

The most noted are those of Saratoga and Ballston, in the State of New-York, where, for many miles of surface, there would seem to be a succession of medicated waters gushing forth from the bowels of the earth, inexhaustible in their sources, and each possessing a distinctive, though more or less analogous character in chemical composition and in medicinal effects; and yet some of these springs are found in close proximity to each other, often within a few feet, and yet essentially different both in their nature and effects.

They may all, or nearly all, be said to be chalybeates; but the proportions of the salts of iron they contain vary very remarkably, in some of them being from 5 to 10 grains of the carbonate of iron to a gallon, while others contain less than one fifth of that proportion. The same differences are observed in the relative proportions of other salts, and some of them contain ingredients no trace of which can be discovered in others. Their adaptation to various diseases, and to varied morbid states of the system, requires accurate discrimination, for lack of which there can be little doubt that positive injury has resulted from the indiscriminate, and especially from the excessive use of these waters.

The spring which has the highest reputation at Saratoga is the Congress Spring, and its water is highly carbonated, besides containing a large proportion of chloride of sodium, bi-carbonate of magnesia, and carbonate of lime, with a smaller quantity of the hydriodate and bi-carbonate of soda, carbonate of iron, and a trace of silex and hydrobromate of potash. Its use is found to be decidedly aperient and tonic when freely employed, and in smaller quantities it possesses alterative powers, adapting it to chronic maladies. Congress waters are bottled and sent all over the country, and a regular supply is kept in most of our large cities, so that, as an article of commerce, it is to the proprietor of the spring a source of great emolument. Thousands annually resort thither from every section of the United States during the summer months, either in pursuit of health or pleasure, ample accommodations being provided in the numerous hotels and boarding-houses of the village.

There are also in Virginia a number of valuable mineral springs, little less celebrated for their medicinal virtues, both for drinking and bathing. There are cold, warm, and hot springs, abounding in sulphur, and their curative powers in cutaneous eruptions, and some other chronic diseases, render the several localities of these springs very fashionable resorts. The limits within which these notes are restricted, however, forbid any other detail, although there are various other springs, north and south, which are in great repute among invalids.]

SECT. XI.—PURIFYING WATER.

2875. *As it is sometimes impossible to procure water pure* and fit for domestic purposes, it is important to know by what methods it may be *purified*, as it is called, that is, deprived of those substances which contaminate it; for it is to be remembered that water, in itself, is necessarily pure and incapable of change, and that when it is unfit for use the cause must be attributed to the presence of foreign matters; in other words, substances which do not belong to it.

2876. Before anything can be determined on this subject, it is necessary that we should have a clear idea of the substances with which water is usually contaminated, and of the mode in which they exist in it. We have already explained, when treating of river water, the difference between materials being in mechanical suspension and dissolved in water.

2877. *The bodies which are merely suspended in the water*, and not dissolved, are earthy powders, as clay, lime, and a mixture of various mineral matters of all kinds, which have been washed down from higher grounds, and are completely mixed up in the water, giving it a turbid appearance. Parts of animal and vegetable bodies are likewise found in water in a state of mechanical suspension, as portions of insects, of fish, dead leaves, fragments of wood and branches, grass, and every part of the animal and vegetable kingdoms. We may have a good idea of what may thus be contained in water, by observing what is brought by rivers in freshes, when the water is quite muddy. Extremely fine sand may be in this list of substances; but when the particles are large they subside immediately, and cannot be said to make water turbid.

All the particles that are specifically heavier than water will subside to the bottom; but if any substances should happen to be of the same specific gravity as water, they will not subside, but will remain suspended anywhere in it; and those particles which are only a very little heavier than water will not fall down until after a considerable time. Everything, in short, may be suspended in water that is light enough not to sink to the bottom immediately, and which cannot overcome the agitation of the fluid. But in general all such matters do subside after the water has stood a sufficient time.

It is very remarkable, and a proof how beautiful is the economy of nature, that there are very few substances in the world that are exactly of the same specific gravity as water: were there many such matters, this fluid would scarcely ever be clear.

2878. *Purifying water by subsidence* is performed by collecting it into a reservoir, and suffering it to remain perfectly at rest; when, in the course of time, those substances which are only mechanically suspended will sink to the bottom. But this method alone is very imperfect, and can never effect the complete purification of water, since, as we have stated, there are a number of extremely minute particles so nearly of the same specific gravity with water, that they are not able to overcome the tenacity of the fluid, and therefore remain in a state of suspension, and cause a cloudy appearance. These may be separated by filtration, which we shall next describe. Water may also contain salts of various kinds, which cannot be separated either by subsidence or filtration; for these distillation is necessary, by which the pure water rises in the form of steam, and is condensed again, the salts remaining in the still. The filtration of water being an important subject, we must treat of it at some length.

2879. *Filtration is the most general method of purifying water* for domestic economy. This consists in allowing the water to percolate through a porous material, the pores of which are too minute to allow of the passage of any substance mixed in the water. Straining liquids through a sieve, cloth, or sponge is a coarse kind of filtering; and a great variety of materials are employed to perform this operation, suited to the nature of the liquids and other circumstances. The chemist employs unsized or bibulous paper for his delicate processes, and porous stones have been employed for filtering water for ordinary purposes. Flannel and cloth of various kinds are also used.

2880. *Sponge may be employed for filtering* by compressing it into the neck of some vessel made to hold the water; this substance is very convenient, as it may be easily taken out, cleaned, and replaced.

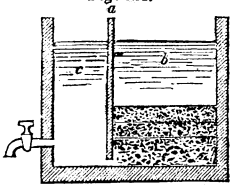
2881. *But the best material for filtering water is charcoal.* This substance not only acts mechanically by its porosity as a strainer, but it has the valuable and peculiar quality of preventing putrefaction by absorbing at once the gaseous matter that is generated, and thus impeding decomposition. Sailors have long been acquainted with this property of charcoal, and they have found it to be an excellent practice to char the inside of the casks in which they take water to sea in long voyages. It was once supposed that the chief use of this was to prevent the water from contracting a disagreeable taste from the wood; but it is now known that it not only effects this, but that it acts much more powerfully by absorbing all putrid matter and offensive odour, and thus rendering, in a considerable degree, even foul and unwholesome water salubrious and transparent.

The best charcoal for this purpose is that produced by burning animal substances, called *animal charcoal*, which is more effective than vegetable charcoal. Charcoal has likewise the property of absorbing colouring matter; brandy may be rendered white by being passed through it, and port wine has been rendered pale; it is also used for whitening the sirup of sugar.

2882. *Nature effects filtration by means of beds of sand.* Water that has percolated through these issues perfectly transparent and clear, and freed from everything except what it holds in solution. Art, imitating nature, employs sand for the same purpose, and filtering beds upon a great scale have been formed for purifying water, the supply of towns, and for domestic purposes. Little more, indeed, seems necessary for rendering water perfectly pure, where the impurities are merely of a mechanical nature.

2883. *To filter water by means of sand,* it is the practice in many places, particularly in France, to construct cisterns in the cellars, and to divide them into two unequal parts by a partition, *a*, *fig.* 524, that does not reach quite to the bottom. The largest of these divisions, *b*, is half filled with layers of sand of different degrees of coarseness, and into this the water to be filtered is put: in passing down through the sand, all the mechanical impurities are detained, and it rises into the other division, *c*, perfectly clear. This method is so simple that it may be practised anywhere without difficulty. The shape and size of the cistern are quite immaterial. If a cock is placed in the smaller division to draw off the water, it should be fixed a little way above the bottom, lest there might be some slight sediment which would be disturbed. It is obvious that the sand can only answer the purpose for a certain time; for it must become clogged with the impurities and sediment from the foul water, and will require renewal more or less often, in proportion to the foulness of the water. The sand should be well washed before it is used, and it should contain no earthy matter, as this would defeat the object of filtration. Clean, sharp sand is best, and it should be separated by sieves into various degrees of coarseness to place in different layers, the finest being put at the bottom.

Fig. 524.



2884. *It may be remarked that when water is filtered by nature through beds of sand,* it *ascends* to the surface, by which the purification is more completely effected than by *descent.* In the latter case, some impurities might be forced through by the weight of the water, or by their own gravity; but, in the former case, gravity must oppose the ascent of the impurities, which are therefore more likely to remain behind. Filters have been executed on this principle, by making the water pass upward through the sand and charcoal, or other filtering materials.

2885. *A very simple apparatus of this kind was made long ago, by M. Parrot,* of Paris, which has been the origin of much of the recent apparatus for this purpose. As it may be very easily executed, it might be sometimes useful to travellers, who may find it difficult, in some situations, to procure pure water. *a b c*, *fig.* 525, represents a curved tube, either round or square, into which sand, or sand and charcoal, are put, up to the level of the dotted line at *c*. A little flannel bag is put into the end *a*, and water poured into this has its coarsest impurities retained by the flannel; and in passing through the sand, in the lower part of the tube, and rising upward to *b*, is completely purified, and drops into a vessel placed below. If found necessary, a piece of linen or muslin may be tied over the mouth, *b*, to prevent any particle of sand coming over. A tube of this kind, about three inches in diameter, will filter about three quarts of water in an hour. The longer the leg *a*, the more rapidly it will filter, from the pressure of the water. The sand should be made pretty compact, for the slower the passage of the water, the more it will be purified.

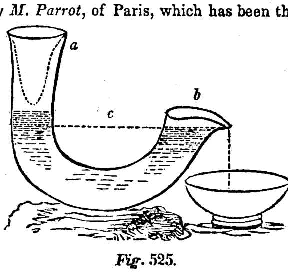
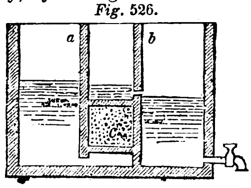


Fig. 525.

2886. *Upon this principle, an improved mode of filtering has been effected* in cisterns, namely, by forcing the water to ascend through the filter, instead of descending. Here the

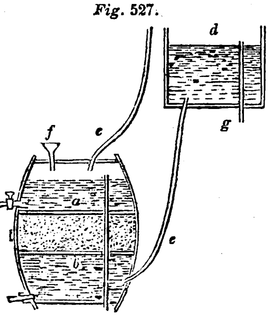
Fig. 526.



cistern has two partitions, *a* and *b*, *fig*. 526. That at *a* does not reach quite to the bottom, and the other has an aperture at *b*. In the middle division a piece of perforated metal, wood, or stone, or a cloth, is fixed a little above the bottom; on this is placed a layer of small pebbles, then coarse sand and layers of charcoal, then finer sand and charcoal, the whole being covered by another cloth, also fixed just below the aperture *b*. The water to be filtered is put into the division *a*; it then passes below the first partition, and by its pressure rises through the perforated plate *c*, and likewise through the pebbles, sand, and charcoal, and passing through the cloth above it, runs through an aperture in the partition *b* into the last division, from which it is drawn by a cock as it is wanted.

2887. *An easy method of cleaning the filtering materials* is by making the water pass through them in a contrary direction to what it does when filtering. For example, supposing, as we have just stated, the division *a* is that which receives the foul water, and *b* that which receives the purified water. Then, to clean the filtering apparatus, reverse the process, and fill the division *b* with unpurified water; it will pass through the aperture in the partition *b*, and descend through the cloth, the sand, and perforated plate *c*, rising in the division *a*, and carrying with it all the impurities, which may be drawn off by a pipe fixed in the bottom.

Fig. 527.



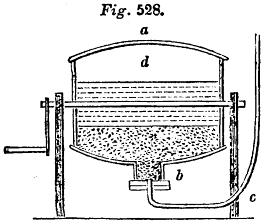
2888. *The principle of filtration being well understood, it may be varied in an infinity of ways*, according to particular localities, or to answer various purposes.

A common cask, *fig* 527, may be divided by partitions, and the filtering materials placed in one of the divisions; or, without any vertical partitions, the cask, as in the annexed cut, may be fitted up for filtering. Let two cross partitions, parallel to the heads, be introduced at *a* and *b*, formed of wood, perforated by a number of holes burned by a hot iron; over each partition put a piece of woollen cloth, and place between them layers of coarse and fine sand and of charcoal. Suppose that *c* is a pipe coming from the roof; the water supplied by it will pass through the filtering materials into the space below *b*, and may be drawn off pure by a cock, or a spigot and faucet at bottom. But suppose that it is desired that the filtration should be performed by ascent, as the most perfect method, then another cistern must be provided and placed on a higher level, as *d*, into which the water to be filtered must be first conducted; the water will descend through the pipe *e*, and enter the lower part of the cask *b*, from whence, by the pressure of the water in *d*, it will force up through the filtering materials into the space above, at *a*, from whence it may be drawn off by a cock. In this case the vertical partition is supposed to be omitted. In either case there should be a waste-pipe in the cask, *h*, to prevent its overflowing, and another in the cistern, *g*.

The foul water may be let off occasionally by the spigot and faucet at bottom. In case of a deficiency of water from the roof, or supposing that none could be had from that source, but plenty from some other source, it is easy to see how the cask might serve as a filtering apparatus. If a funnel, *f*, be put into the top, the water poured into it will pass through the sand in the middle, and come out at the lower cock purified. The best way to clean the sand when it requires it is to take it quite out, wash it and the cask, and replace the sand again.

2889. *Another method of employing a cask as a filtering machine* is the following: hang

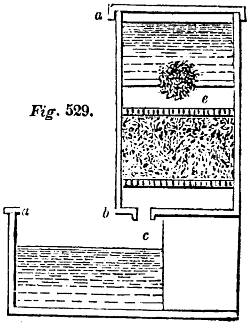
Fig. 528.



the cask, *a*, *fig*. 528, on an axis passed through it, so that it may be turned round by a winch in the manner of a barrel churn: on the lower part fix a short, hollow, cylindrical piece, *b*, to contain a piece of sponge; and connect with it, by means of a flange and screws, a pipe, *c*, to supply water from a cistern placed at some height above. Put sand and charcoal into the cask about one third full. The water will rise through the sponge and sand, and when it arrives at *d* in the cask, it may pass off by a pipe inserted in the end or side of the cask, as may be found most convenient, into any reservoir or vessel to contain it. When it is required to clean the sand, it is only necessary to take off the pipe, *c*, and the sponge, and having stopped up, temporarily, the short, cylindrical hole where it was placed, give the cask, with water in it, several turns round by the winch; this will wash the sand, and make it ready to filter again.

2890. *It must be obvious from the above that a very perfect filtering apparatus may easily be made* by any one possessed of the least ingenuity. All that is wanted is a vessel rather tall than flat, but of any convenient form, as *a b*, *fig.* 529, in which there should be three partitions: the uppermost should have an aperture to contain a sponge stuffed into it, *e*, to stop the worst part of the impurities of the water put in at the top; the two lower partitions may be of wood perforated with small holes by a red hot iron, and having pieces of woollen cloth laid upon them: between these two the sand and charcoal should be put, coarsely powdered; and, lastly, there must be a hole in the bottom vessel, at *c*, through which the filtered water may run into anything placed to receive it; and to avoid the expense of a cock, if the arrangement be as in the wood-cut, where the filtering vessel covers only a small part of the lower one, the filtered water may be got out of it by dipping; and a cover over this part will keep it clean.

Fig. 529.



2891. *It may likewise be seen that any conveniently shaped vessel may serve for a filter*, where sand and charcoal are used: any jar, with a hole in the bottom, or even a large garden pot, may serve as a temporary filter. Put a short bit of tube, or a round bit of wood, with a hole through it, in the aperture in the bottom of the pot, *fig.* 530, so as to project an inch below; then put some sand and charcoal into the pot, and on this pour the water to be filtered. The filtered water may be received in a dish placed beneath. The pot is placed on a stood with a hole.

2892. *Water may be filtered to a certain extent*, even by so simple a contrivance as hanging a thick wick of cotton or worsted thread over the edge of a deep basin or jar, *fig.* 531. The water rises by the capillary attraction of the threads, and continues to run over into a vessel placed below, leaving the impurities behind.

Fig. 530.

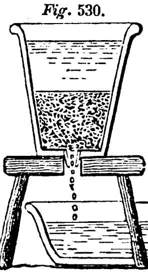
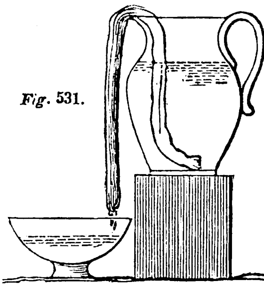


Fig. 531.



2893. *An excellent filtering apparatus of stone-ware was made and generally sold by John Hawkins, formerly of Titchfield-street, London*, from which most of those now seen in the shops are copied with slight variations. *a*, *fig.* 532, is the vessel into which the foul water is put: it comes through the cock *b*, and drops into the projecting lip of another vessel, *c*, which has a moveable partition pierced with numerous small holes; on this partition is placed a piece of woollen cloth, or a slice of sponge, to stop the greatest quantity of the impurities in the water; after that it passes through the holes into the lower part, which contains charcoal bruised small. This vessel has in the bottom several small holes which permit the water to pass into a third vessel, *d*, from which the filtered water is drawn by a cock. These filters answered the purpose completely, and have the advantage that all the parts could be easily got at, and therefore they were easily kept in order.

Fig. 532.

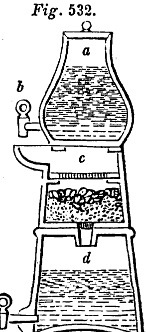
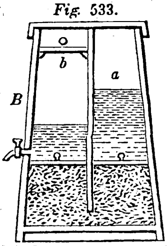
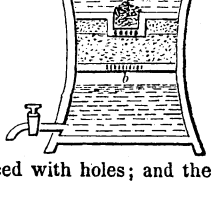


Fig. 533.



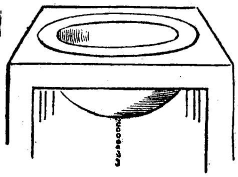
2894. *A large filter, also by Mr. Hawkins*, was made in the following manner: *B*, *fig.* 533, is a cask charred withinside, and having a partition in the middle, *a*, which does not reach quite to the bottom. In the lower part of the cask is put sand and charcoal, or a stratum of charcoal alone, about four inches deep, the upper part of the charcoal in pieces about the size of walnuts, the rest coarsely powdered: this is covered with perforated covers to permit the water to pass through, but to keep the charcoal from mixing with it. The water to be filtered is poured into the division *a*; it then passes downward through the charcoal in the lower part, and rises through the perforated cover in the other division, from which it is drawn off by a cock. The division with the filtered water has an inside cover, *b*, besides the cover over the whole, to prevent any one by mistake pouring foul water into the wrong division.

Fig. 534.



2895. *A*, *fig.* 534, *represents a filtering apparatus made of stone-ware*, which is at present very generally sold in the shops in London: it contains two partitions, which are fixed in with cement. The upper one contains a cavity in the centre pierced with holes; and the lower one is also pierced in a similar manner. Before they are cemented, sand and charcoal are put between the partitions, through which the water put in at the top filters into the lower division, *b*, after first passing through the sponge to detain the coarsest part of the impurities. The filtered water is drawn off by a cock. An inconvenience attends this arrangement, that the charcoal and sand cannot be easily got at to be renewed, on account of the cement; the partitions should be got out when required by the possessor. These filters, though good, have no peculiar superiority over others where the filtering materials are not so concealed.

Fig. 535.



2896. *Water is also filtered by making it pass through a particular kind of porous stones, fig.* 535, *called filtering stones*, which are hollowed out for the purpose in the form of a basin. The fluid percolates through the minute pores of the stones, which are too small to suffer the impurities to pass, and it appears on the outside in clear drops, which are received into a proper vessel. These filtering stones effect the intended purpose, but the filtration proceeds very slowly, drop by drop, and the stones soon clog up, and are then difficult to clean; they should be frequently scrubbed with a hard brush before the mud accumulates too much in them. On first using, water should be passed through for some time before it is drank, as it is necessary to carry off all soluble matter that may happen to be in the stone, and which gives a disagreeable taste to the water. Stones fit for this purpose are found in many parts of the kingdom, particularly in Derbyshire and Durham; but it is said that the best filtering stone comes from the island of Fuenteventura, and the next best from Barbadoes. Both may be procured through Mr. Joseph Bishop, 1 Crescent, Minories, London.

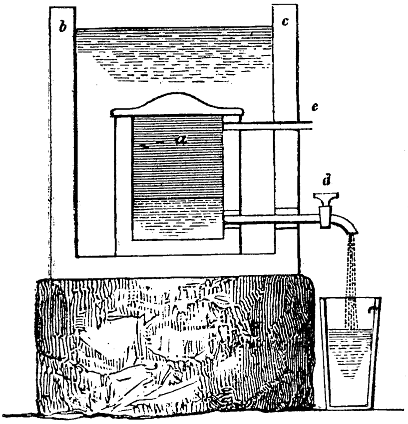


Fig. 536.

2897. *An improved stone filter* is made in the following manner: *a*, *fig.* 536, is a hollow vessel made by hollowing out a filtering stone, with a stone cover cemented on; this is placed in a cistern, *b c*, which may be of stone, slate, or wood. The water to be filtered is put into this cistern, and it passes through the sides of the vessel of porous stone, through the vessel *a*, into the inside, towards which end the pressure of the water arising from its depth assists materially; and this apparatus will therefore filter water more rapidly than the last construction. The filtered water is drawn off by a pipe and cock, *d*, and a small pipe open at both ends, *e*, goes through the cistern and upper part of the filtering stone, for letting out the air as the water comes in, and admitting it as the water is drawn off.

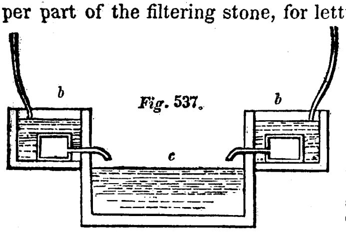


Fig. 537.

2898. *Fig.* 537 represents *an apparatus on a large scale* given in the Gardener's Magazine, vol. iv. Rain water is conducted from the roofs by pipes into the small tanks *b b*, in each of which there is a hollow box of filtering stone, into which the filtered water presses. From these stone boxes the pure water passes by pipes into the great tank, *c*, in the courtyard; this tank is arched over, and from it the water is drawn by a pump.

2899. *Filtering on a large scale* may be easily accomplished by means of several filters which may deliver their filtered water into one reservoir; it is in this manner that the water of the Seine is filtered for the consumption of Paris. The filters made use of there are constructed of vessels containing sand of various degrees of coarseness, and charcoal. A vast number are employed, and pipes or troughs from each of them unite together, and at last empty them into the general reservoir. One great advantage attending this construction is, that every part of the apparatus is accessible, and the filters may be easily renewed when requisite. The performance is very perfect.

2900. Water *contaminated by salts of any kind cannot be easily deprived of them.* Filtration in this case has no effect whatever; and persons who have proposed apparatus for separating salt from water by this process have been totally ignorant of chemical principles, since all salts dissolved in water pass readily through the filters. Neither can any kind of mechanical compression through sand separate the salt from water, as some have erroneously imagined. To render salt or brackish water fresh, other methods must be resorted to; but any chemical re-agents that may be employed to precipitate salts from water must themselves remain in the fluid, and constitute another kind of impurity.

2901. *Distillation is the only effective process by which the water may be obtained quite pure;* but in general this would be too expensive and tedious for ordinary purposes. At sea, where fresh water is absolutely necessary, the distillation of sea water is frequently employed, as we have shown, in order to deprive it of its salt.

2902. It is very important to understand the difference between salts and the soluble parts of animal and vegetable bodies. The former continue in the water without any particular action, and they can be separated by chemical means, or by distillation; but the soluble parts of animals and vegetables decompose and pass into the putrefactive state, giving out gases and other volatile products, which are taken up by the water, and communicate to it highly deleterious properties, some of which are not yet understood, such, for example, as that which generates malaria, giving rise to marsh fever. Such animal and vegetable substances may be in a great measure, or entirely, separated by filtration, if that method be employed before the substances are decomposed or dissolved in the water; but after that there is no method of depriving the water of them completely, with such ease that it can be practised as an affair of domestic economy: we have stated that charcoal effects this purpose partially. Such water as contains much animal or vegetable matter is extremely liable to pass into the putrid state.

2903. *The importance of good water on long sea voyages is obvious;* yet, notwithstanding the great care that is usually taken to select the purest that can be got, it frequently happens that, when long kept, and particularly in wooden casks, it undergoes a kind of putrefaction, and becomes unfit for drinking. The cause of this change depends upon the impurities contained in the water. Water that has been naturally filtered through sand, and which does not contain salts, is generally the fittest for being carried to sea; but frequently, from local circumstances, the water of rivers is employed.

Some rivers that do not take their rise from a rocky soil, and which become considerably charged with foreign matter during a long course, even over a widely cultivated plain, are remarkably free from saline contents, but are often fouled with mud and vegetable and animal exuviæ, which are rather suspended than held in true solution. Such is that of the Thames, which, taken up at London when the tide is down, is soft and good water; and after rest and filtration it holds but a very small portion of anything that could prove noxious. It is excellently fitted for sea store, but, after being some time at sea, it undergoes a remarkable spontaneous change. When a cask is opened that has been kept a month or two, a quantity of inflammable air (carburetted or sulphuretted hydrogen) escapes, and the water is very black and offensive. Upon racking it off, however, into large earthen vessels, and exposing it to the air, it gradually deposites a quantity of slimy mud, becomes as clear as crystal, and remarkably sweet and palatable. This effect is owing to the water having contained originally a good deal of impurities, consisting of animal and vegetable matters, which putrefy and decompose, and, in consequence, give out the gases and offensive smell above mentioned; but as soon as the decomposition of all these substances has been completed, and the fermentation has subsided, the water is pure in consequence of having thus got rid of them. Hard waters which contain sulphate of lime become more offensive than those which contain only carbonate of lime, for the former salt decomposes, and its sulphuric acid gives rise to sulphuretted hydrogen, which has the most disagreeable odour.

2904. It would appear that the soluble vegetable matter of the wooden casks formerly employed in the navy contributed to the putridity of the water; for now that iron tanks are substituted for them, the water may be kept much longer without being offensive. The metal becomes oxydized, and the oxyde of iron thus formed mixes with the water, but by its weight and insolubility it soon falls down; or, should a small portion remain in the water, it can have no injurious effect upon health. It might be supposed that this fermentation of the foul matter in river water might be resorted to in order to purify it for the purposes of domestic economy; but this method would be by far too tedious, and nearly the same effect is produced by filtering through charcoal.

2905. *Alum is sometimes employed in purifying muddy water,* which it does in some measure when there is a small quantity of impure organic matter. If alum be added in the proportion of a few grains to a quart of foul water, with agitation, and then suffered to rest for twenty-four hours, a sediment will fall down, the water will become clear, and may be poured off. Here the alum combines with the impurities, as in the case of dyeing, and occasions them to subside. If any alum should remain dissolved, and not combined in the water, a little carbonate of soda may be added; this will decompose the alum, the soda making, with its sulphuric acid, sulphate of soda, or Glauber's salt, which remains dissolved after the rest has been precipitated. A few drops of a solution of the red sulphate of iron added to a pound of water will produce the same effect.

2906. *A patent was lately taken out by Professor Clarke, of Aberdeen,* for a method of purifying water by adding quicklime to it. But this can only unite with any carbonic acid that may be in water, forming carbonate of lime, which will be precipitated along with any carbonate of lime that may have been in the water; but it can have no effect upon the sulphate of lime in water, which is the chief cause of its hardness.

2907. *In many parts of Hindostan the water is very impure,* being wholly preserved in tanks. In that country, a most valuable plant, *Strychnos potaterum,* or the cleansing nut, is said to have the property of purifying the water. The pulp of the fruit, when ripe, is eaten by the natives, and the seeds are dried and sold in every market for this purpose. If one of the seeds be rubbed hard for a minute or two round the inside of the vessel before the water is put in, the fluid, however foul, will, a short time being allowed for it to settle, be freed from all its impurities, the adventitious matters being settled to the bottom, and the supernatant water left clear and perfectly wholesome. These nuts are constantly carried about by the more provident part of our Indian officers and soldiers in time of war, to enable them to purify their water; they are more convenient than alum, and are, perhaps, more wholesome. It may be mentioned as a curious fact, that the fruit above mentioned, having the property of clearing muddy water, is the only safe species of a large tribe of plants which are virulent poisons.

Sect. XII.—chemical tests for examining water.

2908. We stated, under the head "Building" (Book I.), how essential it is to have a supply of good water; and that, if no well existed on the spot where a house is to be erected, it was desirable to sink one for the purpose. The salubrity of water being a matter of the first importance to health, it is proper that what is obtained from this or any other mode of supply, where its purity may be questionable, should be carefully examined before it be used for the usual purposes of domestic economy.

2909. *When good water is first taken up it is perfectly clear and colourless;* but the ex aminer should not be satisfied with holding up a glassful between his eye and the light; he should also pour some into a deep ale glass, into which he should look downward, when the slightest tinge from extraneous substances will appear.

2910. If the water be discoloured in any manner, it is usually owing to some impurity mechanically suspended in it, and which may be removed by rest and filtration, in the manner already described; but the impurities may likewise be dissolved in the water, in which case they will pass through the filter, which has no power of separating them.

2911. *The existence of various substances dissolved in water* may be discovered by the use of what are called *chemical tests* or *re-agents.* These are substances made and kept for this purpose; by the addition of a small portion of one of these tests the presence of a particular substance in the water may be detected. But although it is extremely easy to detect, in this manner, the substances most usually found dissolved in water, yet the complete examination of this fluid, so as to ascertain all the matters that are contained in it, is a subject that requires a very considerable acquaintance with practical chemistry, the analysis of waters being one of the most difficult and delicate of chemical researches. It would be quite out of place here to attempt an explanation of this subject at any length, and we only propose pointing out the methods of ascertaining the presence of those substances with which spring or well water are most generally contaminated, and which cannot be removed by filtration.

2912. *If the water obtained should be so impregnated with salts* of any kind as to be readily discovered by the taste, it would come under the description of a mineral water, and be altogether unfit for domestic purposes; but if it be transparent, colourless, and free from any peculiar taste, it is probably good: nevertheless, it may be hard, for the hardness would not affect its transparency, nor would this be readily discovered by the palate, except that organ had been much practised in tasting waters. Using the water in washing will determine this point to a certain extent: if it makes a good lather readily with soap, it is soft; if not, it is hard.

2913. *The nature of hard and soft waters* has been detailed at such length when treating of "Spring Water," that it would be a useless repetition to describe it again. We shall here, therefore, content ourselves with giving more particular directions for employing the tests.

2914. *The mere fact of hardness may be ascertained* by a solution of soap in spirits of wine, which is the method usually employed by well-diggers. If this be dropped into distilled water, no alteration will occur; but if the water be hard from an earthy salt, the solution of soap will occasion a white flocculent adhesive precipitate, which is owing to the lime in the water uniting to the fat of the soap, the alkali of the latter having joined the sulphuric acid of the lime. This test, however, only proves there is some neutral salt in the water, but does not point out what that salt is. Most salts, however, except those which are calcareous, are discoverable by the taste, particularly if part of the water be evaporated.

2915. *To determine whether the water contains lime* in any form, the *oxalic acid* should be employed, as the best test for this earth. All waters containing lime are more or less injurious to health, affecting the kidneys if they are drank for any continuance. Some of the springs about London contain a great deal of sulphate of lime, and are unfit for washing, and would be unhealthy to drink. To explain the principle upon which oxalic acid proves the presence of lime, it must be observed that lime has a stronger attraction for the oxalic than it has for any other acid; therefore it will quit whatever acid it may be combined with in a dissolved state, and unite to the oxalic, forming an oxalate of lime, which, being insoluble in water, will fall down as a white precipitate. But, instead of using pure oxalic acid, it is better to employ it as joined to ammonia, or the *oxalate of ammonia.*

2916. *To detect the presence of iron in water,* add to it *tincture of galls;* if there be iron, a black precipitate, like ink, will be perceived; but for this purpose the water must not be boiled, for in that case the carbonic acid would be driven off and the iron would fall down, and would not be affected by the test. *Prussiate of potash* in the same case will give a blue precipitate, like Prussian blue. If this test give the same coloured precipitates after the water has been boiled, then the iron is not in the state of a carbonate, but is most probably a sulphate of iron. If it be required to determine whether the salt be a sulphate, add muriate or nitrate of barytes to some of the water, and if it be a sulphate, but not otherwise, a precipitate will appear.

2917. *Sulphuretted hydrogen is easily known* in water by its disagreeable smell, like that of rotten eggs, or by blackening a silver spoon put into it.

2918. *Carbonic acid in a free state* may be conjectured by the brisk, sparkling appearance of the water, and this being destroyed by boiling; but it is accurately ascertained by the water reddening *litmus paper*, and precipitating barytes water before boiling, but not after it is boiled.

2919. *Vegetable or animal matter may be detected* by adding sulphuric acid and evaporating the water; if such matter be present the water will become blackened.

2920. The above are the substances most usually found in water; others, which are more rare, require considerable knowledge of practical chemistry to apply the tests properly.

2921. *From all this we may perceive the necessity of having a chemical analysis made of water* about which we have any doubt, and which is to be used for any important purpose, as in the case of water from newly-sunk wells. But this, as we have already observed, can only be effected by the skilful practical chemist.

Sect. XIII.—On tanks and cisterns for preserving water.

2922. *In some countries, where springs are scarce, and where it rains only periodically,* great care is bestowed on reservoirs or cisterns erected to preserve water. Anciently there were cisterns all over the country in Palestine; these are frequently referred to in Scripture, and many of large dimensions are still to be seen. As the cities were, for the most part, built upon hills or high ground, and the rains fell in India at two seasons of the year only, in spring and autumn, people were obliged to keep water in cisterns in the country for the use of their cattle, and in cities for the convenience of the inhabitants. Ancient subterranean cisterns are described as still to be seen at Constantinople, the vaults of which are supported by several hundred pillars. In modern times, before the discovery of such excellent cements as we are now possessed of, there was considerable difficulty in building cisterns to hold water; at present, from the perfection of our Roman cement, this has become comparatively easy. Bricks laid in Roman cement, and covered on the inside with a coating of that material, form a wall perfectly tight, and impervious to water.

2923. *The choice of a material for reservoirs* in which water is to be preserved for drink or culinary purposes is extremely important. The material which has long been, and is still, generally employed for common cisterns is lead.

2924. *The deleterious effects of lead* dissolved by various substances and taken into the stomach is well known; but it is necessary to adduce proofs of it in this place. Water absolutely pure has no action on this metal if air be excluded; but, if air be admitted, its action is very sensible. In the atmosphere there is always present a certain proportion of carbonic acid, and most waters likewise contain a minute quantity. The carbonic acid acts upon lead, and converts it into carbonate of lead, which is a poison. A white line may generally be seen at the surface of water preserved long in leaden cisterns, where the metal touches the water, and this is owing to a deposition of carbonate of lead, formed at the expense of the metal. Waters differ much in the power of dissolving lead. Some act upon it with great rapidity, as is evinced by the corrosion of the cisterns and pipes. But the consequence of this is not generally appreciated.

Dr. Lamb, who has paid much attention to this subject, and to whom we are indebted for many valuable facts, states an instance where the proprietor of a well ordered his plumber to make the lead of a pump twice as thick as what is usually employed for such a purpose, in consequence of his observing that it was frequently corroded and required constant repairs, not considering that the lead thus quickly dissolved was poisoning his water.

Nothing is more certain than that lead cisterns and pipes become leaky from the chemical action of the water upon them, and it must be equally obvious that in all such cases the water is contaminated with a portion of active poison. This action of water on lead is increased frequently by the circumstance of vegetable matter, such as leaves, falling into the cistern; this will impart to the water an additional solvent power, which points out the propriety of at least keeping cisterns extremely clean where lead happens to be the material employed.

It may be supposed that the quantity of metal thus dissolved, and still more the portion that is actually taken into the stomach, must be too minute to deserve serious attention, and that its effects cannot be appreciable. But, considering the complicated nature of the human frame, it is neither impossible nor improbable that a very minute portion of a deleterious substance taken with our aliment for a length of time may exercise an injurious influence after a series of years, although this effect may not be perceived in a short period. We find this to be the case in the use of spirituous liquors, and in other destructive habits. From a passage in Vitruvius, an architect of the time of Augustus, we learn that the ancient Romans were acquainted with the deleterious effects of lead; and he condemns the practice of conveying water in leaden pipes, as this metal, he observes, renders the water insalubrious; but it is observed that water has no action on lead pipes if they are kept always full, since thus the air is excluded.

It would appear, therefore, to be a matter of common prudence to avoid, as much as possible, the use of metal so dangerous as lead in forming cisterns and reservoirs; or, at all events, if it is employed for this purpose, care should be taken to clean such cisterns or other vessels frequently, and not to suffer any water to remain long in them without being changed. It has, indeed, been confidently stated by physicians that a dangerous, and even fatal colic has attended persons who have been obliged to use for some time water which has been contaminated by lead from pipes and cisterns; and that, when pipes of wood, earthen-ware, or iron were substituted, the water ceased to produce these dreadful effects. Dr. Paris mentions several cases of this kind.

2925. *A very delicate test for the discovery of lead in water* is sulphate of potash, or sulphate of soda, which, Dr. Thomson informs us, will detect it, even should it not exceed one part in 100,000 parts of water. A drop or two of this test in a glass of water will show the presence of lead by a cloudy precipitate.

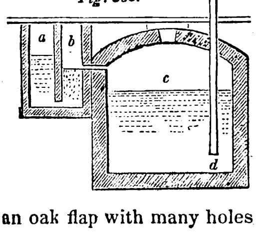
Notwithstanding, however, the opinion which we have just expressed on the impropriety of using lead in general for conveying and preserving water, there is *one case* which forms a remarkable exception to the principles we have stated. It was first shown by Guyton Morveau, and afterward more particularly by Dr. Christison of Edinburgh, that the presence of saline matter of some kinds in water retards the oxydation of lead; and that some salts, even in very minute quantities, prevent it altogether. Such waters, therefore, as have dissolved in them a portion of these salts may be safely conveyed and kept in that metal. Thus a small quantity of muriates and sulphates, which exist in many kinds of spring water, preserve lead from corrosion. "In water containing these," observes Dr. Turner, "the metal gains weight during some weeks, in consequence of its surface gradually acquiring a superficial coating of carbonate, which is slowly decomposed by the saline matter of the solution. The metallic surface being thus covered by an insoluble film composed of the salt and the lead adhering tenaciously, all farther change ceases." The water of Edinburgh has this property; and, likewise, all waters which are hard, though containing sulphate of lime. But no soft water, such as rain water, possesses this advantage.

In recommending that lead cisterns should be frequently cleaned, we must remark that we do not advise that they should be scoured bright; for this would, by exposing the pure metal to the action of the water, occasion it to be more readily dissolved, and destroy the protecting crust; but by cleaning we mean only removing the mud and other loose impurities that may have settled to the bottom, or be attached to the sides, for which brooms and brushes are sufficient.

2926. *In treating of rain water*, we mentioned the possibility of obtaining a sufficient supply by means of a roof properly constructed, a circumstance of great importance in places where wells or springs are scarce.

2927. *Tanks for rain water* have been long employed in some parts of England, particularly in the Isle of Thanet and in Berkshire. They are sunk in the ground, and are of a cylindrical form, resembling a shallow well. The best lining is brick laid in Parker's cement, or very strong mortar, and covered with a coat of cement half an inch thick. It will be best to cause the water to run through a large filter of sand and charcoal previously to passing into the tank. The tank should be arched over with a flat dome of brick, having an opening to clean it out when required, which may be closed by a stone. If the water be first filtered, there will be very little deposite. A pump may be fixed in the tank to raise the water. By means of such a tank almost every house might be supplied with soft and pure water.

Fig. 538.



2928. The annexed wood-cut (*fig.* 538) exhibits a section of the arrangement of this tank with its filter. *a* is the division of the filter into which the rain water is conducted from the roof by a pipe; from this it passes below the partition in the middle, between *a* and *b*, rises through the sand and charcoal in the division *b*, and passes through an aperture into the tank or reservoir, *c*, where it is preserved till raised by a pump, *d*. The top of the tank is arched with brick-work, and has a man-hole to clean it by, covered with an oak flap with many holes bored in it for ventilation.

2929. *Tanks easily and cheaply constructed* have been lately formed at Eastbourne, in Sussex. These have been eminently useful during the last dry summers; they are not liable to decay like wooden vessels, and take up little room.

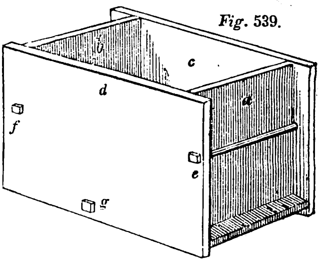
These tanks vary in size; one of less than seven feet wide has served two labourers' families for three years, while most of the springs in the neighbourhood were dry. A tank, twelve by seven feet, has been found sufficient to supply with water a large family and six horses; this was surrounded by only four and a half inch brick-work, and covered in upon the Egyptian plan, by making each row project one third of their length inward before that below it, filling up the back with earth as the building was proceeded with, in order to balance the weight of this overhanging brick-work. At the Eastbourne Workhouse a tank has been made, twenty-three feet deep by eleven wide, of the roughest materials, being only flints of the chalk; and, though they require more mortar than if they had been regularly shaped, only ninety bushels of lime were allowed, including two coats of plaster; and the workmanship is executed like field walls at 10*s*. per 100 square feet, taking care that no clay be used (as worms in time bore through it), and that the Parker's cement be good.

A current of air is said to promote the purity of water in tanks, which is easily effected by the earthen-ware or other pipe which conveys the water from the roof being six or eight inches in diameter, with an opening left in the tank. When the prevailing winds do not blow leaves or soot on the roofs, the water will remain good, even for drinking, without clearing out the tanks above once a year; but in some cases filtering by ascension has been found useful, and effected by the water being delivered by a pipe at the bottom of a cask or other vessel, from which it cannot escape till it has risen through the holes in a board covered with pebbles, sand, or powdered charcoal, as described above.

2930. *The use of such tanks is farther shown* in converting the water that used formerly to injure a public road to the purpose of watering twenty labourers' gardens, by which good crops of potatoes were obtained, when sets not watered failed. Tanks or ponds dug in the chalk four feet deep, what is excavated being added to the sides roofed over, have been found very valuable for the large flocks of sheep in the south downs. Cisterns built with brick and cement, for preserving the rain water from roofs for domestic purposes, are very common in the Ridings of Yorkshire.

2931. *For cisterns on a small scale, for the use of the house, slate is found to be excellent material.* Welsh slate is sawn into thin slabs, and put together with cement, as in the annexed woodcut (*fig.* 539). The ends *a b* are let into groves in the sides *c d*, the latter being held and pressed together by the iron rods with screws and nuts, *e f g*. The bottom is likewise fitted in a groove; thus the whole is kept together in a manner extremely simple.

Fig. 539.



This kind of cistern is very durable, not being liable to get out of repair; and it has the advantage of not in any way affecting the water like lead. A waste-pipe is necessary, of course, as in every other cistern, for this purpose. As slate is liable to be broken by a heavy blow, it may be necessary, in some instances, to provide a wooden casing, or at least a front of wood.

Cisterns of slate may be easily made with a partition, so as to filter all the water that is put into them in the manner already shown.

2932. *The common receptacles for water in small houses* are wooden casks or butts, and these have often been previously used as beer or wine casks. All wood is apt to communicate some unpleasant flavour or odour to the water, except they are charred inside, which they ought to be; and it is too commonly the case that they are left uncovered, and then the water is liable to be contaminated by various substances floating in the air, and by insects of various kinds. They should be frequently cleaned out, and kept carefully covered.

2933. *A ball-cock* is an excellent contrivance, which allows the water to come into a cistern, but shuts of itself when the cistern is full; hence they are always employed in the cisterns supplied by water companies. The plug of this cock is kept in by a screw, or rivet, in the usual manner; it has a copper rod fastened to it, to the other end of which a globular ball of this copper plate is soldered. This ball is so light as to float upon the water of the cistern, and when it hangs down, the cock is open and the water comes in; but, as the water runs into the cistern, it raises the ball and shuts the cock, thus stopping the supply to prevent it from running over. Though this contrivance is very simple, it is sometimes apt to be out of order, and therefore should be frequently examined.

2934. *Every cistern should also have a waste-pipe*, which is a pipe fixed perpendicularly in the bottom of the cistern, having its upper orifice exactly at the level at which it is desired the water should be when the cistern is full. If by any accident the ball-cock should be out of order, or if there is no ball-cock, the superfluous water, that would otherwise overflow, will pass down the waste-pipe.

2935. *Ponds or reservoirs for collecting and preserving water* are frequently necessary for the use of cattle and other purposes in rural and domestic economy, in places where there are no streams or lakes; and these are usually dug out of the ground. It is not difficult to make a pond in a clayey soil, as it is of itself retentive of water; but in cases where the soil is of a loose and porous nature much more care is necessary. It is found, however, that a coat of tough clay, well beaten and rammed in, called *puddling*, is generally sufficient. In some parts of the kingdom, as on the Yorkshire wolds, there is no water for cattle or sheep, except what is collected from rain, and preserved in ponds constructed for this purpose, and they are found to be extremely useful in sheep-walks. The method employed there appears to answer the purpose perfectly, and is as follows: The ponds are made circular, and about forty and fifty feet in diameter, and the excavation is not made above five feet deep in the centre. After the excavation has been cleared out, a layer of clay, well tempered with a little water, is laid over the whole of the bottom, and trodden down and beat with beetles till it forms a compact body of about the thickness of a foot. Upon this a layer of quicklime, of an inch or upward in thickness, is uniformly spread. Over this is put another layer of clay, similar to the last, and trodden down in the same manner. To prevent this clay from being injured by the treading of the cattle, the whole is covered with a layer of coarse gravel or small stones, of such a thickness that the feet of the cattle will not break through it. Some pave the part of the margin by which the cattle enter, which is a good practice, as it is important that the water should be as clean as possible. The use of the layer of lime does not appear to be thoroughly understood; whether it unites with the clay, forming a kind of hard cement, or whether it acts in preventing the worms from boring through the clay, which they are known to do where clay alone is used, and thus let out the water; but it is observed that this mode of construction answers better than where lime is not employed. An improved method of executing this part is to make a mortar by *mixing* the lime with sand, but it adds a little to the expense. Though tough clay is best, yet it does not appear to be absolutely essential; and any earth sufficiently tenacious to bear beating into a solid, compact body, will answer the purpose, though not so well. Paving the whole bottom of the pond will, where the expense and trouble are not an object, be the most complete method.

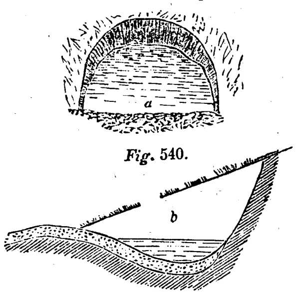


Fig. 540.

2936. *When a pond is to be made upon the slope of a hill*, the form may be a semicircle, as in the ground plan *a*, *fig.* 540, or the segment of a circle. The upper side must be steep, and the lower one of a proper slope for cattle, the bottom being formed out of the materials dug from the hill, as is shown in the section *b*. One pond may be made to supply two or more fields by placing it so that the boundaries of the fields may pass through the pond. Trees should not be planted round ponds or open reservoirs of water, notwithstanding they shade the water from the heat of the sun, and the agreeable effect which they produce, for the leaves which fall into the water, by their decomposition, injure the quality of the water; and such ponds should be frequently raked and kept from aquatic plants, particularly those minute confervæ like green slime, which are very apt to collect in standing water. One great use of paving the whole bottoms of ponds is the facility which this affords of keeping them clean.

2937. *In cases where a pond is supplied by water which runs down sloping ground*, a great deal of impurities is frequently brought along with it, which would render the pond muddy, besides tending to fill it up. It would then be proper to admit the water into another reservoir previous to its entering that from which it is to be used, in order that it may first deposite all its sediment, and the latter will be found extremely useful as manure. The communication may be made by a pipe laid at the surface of the first reservoir, and having its mouth covered with a grating or a plate pierced with holes. As the health of cattle, as well as that of human beings, must depend, in a considerable degree, upon the salubrity of the water which they drink, it would appear proper that more care should be taken to keep the water of ponds in a clean state than is generally bestowed; and a drinking fountain, raised a little from the ground, formed of stone, and kept quite free from weeds, into which the water might flow, filtered from the pond, would not be very difficult to execute upon the principles which have been explained above, and might be a most agreeable object in pasture ground. This latter idea is the more important, since the loose stones with which ponds are covered, as described above, are frequently forced deep into the clay by the feet of the cattle, and the pond is thereby materially injured; besides, sheep are often disgusted when the water is thus rendered muddy, and refuse to drink it.

It is of the greatest consequence that sheep and cattle should be supplied with *pure water*, particularly during the heat of the summer months. For this purpose light, running water is to be preferred where it can be obtained, or, if possible, well water in troughs or shallow tubs, which is very requisite when sheep are confined in folds; but on no account should they be allowed to drink water that has been long stagnant, or in a tainted state, as it must be when it contains any dung. On the Continent the watering of sheep is regarded as a circumstance of the greatest moment. At the best establishments in Sweden and France they are daily watered with running water, or with that obtained from lakes or springs, which is conducted to them by means of pipes into troughs, out of which the animals drink at pleasure, and, consequently, take less water at each time, which is favourable to their health.

2938. In situations where there are natural inequalities of level, it will be easy to construct the pond itself higher than the drinking place, into which it is to be conveyed by a pipe; but where the place is perfectly flat, and the reservoir is to be filled with water collected only from rain, it may be found best, instead of sinking a pond in the earth, to erect extensive low sheds covered by roofs proper for collecting rain water, which might be discharged into the reservoir on the ground; and it has been already shown that any required quantity may be collected by means of roofs. In the best farmeries horses are now more frequently supplied with water, and washed by means of troughs of clean water in the stables, than driven into the pond as formerly.

2939. *The water collected in draining land* may, in some cases, be rendered available for some purposes of domestic economy by conducting it to tanks or other places, where it may first be depurated by deposition, and afterward, if necessary, by filtration. In this case, as much of the drain as possible should be made of drain tiles or earthen-ware pipes. Water so collected has been employed in turning mills and performing other work.

SECT. XIV.—ON PIPES FOR CONVEYING WATER.

2940. *Pipes for the conveyance of water* are made of wood, iron, copper, stone, or pottery.

2941. *Wooden pipes* are the least expensive at first, and are easily made; they are best bored in trees of the proper size, and then the bark being left on preserves them. If small, the passage may be bored by a long auger, turned round by one or two men; but where the pipes are large, and the demand is great, as for supplying towns, machines are employed to bore them. The great objections to wooden pipes are, their want of strength to resist a great pressure of water, and their liability to decay. They are usually made of elm or alder; oak would be preferable, if it were not too expensive. The lengths of pipe are fitted in by enlarging the bore at one end in a conical form with a sort of auger, and cutting the opposite end taper to drive into the conical end of the adjacent pipe, which is hooped to prevent its splitting. Great care should be taken in fitting them well together to prevent leakage, and not to cut away too much of the wood at the taper end, which is frequently the cause of decay. Wooden pipes are apt to generate insects in their decayed and rotten parts, and water lying long in such pipes becomes putrid from the animal and vegetable matter collected in them.

2942. *Cast-iron pipes* are superior to any other for durability and strength. They may be procured of any diameter in lengths of ten feet, and then are united by means of nuts and screws passed through flaunches cast on them; these require to be put together with some cement. After having screwed the pipes together, they first calk the joint with hemp, and then fill it up with a composition of borings or turnings of cast iron, mixed with sulphur and sal-ammoniac, and moistoned with water. The rapid oxydation of the iron unites the whole into one mass, and at the same time expands the bulk of the cement, so as to fill up the space very closely. The use of the hemp is only to prevent the cement from getting into the inside of the pipe. Some have used Roman cement for this purpose; and others have employed melted lead. An idea has sometimes been entertained that the iron is injurious to the salubrity of the water; but a thin black oxyde soon forms upon the inside of the pipe, and defends it from the action of the water, forming a sort of black japan. If the water contains lime, the latter is deposited as a fine crust over the inside, and defends them from corrosion; and there is no fear that iron pipes will fill up with this deposite, since the water only deposites the stony matter from the attraction of the iron, which, being once covered with a slight thickness, the water no longer has access to the iron. Some have put lime into the water purposely at first, when it was found that the water was so corrosive as to become tinged by running through iron pipes newly laid down; a rapid current of lime water being passed through the whole length for a few days, the pipes became coated in the inside with calcareous matter. At first, after this, the water tasted of lime, but it became pure in a short time.

2943. *Stone pipes* have been used; and they are perfectly safe and wholesome, but difficult to execute. Machines have been invented for sawing them out of blocks of stone; but the expense was too great, and they were liable to break.

2944. *Copper pipes* are never employed, except in particular cases, in machinery and apparatus of various kinds.

2945. *Lead pipes* are universally employed for small water pipes, chiefly from the facility of bending them in any direction, and soldering their joints. They were formerly made of sheet lead wrapped round an iron or wooden core, and the joint soldered up. This method was imperfect, as they were apt to give way in the joint; they are now generally made by casting the lead in an iron mould, upon a cylindrical iron rod of the size of the bore of the intended pipe, the lead being three or four times the thickness of the intended pipe, and in short lengths, which are then drawn through holes in pieces of steel in the manner of wire-drawing, till the pipe is reduced to the intended thickness, and drawn out to the proper length. We have already mentioned the bad effects of keeping water long in lead.

2946. *Lead pipes lined with tin* have been made for the conveyance of water where it was in danger of receiving a taint from the corrosion of lead, or for beer.

2947. *Pipes of pottery-ware* are made of a coarse, brown kind of pottery, which is very hard and durable; they can only be made in short lengths, and have one end enlarged to receive the other. To close the joints, tow and pitch are used. These pipes can never be made to bear much pressure, are liable to be broken by accident, and are expensive; but they preserve the water perfectly pure. It appears from some ancient buildings that the Romans sometimes made use of them.

2948. *Pipes are subject to obstructions*, not only from the deposition of sand or mud in the lower parts, where they are curved, but also from air which gets in by accident, and separates from the water, and collects in the upper parts of their bendings. To clear a pipe of this air, if it be of lead, the common method practiced by the plumbers is this: they drive a nail into the place where they suspect the air to be lodged, and while the nail is in, they hammer up the lead round it; they then draw out the nail and suffer the air to escape; when that is all gone, and the water appears, they, with a stroke or two of the hammer, close up the hole in the pipe again, which the lead gathering round the nail enables them to do.

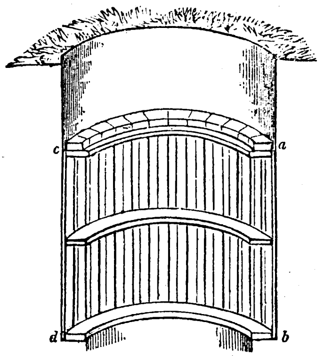
Sect. XV.—Forming Wells and Raising Water.

2949. When water cannot be procured on the surface of the earth, it is necessary to search for it in the interior, where it circulates in numerous places. The origin of well water was shown in Book VIII., Chap. I., Sect. V. Two methods are resorted to for reaching it: digging wells, and boring the earth.

2950. Considerable difficulty is experienced in fixing upon the spot where it is likely that water may be obtained by sinking a well; and much judgment is required, as the operation is very expensive.

2951. *Well-digging* is performed by persons who pursue this avocation exclusively, as it demands peculiar knowledge and practice. The form of wells is always circular. If they should happen to be formed in chalk, no stone or brick lining is necessary; but if made in soft strata, which is most frequently the case, to prevent this from falling in, they are lined within with bricks laid without mortar, which operation is termed *steening*. The steening of a well is a mode of building rather curious, as the internal wall is built and sinks down as the well proceeds. In beginning it, a few feet from the surface a ring or circular curb of wood, called a barrel curb, *a b c d*, *fig.* 541, the size of the well, is laid on the bottom of the digging, and bricks built on it, shown at *c a*, all round, to a considerable height; the well is then proceeded with, and the well-digger cautiously digs away the earth at *d* and *b*, from below the curb, which by degrees sinks down from the weight of the brick-work upon it. When the curb has got to the lowest part of the well that is being formed, the latter is again carried some way farther down, and again the curb and the steening are lowered by the same process as before. This curb is left in the well. If the depth is very great, and the steening will not sink any farther, sometimes they form a new curb within the first, and cause that to sink as they proceed. When they arrive at a spring, it will sometimes burst out with great violence, so as to endanger the safety of the well-diggers, who are then drawn up with all expedition. The depth at which water is found varies in every situation, according to the geological structure of the country. This *latter* branch of knowledge affords the only clew by which the probability of finding water, and at what depth, can be conjectured upon rational grounds; and well-diggers unacquainted with this useful science can prognosticate only from a kind of knowledge and practice of a very limited nature, and are extremely apt to mislead their employers, not always from dishonest motives, but frequently from a total misconception of the true principles upon which they ought to proceed. The thickness of the steening is generally four inches, or half a brick, and the well should be domed over with brick-work, leaving a man-hole twenty inches square, covered with a Yorkshire stone, having a strong iron ring let in in the top to lift it out by. It is usual to contract with the well-digger for a certain depth, that at which water is expected, paying him as extra if the depth should exceed, or deducting if it should fall short of, what is supposed.

Fig. 541.



2952. *Boring the earth to obtain water* has, of late, been practised with great success, not only in this country, but on the Continent, and in many other parts of the world; and it is found to be a very great saving of expense. In consequence, many places are now supplied with this useful fluid where formerly it was entirely wanting. The operation is extremely simple. It consists in fixing an auger or other boring instrument to long iron rods screwed on to each other, which are turned by the action of men with a crossbar. The operation is usually begun by digging a well six or eight feet deep, in the centre of which the boring instrument is placed. The nature of this instrument depends upon that of the stratum to be penetrated, and it is changed accordingly when a stratum of a different degree of hardness is arrived at. Soft clay, or loose, sandy soil, is penetrated by an auger in the form of a hollow cylinder, with a longitudinal slit, *a*, *fig*. 542, or without a slit. This auger is screwed into the rod with a cross-handle turned by the men. If the ground is very hard, a chisel, *b*, is screwed to the rod, and is turned round in the same manner. But, to assist the action of this tool, an elastic pole, *c*, is connected by a chain with the borer, and made fast at one end, while a labourer keeps continually giving to the other end an up-and-down motion, which, corresponding to the beating motion of the men below, helps to diminish their labour. When the ground is thus perforated as far as the chisel and its rod will go, they must be withdrawn, in order to introduce a cylindrical auger, *d*, which has a valve within opening upward; this, passing through the rubbish loosened by the chisel, brings it up as it rises up through the valve, but cannot return. Sometimes an auger like *e* is used, consisting of a hollow cone, having a spiral, cutting edge winding round it. Tools of other forms are likewise employed to suit particular purposes. In order to raise the rod with the auger when required, either to change or to take out the loose matter, a standard is made with three poles over the well, to which a tackle is fixed. The usual length of each rod is about seven feet, and length upon length are screwed together as the boring proceeds. The chisel is generally about four inches wide, and the gouge three inches and a quarter. Raising the rods and displacing them is effected every time the auger has to be withdrawn, which occupies a considerable time. If they meet with rocks, the labour is much increased, as they can get through only by repeated beating the tool up and down to pulverize them. When they arrive at the spring of water which has been expected, the hole is made smooth by passing up and down a rod for this purpose, and a pipe made of tin or other metal is forced down in lengths, which are soldered together as they go down. This keeps the hole open, and prevents the admixture of water from any of the small springs in the side. Upon the whole, the boring is performed with more facility than could be imagined by those who never tried it.

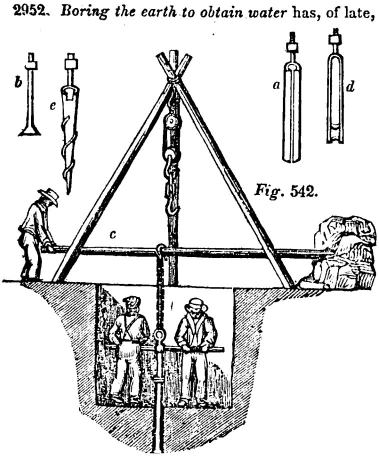


Fig. 542.

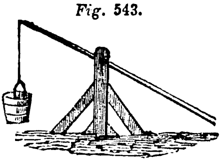
Borings are now made to the depth of several hundred feet, which supply a plentiful stream of water. If the original source from which the water comes be higher than the surface of the ground where the boring is made, the water will overflow; but if the source be at a lower level than the boring, then the water will not rise to the surface of the ground, and it will be necessary to dig a well to the depth to which the spring will rise; and this well serves as a reservoir to contain the water, which must be raised to the surface by a pump.

2953. When a well is formed, it seldom happens that the water rises quite to the surface of the earth, and it is then requisite to have some contrivance by which it is made to reach that level.

A great variety of methods of raising water from wells has been practised at different times and in various countries, each of which may have some convenience or advantage according to the locality and other circumstances.

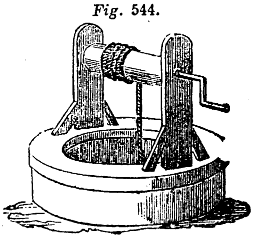
2954. *The lever and bucket* (*fig*. 543) is one of the most simple of these. A long pole, supported by a post, acts as a lever to raise the bucket, and from the end of the lever the water may be raised even by a child by a very trifling exertion. This method is common among the market gardeners near London; but it is only calculated for those cases where the water is very near the surface. It has the advantage of the greatest simplicity, as it can be constructed by any person that can make the lever and upright post.

Fig. 543.



2955. *The next method is the bucket raised by a windlass, fig.* 544. When the well is very deep, or a great supply is wanted, this may be assisted by machinery turned by any of the ordinary powers.

Fig. 544.



2956. But the most convenient method of raising water is by means of *pumps*, which will be described under "Kitchen Furniture," Book XI., Chap. III.

2957. *An old but ingenious mode of raising water* from a well to the upper part of a house is sometimes adopted on the Continent. A post is fixed close to the well; this is connected by a fixed cord with the window or other opening in the upper part of the house where the water is to be introduced. On this cord a wooden collar is placed, and slides freely from one end to the other: the bucket-rope is put through the hole in the collar, and over a pulley in the window, and thus the bucket is raised, first perpendicularly from the water in the well till it comes in contact with the collar, when, the power being continued, the collar slides along the fixed rope, till, together with the bucket, they reach the operator in the window.

2958. It may be proper briefly to notice a few other simple methods of raising water from one level to another, which are occasionally employed.

2959. *Chain of Buckets.*—This consists of a number of buckets fastened to a chain or rope, the two ends of which are united; the chain goes over a wheel, and hangs down into the well, with its buckets having their mouths downward as they descend. On arriving there, the buckets become filled with water, and by the turning of the wheel and the motion of the chain they are brought up, while those on the other side of the chain go down empty.

2960. *The Spanish noira* is a chain of buckets or earthen jars, generally worked by an ass.

2961. *When large buckets are used for deep wells,* they are often made to descend with their mouths upward, and made heavy to sink in the water. They have a valve in the bottom, which rises upward as the bucket sinks, but shuts again when the bucket is raised.

2962. *The Persian wheel* is a large wheel with buckets suspended from the circumference, but so swung that they always hang perpendicularly; of course, one half comes up full, while the other goes down empty.

2963. *The chain pump* is a very simple mode of raising water. It consists of a square or round barrel, placed perpendicularly. A chain is made to pass through this barrel, having on it a great many flat pieces of wood very nearly of the same shape and size as the inside of the barrel The lower end of the barrel being immersed in water, and the wheel turned round, the chain, with its floats or valves, forces up a body of water that fills the barrel. These pumps are found very useful on shipboard, and for draining ponds, and so forth. Sometimes stuffed cushions are used instead of the boards. This pump is often placed in an inclined position.

2964. *The fen wheel,* by which the extensive fens of Holland are drained, is a vertical wheel with floats round the circumference, like a breast wheel for grinding corn. Masonry or wood-work encloses one of the lower quarters of the wheel, so that when it turns round the floats bring up a body of water that fills the trough surrounding the floats. This is also used extensively in the fens of Lincolnshire and Cambridgeshire.

2965. *The bucket wheel* is like an overshot water-wheel, only moved round the reverse way, so that the buckets come up full.

2966. *The endless rope* is a most simple, but not a modern contrivance for raising a small quantity of water. A hair or soft hemp rope is made to pass over a wheel at top, and another at the bottom of a well. The rope is put in motion by a handle, and so much water adheres to it in rising that it is sufficient to make a constant small stream. To prevent the water from descending again with the rope, it is made to pass through a tube at the top to squeeze off the water.

SECT. XVI.—SUPPLY OF WATER TO LONDON.

2967. No city in the world is so well supplied with water as the metropolis of the British empire is at present.

[This may have been correct when this sentence was penned, but not when this work was issued from the London press. The city of New-York, since 1842, by the completion of the stupendous water-works, which for several years have been in progress, has far transcended those of London, both in the purity of the water furnished to the population, as well as in the inexhaustible extent of the supply. The Croton River, 40 miles distant, has been brought, by spacious conduits and aqueducts, to ample reservoirs on the heights adjacent, whence it is conducted through iron pipes throughout the city, and by public hydrants is accessible, without charge, to the entire population. By its descent from the elevated reservoirs, it acquires sufficient head or force to supply public and private fountains, furnishing the citizens, at a trifling expense, with the introduction of it into their upper chambers, for baths and other purposes, while for the extinguishment of fires it is invaluable. The limits which restrict additions to this volume forbid amplification.]

2968. *At the time of the Norman conquest* London was supplied with water from the Thames on the southward side, and on the north of the river by several streams that took their rise on the high ground; the principal of these was the River Fleet, which was once clear and navigable, rising in Hampstead, but which, passing through a populous part of the town, became afterward so filled with impurities as to obtain the name of Fleet Ditch, and is now concealed from view by a vast brick arch, and converted into a common sewer, that conveys its muddy contents into the River Thames. There was another stream, called Wallbrook, that ran through London Wall, through the heart of the city, into the Thames; and a third, named Langbourn, from its great length, which passed through the spot where Fenchurch-street is now placed, and passed by Sherbourne Lane into the river; of these all traces have disappeared, the ground being entirely built upon. Towards the west, a stream called Oldbourne or Holborn, began at Holborn Bars, and ran into the River Fleet. Besides these there were several wells, the names of which remain in several streets, as Clerkenwell, Clement's Well, Holywell, &c.

2969. *Towards the end of the thirteenth century* London had increased so much that the Fleet River became too impure for the supply of water for domestic purposes, and the wells were altogether insufficient. The want of water, one of the first necessaries of life, was severely felt by those who were at a distance from the Thames, and this led to the forming of reservoirs, called conduits, in several places, to which the inhabitants could resort. The first that appears to have been erected was the Great Conduit, in West Cheap, called Cheapside, in 1285, the water to supply which is said to have been brought from Paddington. Many of these conduits were constructed between 1401 and 1610, being chiefly built over wells and springs. One was situated in Lambs Conduit Fields; another near the inn, named after it White Conduit House, and the remains of which existed a few years ago. A regular trade was carried on by persons called water-bearers, employed to convey water from the conduits to the respective houses, and sums of money were frequently left by "good and charitable people" for the purpose of keeping up these conduits; such importance was attached to them that they were put under the care of the lord-mayor and court of aldermen, who annually visited them in great state, to see that they were in proper condition—an occasion which formed a good excuse for a hunting-match and a dinner.

2970. *The conduits having been found insufficient* for the increasing demands, the idea was conceived of conveying water into London by an artificial river; but, although the citizens of London obtained an act of Parliament empowering them to cut and convey a river from any part of Middlesex or Hertfordshire, yet so difficult did such an undertaking appear to be, that it was not carried into effect; nor was a second act obtained in the early part of James I.'s reign more useful in advancing the project.

At length, *Sir Hugh Middleton*, a native of Denbighshire, citizen and goldsmith of London, who had amassed a large fortune by a mine in Cardiganshire, and who had been chiefly instrumental in obtaining the last act of Parliament, offered to the Common Council, on condition of their transferring to him their power under these acts, to undertake the work at his own risk and charge. This being agreed to, he commenced this work in 1609, but experienced numerous unforeseen difficulties through the art of civil engineering being then little understood in England, and from various obstacles through the proprietors of the lands in which the river was to pass. The City of London refused to aid him in his grand and useful design; and his own finances being reduced when he brought the water to Enfield, he would have probably been under the necessity of abandoning the undertaking, had he not petitioned King James himself, who, upon a moiety of the concern being made over to him, agreed to pay half the expense past and to come. The work was, in consequence, completed; and on the 29th of September, 1613, six years after its commencement, the water was let into the great reservoir at Islington.

Notwithstanding the successful accomplishment of this magnificent work, so little was the public sensible of its advantages for some time, that the original shares continued for many years at a small value; but such have been the profits from the project that the shares are now of immense value. To convey the water to various parts of the metropolis was attended with a great additional expense; but, notwithstanding the great benefit thus conferred upon the public, the once wealthy and public-spirited Middleton found himself, at the completion of the whole, a ruined man. Lady Middleton, his widow, received a pension of £20 a year from the Goldsmiths' Company.

2971. *Since that time various companies have been formed for supplying London with water from the Thames;* but complaints having been made of the great quantity of sediment deposited from the Thames water, much attention has of late been given to the subject of obtaining the water in a state of greater purity. No river water is superior to that of the Thames in general; but, when it descends below the bridges, it receives much impurity from the sewers which discharge themselves into it, as well as from manufactories and other sources, which have considerably increased of late. Filtration will, in a great measure, deprive it of its impurities; and, it is well known to those who have examined into this subject, the chemist will find it difficult to distinguish between water taken up at London from that procured higher up at Hampton Court, after each has been so purified.

2972. *A great number of Artesian wells have likewise been* made by boring through the London clay in London, from which a valuable supply is procured of very fine water; and it has been proposed to sink *large shafts* for the purpose of supplying the metropolis; but it does not appear that the quantity that could be raised in this manner would be sufficient, nor that the constancy of supply could be depended upon. Besides, as the water is now managed by the water companies, there seems little cause for complaint; on the contrary, no capital enjoys such abundance of fine water as London.

2973. *Much information respecting the qualities of the Thames and other waters* with which the metropolis is supplied has been obtained, in consequence of the experiments made by Dr. Bostock and other able chemists at the request of the parliamentary commissioners appointed to inquire into the subject. Dr. Bostock confirmed the observation that, when the Thames water was kept some time, a species of fermentation took place, on account of the animal and vegetable matter contained in it; inflammable gas was therefore disengaged, a disagreeable smell was given out, a scum rose to the top, and some impurities settled to the bottom. After some time, the water, by the separation of those matters, became more pure, and free from bad taste and smell, but containing more salts, and therefore harder than at first, which he considers was owing to the salts which had been contained in the organic substances, and which now remained dissolved in the water, in addition to what had been there before. The more foul the water, the more complete will be the depuration, since the fermentation is brought on by the organic matter; and hence we have an explanation of the popular opinion, which we have already mentioned, that the Thames water is peculiarly valuable for sea stores, its extreme impurity inducing the fermentative process, and thus removing from it all those substances which can cause it to undergo any farther alteration. The brown colour which this water often exhibits after its depuration is owing to a portion of what is called extractive matter, derived from decayed vegetable substances, and which is most abundant in the beginning of winter, when the heavy rains bring down much fallen leaves. This colour is not removed by simple boiling, nor by filtration through sand and charcoal; but a little alum or sulphate of iron boiled with the water threw down a precipitate, and left the water colourless. But this extractive, which stains the water, is not in the slightest degree injurious to health, which cannot be said of organic matter in a putrid state.

Much complaint having been made respecting the general quality of the Thames water, to satisfy the public, almost all the water companies not only now filter their water before they deliver it to the houses, but most of them take their supply higher up in the river than where the water can reasonably be complained of. The West Middlesex Company, in particular, take theirs as high up as Twickenham, and, by means of filtration, deliver it in a state of purity quite unexceptionable.

CHAPTER II.

ON FERMENTATION.

SECT. I.—GENERAL OBSERVATIONS.

2974. As several important processes connected with domestic economy cannot be satisfactorily explained, nor clearly understood, without adverting to the principles upon which fermentation depends, we propose in this chapter to give a rather full account of it; and we will endeavour to treat the subject in a familiar manner, so as to be intelligible to those who have little or no previous acquaintance with chemical science. Towards the end, we shall add some observations which, being explained only by chemical principles, may be less easily understood by the popular reader.

2975. *Various beverages, such as wine, beer, spirits*, &c., are the most remarkable products of fermentation; but the ordinary mode of making bread, the production of vinegar, and all the changes which animal and vegetable substances undergo, as well as the manner of checking and preventing those changes, and thus preserving food from decay, also depend upon the principle of this process. From this we may perceive how much the previous explanation of its nature will facilitate the study of several of the most important branches of domestic economy, by enabling us to distinguish the advantages and disadvantages attending particular processes which may have been recommended.

2976. *Animal and vegetable substances alone are capable of fermenting*; for though this term has been sometimes applied to natural changes in mineral bodies, it is incorrect to do so, since these substances are not susceptible of the peculiar chemical actions to which the name of fermentation is now restricted. We shall at present confine ourselves to the fermentation of vegetable substances, the products of which compose a particular class; and we shall treat, in a subsequent part of this work, of the changes incident to animal bodies, by which their decomposition or preservation must be explained.

SECT. II.—FERMENTATION OF VEGETABLE SUBSTANCES.

Although we have already described the chemical constitution of vegetable bodies in Book VII., Chap. VII., where we considered them as food, yet, in order to give a connected view of the subject of fermentation, it will be useful to repeat a few facts which we there stated. All the various kinds of vegetable substances, as fruits, grain, roots, in short, everything produced by the growth of plants, are composed of the same species of materials, but in different proportions; the elementary principles of which they all consist being carbon, hydrogen, oxygen, and nitrogen, but the last only in certain parts of vegetables and in small proportions. We likewise explained that these simple elements are supposed, first, to unite into what are termed the *proximate principles*, as starch, sugar, mucilage, gluten, lignin or woody fibre, and acids, together with various resinous and other matters elaborated by the organs of living plants.

2977. *While vegetables are living*, the elementary principles of which they consist remain united, and such internal motions and changes only go on as are essential to vitality, and the performance of their several functions. The vegetable takes in food from the earth and the atmosphere; this is converted first into sap, from which are afterward elaborated the various secretions, as starch, gum, wood, &c., and the plant grows and increases in bulk by the constant accession of fresh materials.

2978. *But with the life of the vegetable, as with that of the animal, all the functions of nutrition and digestion cease*, and the organic body becomes subject to the laws of chemical attraction. The sap no longer moves through the several vessels; nor is it altered any more into sugar or into starch. The body, whether tree or herbaceous plant, being no longer itself part of the living world, passes into that state in which it becomes fit for the nourishment and support of animated beings. Even then it remains but a short time in the same condition; the minute atoms or particles of which it consists exhibit a strong tendency to separate from each other, and, finally, it is doomed to decompose. The proximate principles, sugar, starch, gluten, &c., are, under the influence of moisture, air, and warmth, resolved into the elements of which they are formed, oxygen, hydrogen, carbon, and, in a few cases, nitrogen, which, absorbing oxygen from the atmosphere, again unite into new compounds, as carbonic acid gas, carburetted hydrogen gas, aqueous vapour, &c. If these changes happen while the dead vegetable continues upon the surface of the ground, the new combinations, being gaseous, are volatilized, disappear, and mingle with the atmosphere; nothing remaining except a small quantity of carbon, which composes a part of the black vegetable mould, together with a minute portion of earths, alkali, and metallic oxydes that were constituents of the plant. It is to this natural decomposition that we apply the terms *decay* and *rotting* of these bodies.

2979. *But previously to this final destruction, or, rather, resolution*, of these substances by natural decomposition, the component parts of vegetables go through several very curious changes, in which they linger, as it were, for a while, before the final separation takes place; and it is to these alterations that we are now about to direct our attention.

2980. *Vegetable substances differ much in their tendency to undergo these changes.* Wood, for instance, which consists chiefly of ligneous fibre, will remain for ages without perishing: the same is the case with resin, camphor, and some others, though mixed with water; oils absorb oxygen from the atmosphere, and alter slowly into resins. On the contrary, starch, sugar, gum, and gluten, or substances containing them, if kept moist, very soon exhibit a disposition to change; a peculiar internal motion takes place, a degree of heat is excited, and the substances are said to *ferment*.

2981. In general, the pure proximate principles of vegetables alter but slowly by themselves. But it is when they are mixed together that the fermentation is most perceptible, and the change most remarkable. Thus, when gluten is added to a solution of sugar and water, the liquid soon runs into vinegar, or into alcohol and vinegar.

2982. The complicated parts of plants, in which the various proximate principles are already mixed by nature, especially the liquid parts, exhibit the finest specimens of fermentation; such as the sap of trees, the juices of fruits, the decoctions of leaves, seeds, &c. It is from such natural and artificial mixtures that we obtain all the products of fermentation which mankind has applied to useful purposes.

2983. *This fermentation, though frequently brought on by art, is, in fact, a natural operation*, and all that we can do is to put substances into the conditions necessary for its action. It is the result of laws established in nature, which we cannot alter in any degree. It is usual to consider fermentation as consisting of successive changes, forming so many *steps* or *stages* in the process, each of these products being extremely different.

2984. *The first stage is called vinous fermentation*, because it is that by which wine is produced; and it might with propriety have been called the *spirituous* or alcoholic stage, because through it alone spirit is formed, not only in wine, but in every other liquor containing spirit. *The second is named the acetous* fermentation, the result being acetic acid or vinegar; and *the last is the putrefactive* fermentation, because putridity is the consequence. These several stages usually follow each other in the order just mentioned. The vinous begins; and this, after a time, passes into the acetous stage, and that into the putrid.

2985. *There are but a few of the proximate principles of vegetables which are capable of undergoing the vinous fermentation: the chief of these are sugar and starch;* and we may perhaps say sugar only; because, when starch assists in the formation of spirit, it is supposed to be first changed into sugar during the process. This fact occasions a very striking distinction in vegetable matters, namely, those which, by possessing sugar or starch, are capable of affording fermented liquors; and those which, being deficient in these materials, cannot be so fermented.

2986. *Some chemists enumerate another species of fermentation*, which sometimes takes place, and precedes all these, viz., the *saccharine* fermentation, by which starch or fecula, and perhaps gum, are converted into sugar. Instances of this may be observed in the ripening or maturation of fruits, in preparing sugar from starch by an artificial process, and in the art of brewing. Still another species of fermentation has been mentioned, the *panary*, supposed to take place in the baking of bread; but this latter is now considered as only the commencement of the vinous fermentation.

SECT. III.—GENERAL PHENOMENA OBSERVED DURING THE FERMENTATION OF VEGETABLES, AND PARTICULARLY DURING THE VINOUS FERMENTATION.

2987. If a saccharine vegetable juice, whether that of the grape or of any other fruit, or the decoction of malt, diluted with a sufficient quantity of water, be left to itself, at a heat equal to the ordinary temperature of summer, that is, from 50° to 70°, it will soon begin to *ferment.*

2988. *The appearances presented by this fermentation will be as follows:* A number of small air bubbles will rise to the surface and break; these will gradually increase in number, until the whole fluid will seem to be in a state of gentle ebullition. An internal motion in the mass will now be evident, and the liquor, though at first clear, will become turbid; the temperature will rise a little; a bubbling noise at length is heard, from the increase of the internal action, and the breaking of the air bubbles on the surface, and the liquor will have a tendency to swell so as to overflow the vessel. The gas or air which is generated, and which ascends in bubbles to the surface, not easily escaping, raises the fluid, and fills the upper part of the vessel; and, if it be examined, it will be found to consist mostly of carbonic acid gas, or fixed air. A lighted candle or taper will be instantly extinguished if held in it; and an attempt to breathe it would produce suffocation. This gas is heavier than common air, and, consequently, though invisible, it will be found to have flowed over the edge of the vessel containing the fermenting liquor, and to cover the floor of the apartment; and as, from its weight, it chiefly occupies only that part of the room, and does not mix readily with the common air, we are not always sensible of its existence, except we make some experiment to ascertain it. A dense froth filled with this gas now covers the surface of the fermenting liquor, and contains a viscid matter, in which it is entangled; the latter is called *yeast,* and has evidently been generated by the process which is going on. At length, after a few days, this action becomes languid; the formation of gas and of yeast lessens gradually; what has been formed of the latter settles to the bottom, and the liquor loses its muddiness, and becomes clear and transparent.

2989. *The liquor which has thus fermented will be found to have been very much altered in its properties:* its sweetness and viscidity have disappeared, and it has acquired a *spirituous* or a *vinous* taste and odour, evidently containing a quantity of *alcohol* or *ardent spirit:* hence this first stage is called the *vinous fermentation.* If the juice of grapes, called *must,* is the fluid that has been fermented, the product or new fluid will be *wine;* if it is a decoction of barley dried and made into malt, the liquor will be *ale;* and if either of these be put into the still, and heat be applied in the usual way, the spirit may be obtained, because, this being the most volatile part, will rise first as vapour in the still. This spirit, when deprived of much of its water by redistilling and other processes, will form *alcohol,* which is only another name for spirit perfectly pure. Pure spirit, or alcohol, whether derived from the distillation of wine, ale, even small beer, or any other fermented liquor, is of the same nature, and indeed absolutely the same liquid.

2990. *The first stage of fermentation always terminates in the production of more or less of the intoxicating fluid, alcohol;* and it is the proportional quantity alone of alcohol or spirit in any liquor which determines what is called its *strength.*

2991. *The explanation of this change* by means of fermentation, in which the sweetness of the liquor has disappeared, and alcohol has been produced, is this: the water remains unaltered, and it is the saccharine matter that has been changed into three new substances—alcohol, water, and carbonic acid. The decomposition has been effected by the chemical power of a certain substance called a *ferment,* a distinct principle from the sugar, and which either exists naturally in the juices of certain fruits, or in the yeast which is added to excite fermentation, as will be particularly described afterward.

It is necessary to observe that no vinous fermentation can occur in any liquid, except it contains a portion of both these principles, *sugar* and *ferment;* and it is only by the mutual action of these on each other that the process can take place.

2992. *But the natural operations by which the sugar is changed into spirit or alcohol, in consequence of fermentation, do not stop when this alteration has been effected;* for this is but the commencement of a series of changes which are to lead finally to its total decomposition, if nothing impedes it.

If the saccharine liquor, rendered vinous or spirituous by fermentation in the manner which has been just described, be exposed to the air in a temperature of about 75°, new changes, after a time, accompanied by a new set of phenomena, will take place. An internal motion will be again perceived; a hissing noise is again heard, occasioned by the disengagement of a little gas; and the temperature rises a few degrees. The liquid again becomes turbid; floating shreds appear on the surface, which partly collect into a sort of cake, and partly subside to the bottom. After this the liquor becomes transparent; but it is found that the spirituous or vinous taste has totally disappeared, and is succeeded by one that is extremely *sour.* In fact, the *acetous fermentation* has succeeded to the vinous, and the alcohol or spirit has been converted into *acetic acid* or *vinegar.*

2993. *If this vinegar be kept, not freed from much water, and for some length of time exposed to the air*, its acidity will gradually lessen, and at last disappear altogether; its surface will become covered with a mould that will increase into a cake, and, instead of the sharp acid taste peculiar to vinegar, the liquid will acquire a very disagreeable odour, and become putrid. This last change, therefore, is called the *putrefactive fermentation.*

2994. *We have stated that these three kinds, or, rather, stages of fermentation generally succeed each other* in the order which has been mentioned, viz., first the vinous, next the acetous, and, lastly, the putrefactive; but, perhaps, instead of considering them as entirely different species of fermentations, it is more correct to view them as the several parts of one great process; at the same time it must be observed that this rule of succession is not invariable. For instance, many vegetables become sour, that is, undergo the acetous fermentation, without any evident appearance of the vinous; and many substances pass apparently at once into the putrefactive stage. But these are cases where scarcely any sugar is present.

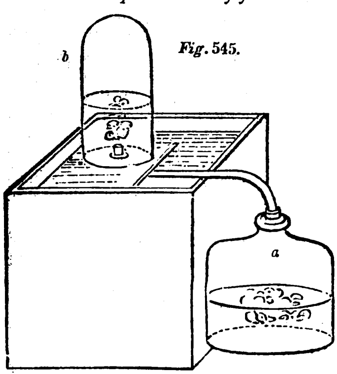
2995. *Certain conditions are necessary, in order that any of these stages of fermentation may take place:* 1, the presence of sugar, or some sort of saccharine matter; 2, a certain quantity of water mixed with the body to be fermented; 3, a natural fermenting principle, or the addition of yeast or some other ferment; 4, a moderate degree of temperature; 5, the presence of air. These several conditions we will proceed to illustrate.

2996. *We stated that sugar is the only substance capable of undergoing the vinous fermentation by which alcohol or spirit is produced.* Every modification of saccharine matter, such as honey, and sweet juices of any kind, can be fermented; and likewise all vegetables, such as carrots, beet-root, &c., that contain sugar; consequently, all substances of this kind will, by fermentation, afford spirit.

But sugar, as stated, will not ferment except it be dissolved in as much water as will make a thin liquid; and it is necessary that there should be much more water than is sufficient to form it into a strong sirup.

2997. *The phenomena of fermentation may be very conveniently examined and studied* by fermenting sugar. Place five parts of sugar with about twenty of water in a glass vessel, *a*, *fig.* 545, furnished with a bent tube, the extremity of which opens under an inverted jar, *b*, full of water; and, after adding a little yeast to the sugar, expose the mixture to a temperature of about 60° or 70°. In a short time bubbles of gas begin to collect in the vicinity of the yeast, and the liquid is soon put into a brisk motion in consequence of the formation and disengagement of a large quantity of gaseous matter, which, passing into the vessel *b*, will be found, on examination, to be carbonic acid gas; the solution in *a* becomes turbid, its temperature rises, and froth collects upon the surface. After continuing the fermentation a few days, the evolution of gas begins to abate, and at length ceases altogether; the impurities gradually subside, and leave the liquor clear and transparent. The only appreciable changes which are found to have occurred during this process are, the disappearance of sugar and the formation of spirit, which remains in the flask, and of carbonic acid gas, which is collected in the glass vessel inverted over water. When the weight of the spirit produced and that of the carbonic acid gas are both added together, they are found to be very nearly equal to that of the sugar; hence it appears that the latter is converted into alcohol and carbonic acid gas.

Fig. 545.



Bodies in a complete state of dryness cannot undergo any kind of fermentation. Though animal and vegetable substances, containing their natural juices, soon ferment, and, at last, putrefy, yet, if the moisture be entirely expelled by drying, they may be preserved for any length of time without change. This will be farther illustrated in Book X., "On the Preservation of Food."

2998. *We stated that the substance called the Ferment is a necessary and important ingredient in fermentation.* The researches of chemists have, perhaps, not yet satisfactorily shown what is the vegetable principle in which this property consists. It is generally supposed to be gluten; some, with less probability, have supposed it to be vegetable albumen; and, if not identical with one of these, it is evidently something very analogous. However this may be, it appears to be essentially necessary, as well as the saccharine principle, to the process, and both together frequently exist in vegetable juices. When that is the case, the juice will ferment *of itself*, if exposed to the proper degree of heat. The *must*, or expressed juice of grapes, is of this kind; to make it ferment nothing is necessary farther than to place it in the proper temperature, as it contains naturally both saccharine matter and the proper ferment. Though we nave stated that sugar is the only substance that can afford alcohol by fermentation, yet it appears that *sugar perfectly pure* will not ferment by itself, and that the addition of some portion of ferment is essential. It is true that solutions of coarse sugars and sirups will ferment of themselves in warm weather, as the sugar refiners often experience to their great inconvenience; but these impure sugars contain a small portion of natural ferment in the other vegetable principles which exist in the raw sugar as imported; and our observation applies only to sugar perfectly pure, when refined. If a solution of fine crystallized sugar be suffered to repose and evaporate, it deposites crystals instead of fermenting; if it has been perfectly fine, the remaining sirup will not ferment; but if it has been imperfectly refined, the residuum contains some of the natural ferment, and it will run into fermentation.

2999. *All vegetable juices containing saccharine matter have also a certain portion of this natural ferment*, as well as the juice of grapes, the sugar-cane, and also the decoction of barley or of malt, and therefore they also will ferment of themselves; but most of these have so little of this principle that the vinous fermentation would take place very slowly, and often so slowly that the acetous fermentation would set in almost as soon, and vinegar, instead of alcohol, be the result; or it might even be the case that the putrefactive fermentation alone would appear.

3000. *It is the practice, therefore, to add an artificial ferment* to most materials, in order to bring on the process of fermentation more rapidly and effectually. In our description of the general phenomena which appear during the process, we mentioned a froth thrown up, called *yeast*, which is generated partly by the very process itself, though the elements composing it must have existed in the mixture; this has the peculiar property of acting as *artificial ferment*, that is, if added to any liquids containing the other necessary ingredient, saccharine matter, it will excite in it the vinous fermentation. Instead, therefore, of suffering the materials for the production of spirit to ferment of themselves, it is the practice sometimes to add to them a portion of the yeast which was produced by a former fermentation of similar substances. Thus, in the fermentation of wort, or the decoction of malt, in the brewing of ale, some yeast from a former brewing is added, not because the wort would not ferment at all without it, but because, in that case, the vinous fermentation would come on very slowly and imperfectly, and the liquor would soon turn sour.

3001. *There appears to be something peculiar in the ferment generated in each stage of the fermentative process:* thus, to produce the vinous fermentation, the yeast thrown up by another vinous fermentation is necessary. The matter deposited in the making of vinegar by the acetous fermentation is capable of acting as an acetous ferment; and it is well known that the putrefaction of flesh is hastened by being placed in the proximity of flesh already putrid. The acetous and putrefactive ferment, however, cannot, like yeast, or the vinous ferment, be procured in a separate form.

3002. *The nature of yeast is a subject of particular interest;* but, although it has been much studied by chemists, it is still imperfectly understood.

3003. *The yeast of beer, analyzed by Westrumb*, was found to contain, in 15,360 parts,

	Parts.		Parts.
Potash	13	Mucilage	240
Carbonic acid	15	Saccharine matter	315
Acetic acid	10	Gluten	480
Malic acid	45	Water	13,595
Lime	69		
Alchol	240		15,142
Extractive	120		

But it is obvious that all these ingredients in yeast are not essential to it as a ferment. From the experiments of the same chemist, it appears that, when the yeast is filtered, a matter remains upon the filter which possesses most of the properties of gluten; and that, when this substance is separated, the yeast loses its properties of exciting fermentation, but recovers it again when the gluten is added. The same thing happens when yeast is kept for some time: a white substance, not unlike curd, separates and swims upon the surface; if this be removed the remainder of the yeast cannot excite fermentation. This substance possesses many of the properties of gluten, though it differs in others; and it is generally considered to be that part of the yeast which is the active or real ferment. This apparently *pure yeast* has been analyzed, and it is found to consist of carbon, water, oil, ammonia, and carbonic acid.

3004. *An experiment of Kirchoff throws considerable light on the nature of yeast.* If pure starch be infused in hot water it is not converted into sugar; neither does gluten become saccharine matter when treated in the same way. But if a mixture of pure pulverized wheat gluten and potato starch be infused in hot water, the starch is converted into sugar. During the process an acid is evolved. The gluten is little altered in appearance, and if the liquid be filtered, most of it remains upon the filter. But it cannot be successfully employed a second time to convert starch into sugar. It appears, therefore, that it is some substance connected with gluten that acts on the starch and occasions this conversion.

3005. *Yeast, then, would appear, as we have said, to consist principally of a substance very similar in composition, and in many of its sensible properties, to gluten*, and when new or fresh it is inflated and rendered frothy by a large quantity of carbonic acid. When mixed with wort this substance acts upon the saccharine matter; the temperature rises, carbonic acid is disengaged, and the result is *ale*, which always contains a considerable proportion of alcohol or spirit. The quantity of yeast employed in brewing ale being small, the saccharine matter is but imperfectly decomposed; hence a considerable portion of it remains in the liquor, and gives it that viscid quality and body for which it is remarkable.

3006. *Yeast may be preserved by drying.* In large distilleries, where the required quantities of yeast are not easily obtained, it has been the custom to procure this substance from a distance; and in order to diminish the expense of carriage, the recent yeast has been put into bags to drain, and afterward has been compressed into solid cakes; or yeast may be preserved by dipping twigs in it and drying them in the air. This dried yeast is found, on trial, to excite fermentation in wort, but not so regularly as recent yeast; and a much larger quantity of the former than of the latter is required. Though dried yeast has been transported to certain distances, particularly in Germany, it has been found impracticable to convey it always in an effective state to India. In a warm, moist atmosphere yeast gradually putrefies, a sufficient proof that nitrogen forms one of its elements.

3007. *The fermenting property of yeast is weakened* by boiling for ten minutes, and is entirely destroyed by continuing the boiling. Alcohol poured upon it likewise renders it inert, on which account its power lessens as the alcohol is formed during fermentation. A thousandth part of sulphuric or acetic acid destroys its peculiar properties: a very small portion of sulphurous acid, or a sulphite, produces the same effect; so, likewise, do mustard, horseradish, and garlic. These substances are, accordingly, sometimes employed to check a too rapid fermentation.

3008. *When the juice of grapes is suffered to ferment by means of the natural ferment which it possesses, without the addition of yeast*, the saccharine matter of the fruit is decomposed during the process; a portion of this ferment is separated, and rises to the top in the form of yeast, while another portion falls to the bottom of the vessel, and is called *lees*. Both of these are chiefly decomposed ferment, which has already acted upon the sugar; but they still contain a quantity of the active and undecomposed fermenting principle, or leaven, and, consequently, can be employed as such in exciting fermentation.

3009. *What the natural ferment of grape juice consists of is not exactly known;* but from an observation by Gay Lussac it appears to require the addition of oxygen before it becomes active; for he observes that, if *must*, or *grape juice*, be heated to 212° in bottles, and corked immediately and carefully, it may be preserved without change, and be conveyed to any distance; but if it be exposed to the air only for a few seconds, it absorbs oxygen, and fermentation takes place.

3010. *Fermentation, once induced, will go on* of itself, if the temperature is sufficient, until one of the principles necessary—either the saccharine principle or the ferment—is exhausted: it will then stop; but it is a curious fact that the very process of fermentation itself occasions the production of a fresh quantity of ferment. If this generated ferment be separated, the process will not proceed so long as if it be continually mixed up with the fermenting fluid: hence the practice of breaking the head of yeast, and stirring it up with the mass, when it is required to prolong or renew the languid fermentation.

3011. *The fermented juice of the grape, and that of wort, or the decoction of malt, are essentially different*, although each contains saccharine matter and a natural ferment. The former will produce *wine*, the latter *beer;* but for the production of the liquor properly called *wine*, another principle besides sugar and a ferment is necessary. This additional principle is *tartaric acid*, which is always present in the juice of fruits, but most abundantly in that of grapes.

3012. *Sugar and tartar alone will not ferment;* therefore tartar cannot be the natural ferment, but the latter is contained in some other principle in grape juice, and probably not very different from the ferment in wort. If the experiment of fermenting sugar and tartar be made in a wooden vessel, they will ferment alone; but this experiment will be deceptive, for the wood supplies the ferment.

3013. *It is essential, also, to a complete fermentation, that there should be a just proportion between the saccharine matter and the ferment, or yeast.* If the yeast be in too great a quantity, there is a danger of the fermentation being too rapid, and that the liquor, after all the sugar is exhausted, should, by a continuance of the fermentation, pass into the acetous state: if, on the contrary, the yeast be too little, the fermentation will be too languid, too little alcohol will be produced, the whole of the saccharine matter will not be decomposed, and the liquor remain sweet. A perfect fermentation is when the whole of the saccharine matter and of the ferment are decomposed by their acting upon each other, being thus converted into alcohol. But it is sometimes desired to have the fermented liquor a sweet, vinous liquid. In that case the quantitv of ferment must be less than would be necessary to decompose the whole of the sugar, or the action of both upon each other may be reduced by some expedient, such as separating some of the ferment by a filter.

3014. *Fermentation probably commences somewhat sooner than it appears to do* by the bubbles of gas, which are the first indications; for the first carbonic acid gas that is produced in consequence of the process is absorbed by the water of the fermenting liquor, and it is only when the liquid is saturated that the gas escapes into the atmosphere with the appearance of effervescence.

3015. *A certain degree of temperature is essential to the process of fermentation.* Substances cannot ferment if exposed to considerable cold; the vinous fermentation cannot take place at the freezing point, or 32°; at 50° it is languid; at 60° it is quickened, and at 70° is so rapid that there is danger of its passing into the acetous; but, again, if the heat be much more considerable, yet below boiling, fermentation cannot happen; thus too low or too great a degree of heat prevents this process from taking place, or arrests it if begun. As the fermentation of beer does not succeed if the heat exceeds 77°, this beverage cannot be made in very warm climates, and very cold ones would require much expense to produce sufficient artificial heat.

3016. *The heat excited by fermentation is one of its most striking phenomena.* Its cause is entirely unknown, but an increased temperature is frequently one of the results of the decomposition of bodies. It will not begin until the temperature is raised to a certain point; and the heat excited by it is in proportion to the bulk of the fermenting mass, and the rapidity of the process. If the heat generated by the process, joined to that of the atmosphere, arise to too great a degree, it is necessary to restrain it, lest the vinous should pass into the acetous stage, and this is often found necessary by brewers and distillers. In the making of wine, strong must will bear a higher temperature than weak must, as the alcohol which is produced has a power itself in checking the fermentation, and also of preventing the acetic process; but in too high a temperature the juice of fruits that contain too little of the fermenting principle is apt to absorb oxygen, and to become sour; and this is often the case in the making of sweet wines. The larger the quantity of liquor, the lower the temperature may be at the beginning, as the process itself generates much heat. When the fermentation languishes from deficiency of heat, it is easily augmented by introducing a stove into the apartment where the process is conducted, or by heating a portion of the fluid, and then mixing this with the mass; agitation will diffuse an equal temperature through the whole. It is very important during fermentation to guard the fermenting vessel against any irregularities of temperature from change of weather or other causes.

3017. *The effect of air on fermentation was long disputed, but is now better understood.* It was once thought that no fermentation could take place in vessels absolutely close; and that the reverse practice, fermenting for a long time in open vessels, was productive of much injury and loss, partly from the evaporation of the alcohol as soon as it was formed, and partly by the yeast becoming sour and putrid, and communicating these properties to the wine, or other fermenting liquor. But the fact, as now ascertained, is as follows: if artificial ferment be used, a perfect fermentation will take place in vessels, however closed from air; but if the natural ferment only is present, as in the case of the mere juices of fruits, fermentation will not occur, as is shown by some experiments by Gay Lussac, which we shall describe, unless air be admitted.

3018. *Gay Lussac's experiments on the necessity of oxygen to excite fermentation are important*, as showing how small a quantity of it is sufficient. He took a bottle of the must of the grape, which had already been preserved more than a year by Mr. Appert's method of excluding the air, and was still perfectly limpid: he decanted this juice into another bottle, which was then closely corked, and placed in a temperature varying from 60° to 86°. In eight days it had lost its transparency, fermented, and was changed into a vinous liquor, frothing like the best Champagne. A similar bottle of juice, that had not been thus opened and exposed to the contact of air, although placed in the same circumstances, exhibited no signs of fermentation. He next passed a portion of juice into a vessel filled with and inverted over mercury, and added to it a small quantity of oxygen gas; and another portion of juice he confined in a similar vessel, perfectly freed from air. The former fermented in a few days, but the latter gave no signs of fermentation, even at the end of forty days. Similar results were obtained in experiments on the preserved juice of gooseberries; and he found the same thing to hold with regard even to the juice of fresh fruit. He passed some entire grapes into a vessel over mercury, and added to them hydrogen gas repeatedly, with the desire of removing all atmospheric air; the fruit was then broken down by passing a wire into the jar, and the vessel was left in a temperature of from 59° to 68°. At the end of twenty-five days it exhibited no signs of fermentation; but this process commenced the same day in juice to which a little oxygen had been added, and was also rapidly excited in the former portions when a little of that gas was supplied.

Grape juice could not be made to ferment when the air was *completely excluded*; but, on admitting a very small quantity of oxygen, this gas was absorbed, and fermentation commenced, and continued independently of any farther contact of oxygen. But a solution of sugar, mixed with yeast, fermented even in closely-corked bottles, therefore without access of air; from which Gay Lussac concluded that there must be a difference between the natural ferment in the grape and the artificial ferment yeast. The application of these experiments is obvious, not only in the preparation of fermented liquors, but also, as we shall afterward see, in the preservation of vegetable and animal food.

Exposure to the air, therefore, or the presence of oxygen, is necessary to fermentation in the first instance; but it is only necessary at the commencement, and for a very short period; so that when once the process has begun, in the case of natural ferment or mere juices, it goes on in closed vessels: the reason of this is, probably, that the artificial ferment contains oxygen itself sufficient to begin the process, and in the case of natural ferment the very air contained in the wood of the cask is often sufficient.

3019. *It is certain that the carbonic acid which escapes during fermentation holds in solution a considerable portion of alcohol*, as is proved by a vessel of water placed near to the fermenting vessel absorbing alcohol, and being distinctly impregnated with it; and likewise by the intoxicating effect produced by the fermentative process on those persons who are much exposed to the fumes. The real loss of alcohol, however, from this cause, though important in a large manufactory, is not deserving of attention in domestic practice.

3020. *Several inventions have been made for fermenting in tuns* closed, instead of being open to the air, but their advantages are not very obvious, even in the large way, where the loss of alcohol may be considered as of most importance. Some suppose that the exclusion of the common air may prevent the liquor from passing into the acetous fermentation; but it should be recollected that while the vinous fermentation is going on, the whole surface of the fermenting fluid is covered with a stratum of carbonic acid gas, which effectually excludes the atmosphere; and it is only when the vinous fermentation has ceased that common air can come in contact with the liquor.

3021. *Fermentation is considerably influenced by the mechanical agency of the atmosphere, that is, by its pressure.* The pressure of the atmosphere retards it, and when that is removed it goes on more rapidly. If liquor to be fermented be put into a well-corked bottle, the fermentation takes place *in time*; but the process is very slow, because the carbonic acid formed during the process cannot escape; it is absorbed by the liquid as soon as it is formed, and this will go on until the liquor is thoroughly saturated with the gas; and then, there being no farther room for this gas, it cannot be generated, and the fermentation is suspended. Liquor in this state will be thoroughly impregnated with carbonic acid gas, and hence the briskness of bottled malt liquor. But if there be facility for the escape of the carbonic acid, the fermentation proceeds; and hence, if bottles are badly corked, the vinous fermentation continues until it passes into the acetous stage, the liquor becoming sour. In brewing in the large way, means have sometimes been contrived of regulating the rapidity of the fermentation by preventing, in some degree, the escape of the carbonic acid gas, and thus subjecting the fermenting fluid to the pressure of this gas.

3022. *The quantity of the fermenting liquor has also an effect upon the fermentation.* Chaptal observed that grape juice contained in a small cask did not finish its fermentation until the eleventh day, while a large tub, which contained twelve times the quantity, completed its fermentation in four days.

3023. *The temperature of the fermenting liquor is also influenced by the quantity.* The heat of the liquor in the cask just mentioned never exceeded 74°, while that of the large tub reached 94°. It is probable that the combination of the principles would be less perfect, and therefore the wine, on this account, would not be so good in the small vessel as in the large one; but the latter would have an advantage, that there being less heat produced, a smaller quantity of alcohol and aroma, upon which the excellence of the wine chiefly depends, would be lost by volatilization. The same observations apply to the fermentation of beer of any kind.

3024. *The fermenting liquor becomes specifically lighter as the fermentation proceeds,* a fact which is ascertained by an hydrometer, and this is called by brewers the *attenuation;* and they are in the habit of taking the specific gravity of the fermenting liquor frequently, in order to judge accurately of the degree to which the process has arrived, and regulating its management accordingly. The reason is this: the specific gravity of alcohol is much less than that of water, which forms the principal part of every fermenting fluid; that is, a certain quantity of alcohol will weigh less than the same bulk of water; of course, a quantity of alcohol and water will weigh less than an equal quantity of water alone, and the greater proportion of alcohol which the water may contain, the lighter the fluid will be. Now, as alcohol is constantly generating during the process of fermentation, it is easy to see that any certain measure of the fermenting liquor will get lighter as the process of forming alcohol proceeds.

3025. *The opinion we have stated, that sugar or saccharine matter is the only one capable of the vinous fermentation, may appear to be contradicted by some known facts.* Raw corn, which contains much starch and but very little sugar, is, when mixed with malted corn, found to ferment, and afford as much alcohol as if the whole was malt. Also, alcohol may be abundantly obtained from potatoes, which contain much starch and scarcely any sugar, without any other preparation than boiling them in steam, breaking them into a fine paste with water, and adding a little raw wheaten flour and yeast. From these and similar facts it might appear that starch may at once be converted into alcohol by fermentation, as well as sugar. The observations by Kirchoff threw great light on this subject. He found that neither gluten nor starch, when kept in hot water separately, became sweet; but when a mixture of these two substances was put into similar circumstances, the starch was converted into sugar. Here it is plain, therefore, that this conversion of the starch was in consequence of some agency of the gluten. In the cases above alluded to, of raw corn and potatoes, there is some gluten present, by the action of which the starch might be changed into sugar; and a very small quantity of gluten as a ferment is sufficient to produce this conversion into sugar. The mode by which raw grain is converted by germination into malt, which is a sweet substance, is a similar process; and the production of sweet wort by the brewer or distiller from raw corn is another instance; so is the sweet taste of bread. As soon as sugar has been formed from the starch by this means, it passes so rapidly into the vinous stage that the state of sweetness sometimes escapes notice.

Thus it appears that not only do vegetables which contain actual saccharine matter produce spirit, but those also which contain starch can be made to undergo the vinous fermentation, owing to the starch being converted into sugar, which we know it is capable of by several processes; and that this newly-produced sugar goes at once, and as soon as formed, through the vinous fermentation.

3026. *The nature of ferments, we observed*, was yet little understood; but it would appear that various substances are capable of acting as ferments, or exciting fermentation of some kind. This property appears to be possessed in the highest degree by vegetable gluten and vegetable albumen; but caseous matter, fibrin, and gelatin, carbonic acid, &c., have also this power in some degree. But the substance which is usually employed to excite the vinous fermentation is the only one that has yet been studied with much attention, and it is much more rapid in its action than any other. That an acetous ferment exists is evident from the acetous fermentation being soon excited in a cask in which vinegar has been made.

ACETOUS FERMENTATION, BY WHICH VINEGAR IS PRODUCED.

3027. We stated that if liquids which had passed through the vinous stage of fermentation were exposed to the air for some time, in a temperature between 40° and 80°, a new change took place, by which the alcohol disappeared, and was succeeded by an acid taste in the liquor. During this change a slight intestine motion is perceived; the liquid rises in its temperature about 10° or 15°; it becomes turbid, and floating shreds appear, which subside at length into a gelatinous-like deposite. After some weeks it becomes transparent, and is found to be converted into vinegar, which consists of acetic acid, water, and some impurities. This acid has been generated by this new fermentation; the alcohol produced by the vinous fermentation has been decomposed into its elementary principles, and a new arrangement of them has taken place.

3028. *Every liquor which has undergone the vinous fermentation is spontaneously and necessarily disposed to the acetous.* Accordingly, every vinous liquor continually tends to become vinegar, and is actually changed into it sooner or later, according to circumstances, unless this change be prevented by some cause that is an obstacle to fermentation in general.

3029. *The acetous, like the vinous fermentation, requires a peculiar ferment;* andt his is supposed not to be very different from the vinous ferment, although its nature is very imperfectly understood: it would seem, likewise, to be some modification of gluten. The same yeast which excites the vinous fermentation in malt wort will also run the liquor into the acetous stage, if not prevented, but the matter which subsides in the making of vinegar is the most active in exciting the acetous fermentation. A cask in which vinegar has been already made will promote it, and fermented liquor can be converted in vinegar sooner in that than in another. But there is this difference between the vinous and the acetous ferments, that yeast, or the vinous ferment, is capable of exciting both the vinous and the acetous fermentations; but the proper acetous ferment can only excite the latter of these.

3030. *The theory of the acetous fermentation has been stated as follows:* during the process some carbonic acid is given out, which is supposed to be generated by the oxygen of the atmosphere combining with some of the carbon of the alcohol which is decomposed; and it is thought that vinegar, or the acetic acid, is formed at the expense of the alcohol. Alcohol by itself, as has been shown, is indestructible when pure; but when diluted with water, and mixed with vegetable matter, such as gluten, starch, sugar, or mucilage, it finds among these a ferment, which soon converts it into the acetic acid by a new arrangement of principles.

3031. *From these statements, we see that all substances capable of the vinous fermentation may pass into the acetous,* and do so naturally; but it would appear that some also acetify without apparently undergoing the vinous fermentation, and this occasions some obscurity in the theory.

3032. *Dr. Turner, in his System of Chemistry, has made a distinction that is very important.* The acetous fermentation, and the mere production of acetic acid, have been generally confounded together in books, whereas it is well known that although acetic acid is always the result of the peculiar fermentation that bears its name, yet this acid is often produced by the decomposition of vegetable substances, without any fermentation whatever. Mucilaginous substances, in particular, even when excluded from air, gradually become sour. Gum water sours without exhibiting any of the ordinary signs of fermentation. Weak ale, and beer, and wine, acquire acidity frequently, even in bottles well corked. These, and many similar processes, appear to be effected by a particular change of affinities, and are not attended by that visible movement in the liquid, with absorption of oxygen, disengagement of carbonic acid, and the other phenomena which accompany the acetous fermentation; to which we may add, that acetic acid is produced by the destructive distillation of vegetable matter in close vessels. The term acetous fermentation, therefore, instead of conveying the idea of taking in all the cases of the production of acetic acid, ought to be limited to the conversion of alcohol into this acid. That this change does really take place is inferred, not only from the disappearance of alcohol, and the simultaneous production of acetic acid during fermentation, but also from the quantity of the latter being precisely proportional to that of the former.

3033. *Of the three most important substances concerned in fermentation,* sugar, mucilage, and gluten, or the ferment, it would appear that the first is most disposed to undergo the vinous fermentation, and to produce alcohol; the second is extremely liable to change into the acetic acid, without apparently going through the vinous fermentation; and the gluten, if it does not act upon the sugar in producing the vinous fermentation, is most disposed, like animal matter, to pass at once into the putrid state.

3034. It would appear, also, that in some cases the acetous fermentation goes on, in a small degree, along with the vinous fermentation, and of course produces some acetic acid with the alcohol. This is evident in the distillation of malt spirits, where an acid is found to be left behind, which can have no other origin than the acetous fermentation, there being no natural acid in the malt. A part of this acid combines or unites with the spirit during fermentation; the other part remains behind, mixed, not combined, and such part as is more volatile rises with the spirit during distillation.

3035. *The presence of alcohol retards the acetous fermentation:* hence strong wines, and similar strong liquors, acetify with great difficulty, and bottled strong wines do not readily become sour. But when at last strong wines do acetify, they afford a stronger vinegar or more acetic acid than weak ones; however, in this case, the acid is not entirely supplied from the alcohol, for the mucilage of the wine contributes its share. Adding sugar during the souring increases, instead of diminishing, the quantity of acid.

Sect. IV.—Alcohol.

3036. We have mentioned that alcohol is the chief product of fermentation, and that it is the intoxicating principle in all fermented liquors; but it is never produced in a free state by this process. It is, at first, always mixed with water, mucilage, and some other of the constituent principles of the vegetable matter fermented, and from which it has been procured, as is the case with respect to wine, ale, or beer.

3037. *We likewise stated that pure alcohol is exactly the same from whatever vegetables it has been produced* by the process of vinous fermentation, all that is necessary being that they should contain saccharine matter. For this purpose, a vast variety of saccharine vegetable substances are employed in different parts of the world, each country making use of those which it has in greatest plenty, in order to produce a fermented liquor. Thus, in the south of Europe, the grape is chiefly used; in the East Indies, the juice of the palm affords an intoxicating beverage called toddy; in the West Indies, the sugar-cane supples rum; with us, malted corn is the chief material. After the alcohol has been formed by fermentation, another process is necessary to separate it in a pure state from the substances with which it is combined in the fermented liquor; and this process is *distillation*, for the nature of which, see Book VIII., Chap. VIII., Section 3, "Distillation."

3038. *When the produce of fermentation is distilled,* the spirit, being extremely volatile, rises in vapour, and is condensed by cold into a liquid: this, however, is not pure alcohol, for a quantity of water and other impurities rise with it. It is necessary, therefore, that this should be re-distilled, and go through other operations before it arrives at that state in which it is called rectified spirit, or common spirit of wine, the purest condition in which it is manufactured on a large scale. By another distillation it becomes *rectified spirit of wine.* But this still contains some water, which must be separated in order to obtain *pure alcohol,* which, however, is never employed in beverage; it is only required by chemists for pharmaceutical compounds, or for experiments and other nice purposes.

3039. *The method which chemists usually employ to get rid of the water* to procure alcohol is to mix the rectified spirits with a quantity of carbonate of potash heated to redness to expel all its moisture. This salt has a strong attraction for water, and the greatest part of it is insoluble in alcohol. It, accordingly, combines with the water of the spirit; and the solution thus formed sinks to the bottom of the vessel, and the alcohol itself, which is lighter, swims over it, and may easily be decanted off; or, what is perhaps better, the solution of potash may be drawn off from below it by means of a stop-cock placed at the bottom of the vessel. The alcohol thus obtained contains a little pure potash dissolved, which may be separated by distilling it in a water-bath with a very gentle heat. What now comes over is alcohol very nearly pure. Instead of carbonate of potash, substances having a strong attraction for water may be employed to purify alcohol; for instance, muriate of lime. The specific gravity, as usually obtained, is 0·800; but by great care, alcohol has been obtained so low as 0·796, at the temperature of 60°, that of the least specific gravity being always the purest, as having the smallest quantity of water; equal quantities of water and alcohol constituting what is called proof spirit, the specific gravity of which is 0·917.

3040. *The properties of pure alcohol are the following:* It is perfectly colourless and limpid. It has a burning taste, and peculiar, rather agreeable odour. It is highly volatile, and it boils, or is converted into vapour, at 176°; consequently, it is easily separated from water by distillation, as the latter does not rise into vapour till heated to 212°. Like all volatile liquids, it produces a considerable degree of cold when any body is wetted with it, on account of its rapid evaporation: if the finger be dipped in it, on drying, the cold will be felt. It has been found impossible, hitherto, to freeze it with the greatest degree of cold that can be produced: it has been tried by a cold 91° below the freezing point without rendering it solid; hence it is employed for constructing thermometers.

It is highly inflammable, burning with a lambent, yellowish-blue flame; the colour varying with the degree of strength, the bluish tint prevailing when its strength is greatest, and the yellowish as it is weaker. Its combustion is attended by no smoke, the only products being water and carbonic acid. When burning, it gives an intense heat, though the flame is so faint as scarcely to be distinguished in daylight. It unites with water in every proportion; and the union is attended with a slight diminution of bulk and consequent increase of temperature.

It acts as a powerful solvent on many of the substances belonging to the vegetable kingdom; hence it is extensively useful in preparing liqueurs for the table, and in many processes in the arts. The principal substances which it dissolves are *resin, sugar*, manna, camphor, balsams, essential oils, the vegetable alkalies, tannin, and extractive matter. It also dissolves the deliquescent salts; but generally those insoluble in water are so in alcohol.

Most of the acids unite with alcohol by the assistance of heat, and form the substances called *ethers*. Albumen and muscular fibre are not dissolved by alcohol; on the contrary, they are coagulated, hardened, and contracted by it; and milk is speedily curdled by it. It likewise dissolves soap, wax, and spermaceti.

3041. *When analyzed, alcohol is found, in* 100 *parts, to consist of* hydrogen, 13·64; carbon 68·18; oxygen, 18·18.

CHAPTER III.

BREWING.

Sect. I.—Introduction.

3042. *Brewing, or the art of preparing malt liquors*, was formerly considered as a more important part of domestic economy than it is in the present day, when the great increase of public establishments for this purpose has considerably diminished the necessity for private brewing. This, however, is chiefly confined to towns; in the country, many private families still brew their own beer, and there are many good reasons why this custom should still be adhered to.

3043. *In treating on this subject*, it might be perhaps expected that certain practical rules, founded on the best experience, should at once be laid down, exhibiting the perfection of the art. But, unfortunately, this is not possible. Not only are the best receipts for practice kept secret by professed brewers, but it does not appear that these are agreed among themselves respecting many important points. We are correctly informed by a writer in the "Library of Useful Knowledge,"

That the practical instruction for brewing ale and beer, as given by different "persons, are by no means uniform. The cause is obvious. The mode of manufacture, and, consequently, the quality, differ in every age and country; and, even in the same nation, the ale of one district has little resemblance to that of another." "He who has seen only one of the modes of brewing can have no conception of their number and variety. One shall mash three or four times, while another shall do so but once. A second shall pitch his tun at 80°

when others do so at 45°; the former cleansing in twenty-four hours, and the latter waiting three or four weeks for the finishing of the fermentation. One class of brewers attend chiefly to the attenuation, are minute in the heats of their fermentation, weighing the yeast with the utmost care; while there are many gentlemen (at the same time priding themselves on the goodness of their ale) who turn the worts into the barrels boiling hot, bung them up, and stow them for a year in their cellars, without any yeast at all. Each of these modes of brewing may be considered as producing a different species of ale; and each species has its varieties depending on natural or accidental circumstances, such as the water or the skill of the brewer, which add to its preservative qualities, and give certain adventitious flavours."

3044. *It is necessary, therefore, for every one who wishes really to understand the art of brewing to study its principles*, and not be contented with the mere routine practice of any one person or place.

3045. *With this view we have divided this treatise into two parts:* in *the first part* we shall describe the principles and operations of brewing, including a view of the chemical theory, as well as the general practice of the art, which we have kept together, so that one shall throw light upon the other: this we considered essential for those who are desirous of studying the subject scientifically. *In the second*, called "practical directions," we shall describe the practice only with all the minute particulars necessary to be observed. This separation we found necessary, since many persons may desire to see all the principal points to be attended to in practice, without going much into the theory; and had the whole been blended together, it would have been almost impossible to have distinguished the simple practical processes alone amid so much theoretical explanation; the theory would also thus have been encumbered with numerous fatiguing practical details. This arrangement has, indeed, rendered some repetition unavoidable; but we trust it will be found advantageous, although, without this explanation, it might have been thought unnecessary.

If the reader has perused with attention the article "On Fermentation," it will assist him much in comprehending what we shall say on this subject.

3046. *Brewing has been often practised successfully by persons who possessed no scientific knowledge*, and excellent beer and ale have been made in various parts of the country by our ancient dames, to whom the name of science was scarcely known. It might therefore be doubted whether there is any advantage to be expected by considering the subject in a scientific manner. The reply to this is easy. No theoretical knowledge can wholly supply the place of that which is the result of experience; but it may materially assist it, and more particularly with those who have had but little practice, to whom a work such as the present is chiefly addressed. An acquaintance with the theory of any process prepares the operator for his various operations, that may be regarded in the light of so many experiments, which, by this, he will understand and pursue with more certainty and intelligence. He is likewise by these means enabled to avoid many errors to which those unacquainted with principles are liable, and likewise the waste which they frequently occasion; an acquaintance with the scientific principles of an art renders the practice of more easy acquirement; and it is deserving of attention that the experience gained in this manner can be transmitted to others with greater facility. By connecting practice with theory, the latter being the knowledge of causes, an art is elevated, and may be rendered highly amusing, instead of its being, as it otherwise would, mere drudgery.

3047. Fifty years ago, brewing, both public and private, was in a very rude state. The first attempt to reduce it to scientific principles was made by a skilful brewer, Mr. John Richardson, to whom the art is much indebted, and to whose example we owe the present race of scientific brewers; but the modern discoveries in chemistry have likewise of late been successfully applied to the improvement of this art, which really involves some of the most curious and interesting phenomena in nature, and which has been considered to deserve the attention of some of our greatest philosophers.

3048. *It has been supposed that brewing on a large scale is necessary to produce good malt liquor.* This, however, appears to be an error; and though there are some difficulties in private brewing which are experienced in a less degree by manufacturers, yet there are some advantages in the former. Mr. Donovan observes that less heat is excited during the fermentation of small than of large quantities; and there is less danger of over attenuation, which renders the liquor liable to pass into acidity. When some of the fermentable matter is left unexhausted, it undergoes a slow and long-continued fermentation in the bottle, during which it mellows and becomes highly vinous. The great brewers, accordingly, have, in consequence, often fermented in small quantities; and Mr. Donovan, as well as other chemists who have paid attention to the subject, farther states that, from his own experience, malt liquors are best made in this manner in point of briskness, soundness, and body.

3049. *The economy or saving in domestic brewing* is, perhaps, not considerable; though, from calculations which have been published, the cost of beer should not be so great as when purchased from the brewer. But we are not to suppose from this difference in price that the brewer's profits are exorbitant; for he must have to pay for extensive premises, a very numerous establishment, and very costly apparatus; and out of this, too, the publican must have his profit. But economy is not the only advantage in domestic brewing. Good malt and hops are the only materials that we can depend upon, in general, for making sound wholesome beer; and it is by domestic brewing alone that the genuineness of beer can be secured. There are many public brewers, no doubt, who use only the legal ingredients, malt and hops, in brewing; but it would appear that, before the beer or ale arrive at the consumer (unless common report in this instance deserves no credit), either improper substitutes are used in part for these materials, or some of the dealers adulterate these beverages; and it is well known that many of the articles employed for this purpose are of an extremely deleterious nature. Nothing is more usual than for persons to express their preference of *home-brewed beer*, which would not be the case were it not really of a superior quality. Home-brewed beer is, in fact, if properly made, excellent in every respect. It spontaneously becomes transparent, and requires no addition for fining: it is also particularly calculated for bottling.

3050. *It has been stated, very erroneously, that cottagers* and others could buy beer at a lower price than they could make it at, since large quantities are made cheaper than small. Here the brewers' and the publicans' profits have been forgotten; the labourer saves all these, and, besides, the women can do this work.

Before we proceed to lay before our readers the principles of the art of brewing, it may be useful to give a sketch of the general process.

3051. *Outline of the general Process of Brewing.*—The term *brewing* is confined to the art of preparing from grain the fermented beverages called *malt liquors*, such as *ale, porter*, and *beer*. Grain, of itself containing too little saccharine matter to produce the vinous fermentation, is made to go through a process by which the quantity of its sugar is much increased, and by which it is converted into *malt*, the substance from which the term malt liquor is derived. An infusion of malt is then made with water, at about 170°; this is termed *mashing*, and the extract so produced is called *wort*. This wort, containing much saccharine matter in solution, might now be fermented; but the produce of such fermentation, though it would contain spirit, and be a kind of ale, would very soon turn sour, on account of the great quantity of mucilage and starch in the liquor, which would pass rapidly into the acetous fermentation. To precipitate these substances, and thus destroy one of the chief causes of the injurious change which would otherwise take place, as well as to communicate a more agreeable flavour and taste, *hops* are boiled with the wort; the hops contain some tannin, an astringent principle, which, combining with the mucilage, causes it to coagulate and separate, thus enabling the beer to be longer kept; and they possess, likewise, an aromatic flavour, which they communicate to the liquor, and cover its sweetness. The wort, after having been impregnated with the hops, is now thrown into large shallow vessels, called *coolers*, where it is cooled to about 50° as quickly as possible, before it has time to get sour; it is then submitted to the process of fermentation, after having been mixed with some yeast, which, by the vinous fermentation, produces alcohol or spirit in sufficient quantity to give the required strength to the liquor; at the same time, a portion of undecomposed saccharine matter, and of the mucilage, still remain, and assist in giving the peculiar taste which is essential to constitute good malt liquor. But if the liquor was allowed to remain in the fermenting vat until the fermentation was quite finished, there would be great danger of its passing immediately into the acetous stage; therefore, as soon as it has fermented sufficiently, the new-made beer is transferred into barrels or casks with bung holes, in which the fermentation is finished in a slower manner. During this *slow fermentation*, which is technically termed *cleansing*, the remainder of the yeast works out through the bung holes, and some coagulated lees settle to the bottom, leaving the beer clear. If it be not then quite transparent, it is rendered so by the operation of *fining;* and sometimes it is racked off into other casks, or bottled.

3052. This sketch of brewing will prepare the reader for understanding the enlarged descriptions of the several processes which follow.

Sect. II.—materials for brewing.

Subsect. 1.—*Malt.*

3053. Although in domestic brewing it might be thought sufficient to point out the qualities of the various kinds of malt as made by the maltster, since the preparation of it from barley is seldom attempted by private individuals on a small scale, yet, in accordance with the plan we have proposed to follow through this work, of teaching the *principles* as well as the practice of the various domestic arts, we feel it necessary to give a short account of the manner of preparing the malt, or, as it is called, *malting*.

3054. *The important part which saccharine matter acts in the vinous fermentation*, and, consequently, in producing the spirituous part of beer, has been already explained under the article "Fermentation."

3055. *Sugar of some kind occurs very generally in vegetables*, though not always in sufficient quantity to be recognised by the taste; and a small quantity is even discovered by the chemist in the farinaceous seeds, or corn. But, as we have shown, *starch*, called also *fecula*, is another very important principle, existing ready formed in vegetables. It is found in very large quantity in the farina or flour of various kinds of grain, particularly wheat, and in certain roots, as potatoes, arrow-root, &c. It is a curious and in teresting fact that starch is often converted into sugar by nature, and that this natural process can be imitated by art. We shall presently see that this change is effected during the time that the grains of corn begin to germinate or grow. The sugar of starch is, however, not so sweet as that of cane sugar, though equally capable of affording alcohol by fermentation.

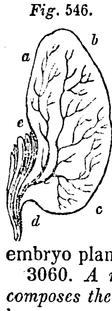
3056. *We may perceive, from these facts, that sweetness alone is not the only test of a substance being fit for fermentation;* one that is not sweet, but which contains starch, can likewise be fermented. This discovery, which was made not many years since, has thrown great light upon some circumstances in brewing that otherwise would prove extremely puzzling, particularly that of the ready fermentation of unmalted barley. The fact is, that raw barley does contain a portion of saccharine matter, as is evident from its analysis; the use of malting is only to increase this quantity by a conversion of its starch into sugar, which actually takes place, as also during the process of brewing previous to the vinous fermentation.

3057. *Barley is the grain almost always employed in Britain* for the purpose of the maltster, being superior to any other corn we possess; but every kind of grain, with scarcely any exception, might be used upon occasion by the brewer.

3058. *The preparation of malt is chiefly to procure a cheap sort of sugar;* but the other principles in the barley also assist in giving their peculiar qualities to the beverages called *malt liquors.* The mode of increasing the saccharine matter in barley is by taking advantage of the process which nature always performs when seeds begin to germinate or grow; but, to render this intelligible, we must describe the nature of germi nation itself.

3059. *Seeds, when planted in the ground, will not germinate except there be moisture* and a certain degree of temperature, which must always be above the freezing point and below 100°; likewise, they must not be entirely excluded from air. The seeds of vegetables consist of two essential parts: the *germe,* that part endowed with the principle of vitality, and the rudiment of the future plant; and of the *cotyledons,* or *seed lobes,* which contain the matter designed to serve for the nutrition of the embryo, or young plant, in the commencement of its growth, and before it is able to extract nourishment from the soil; the whole is included under a skin, called the *cuticle.* In the germe two distinct parts are discoverable: the *radicle,* or little roots, which, in germination, descend into the earth; and the *plumula,* which rises upward, and forms the stem and young leaves. When seeds are planted, or placed in circumstances favourable for their germination, they absorb moisture and swell, the membranes which cover them burst, the radicle shoots downward, and, at the same time, we perceive it sending out minute vessels into the farinaceous part of the seed, for the purpose of extracting nutriment to supply the plumula, or young bud, when it begins to grow. This commencement of germination may be easily examined by pulling up seeds that have been lately planted, and a little before the leaves appear above ground; and they should be looked at in various stages of their growth. To see the minute vessels mentioned, which the radicle sends into the seed lobes, a large seed, as a bean, should be chosen; and the annexed cut will exhibit the appearance of it. *a b c, fig.* 546, is the external membrane, or cuticle; *d* is the radicle; *e,* the plumula: the substance within the cuticle contains the nutriment of the embryo plant, which is seen sending into it ramifying vessels.

Fig. 546.



3060. *A remarkable change at this period of growth takes place in the substance which composes the mass of farinaceous matter in the seed.* Though originally almost insipid, it becomes sweet; in fact, a large portion of the starch in the farina has been converted into saccharine matter, evidently for the nutriment of the young roots which have shot out; when these have acquired size and strength enough to find their way into the soil, so as to extract their food from the earth, and the young plumula appears above ground, this first supply from the farina is exhausted, and then nothing of the seed remains but the skin.

3061. *It is this very curious natural process, this conversion of the starchy matter of the seed of the barley into sugar* by the means of germination, that is brought on artificially in the art of malting, on which chiefly depends the preparing of fermented liquors from farinaceous grains.

Malting is, then, a method of causing barley to germinate when moistened and laid in a heap above ground, by which a great quantity of saccharine matter is produced; and after this, and before the young plant has begun to reduce the saccharine matter by feeding upon it, the process of nature is stopped through the application of a sufficient degree of heat.

3062. *The following is the process of malting barley:* Malting consists of four distinct operations, which follow each other in succession, *steeping, couching, flooring,* and *kiln-drying.* Barley intended for malt should be of the kind that is largest, heaviest, and thinnest skinned. It should be perfectly sound, but need not be of the fullest kind. It should be all, if possible, of one growth, and not mixed, as grain of different kinds will not malt so equally together as if the whole was of the same sort. It is better also not to be quite new, but to have been in store for some time.

3063. *Steeping.*—The whole of the barley intended to be malted is put into a cistern lined with stone or slate, and water is poured upon it as many inches above the grain as it is expected to swell. The grain now imbibes moisture, and increases in bulk. A small quantity of carbonic acid is evolved, but does not rise in bubbles, as it is absorbed by the water, and may be discovered from the latter becoming milky if a little of it be mixed with lime-water. The steep water gradually acquires a yellow colour, and the peculiar smell and taste of water in which straw has been steeped; the barley at the same time becomes whiter, clearly showing that the water has absorbed a portion of the colouring matter that existed in the husk of the grain. Dr. Thomson observes that this yellowish colouring matter, when procured dry, by evaporating the water, has a disagreeable bitter taste, and contains a little nitrate of soda. This water is sometimes removed and replaced by fresh water.

After remaining in steep from forty to fifty-five hours, it is judged by the maltster to be sufficiently softened when the two ends of the grain can be easily squeezed together between the finger and the thumb. The water is then drained off, and the barley is removed to the malt floor to be couched. The increase of weight by steeping is considerable, but under twenty per cent.; when greater, the acrospire will have grown too much, and there will be a loss of saccharine matter.

3064. *Couching.*—It is now distributed on the floor in regular, rectangular heaps, about thirty inches deep, sometimes enclosed by boards, called *couch frames*, and in this situation it is allowed to remain for about twenty-six hours. If, some hours afterward, we plunge a thermometer among the grain, no increase of heat will be perceived; but at last the thermometer begins to rise, and the temperature of the grain will be observed to continue increasing until it is, on an average, about 10° above that of the atmosphere, which usually happens in about ninety-six hours; this increase of heat will be perceived by thrusting the hand into the heap. It now exhales an agreeable and peculiar odour, somewhat like that of apples.

The grain, which had become dry on the surface, now begins again to exhibit the appearance of moisture, called by the maltsters *sweating*, which is the first sign of germination. But it is requisite that this does not proceed too rapidly, which it would do were the heat allowed to increase still farther; and if the heaps were suffered to remain as at first, the heat would be greater in the centre than at the edges, which would cause the germination to proceed unequally. To prevent this, the maltster turns over the heaps with wooden shovels, and spreads it out in thinner heaps. The turning is repeated twice a day, and each time the heaps are made thinner and thinner, until at last they are reduced to three or four inches. The temperature which the maltsters wish to preserve is from 55° to 62°, according to the kind of malt they wish to make; but if not checked it would rise to 70° or 80°, and would at length actually char the grain.

But it is from the growth of the rootlets and plumula that the maltster ascertains when the germinating process has advanced as far as it is prudent to allow it. If we examine the grain soon after the commencement of the sweating, we shall perceive the roots beginning to make their appearance, at first as a white prominence, which, as it advances, divides into two or three, or more. These rootlets sometimes increase in length with great rapidity, even an inch or two in one night, except their growth be checked. About a day after the sprouting of the roots, the other part of the germe, the plumula, or embryo stalk, which is to produce the future stem and leaves, begins to shoot: this is called the *acrospire*. It rises from the same extremity of the stem with the root, and, advancing within the husk or skin, would at last (if the process were suffered to continue long enough) issue from the other extremity in the form of a green leaf; but, for the reason already mentioned, the malting is stopped before this takes place.

As the acrospire shoots along the grain to arrive at the opposite end, the kernel or mealy part of the corn undergoes a remarkable change. The glutinous and mucilaginous matter in a great measure disappears; the taste has become sweet, the colour white, and the texture is so loose that it easily bruises or crumbles to powder between the fingers, and this change is considered to be sufficient when the acrospire has come nearly to the end of the seed, and is just ready to burst out.

The object of the maltster is now accomplished; the farinaceous matter has become more soluble in water, much saccharine substance has been produced, which very readily undergoes the vinous fermentation. Before the acrospire has reached the end of the grain it is considered that a part of the fecula of the grain remains unconverted, hard, and insoluble; and if the acrospire be suffered to grow to a great length, then a portion of saccharine matter has been lost by the germination, having been employed as the food of the young plant. It may be observed that in the smaller kinds of barley, and in bere or bigg, it is considered that the acrospire should not be allowed to grow above three quarters or four fifths of the length of the grain, as more than that will diminish the saccharine matter. With respect to the actual nature of the change which takes place, there is still some obscurity in the subject, and the best chemists are in doubt respecting it; it does not appear to be understood whether all the actual sugar is formed in malting, or whether much of the starch has only undergone such a change as disposes it to be easily converted into sugar by the hot water during the next brewing process, the mashing. The difference is very interesting in a speculative point of view, but less so in practice; for, however the case may be, we are certain that such a change is brought about by the process of malting; that barley which has been malted furnishes a decoction called sweet wort, much more capable of undergoing the vinous fermentation than one made from raw barley alone.

The time required for the grain to continue on the malt floor must vary with circumstances; the higher the temperature the sooner the germination arrives at that point when it must be altogether stopped by being dried in the kiln. In general, the operation of couching occupies fourteen days. In certain cases, where it is desired to have a milder but more viscid ale, the germination is not carried so far, and the time is shortened. Malting cannot be performed with any success in the summer months, and the best maltsters prefer cold weather; in winter they can always keep the germination at the rate they wish by heaping up the grain, whereas in warm weather it grows so rapidly that no effort can keep the process equal and regular.

3065. *Kiln-drying.*—By this process all farther vegetation is completely checked, and the malt is dried so as to enable the brewer to keep it for some time without injury. The mode of drying malt is a matter of great nicety, and there are various constructions of the floors of the kiln or chamber in which it is spread. Some are made of wire net-work or hair cloth; others are formed of earthen-ware tiles, or iron plates perforated with innumerable conical holes, very small at the upper surface, and much wider beneath. In the roof there is an aperture to permit the escape of the heated air and vapour. The malt is spread out on this floor about four inches in thickness, that it may dry equally; and beneath there is a large fire of charcoal or coke, the heated air from which ascends through the holes in the floor, passes up through the malt, and makes its way out through the roof, carrying the moisture along with it. The heat should be very gentle at first, not higher than 90°, and should be raised very gradually till it reach 140°.

Dr. Thomson informs us that he has seen malt dried at a temperature of 175° without becoming brown. The great secret in drying malt properly appears to consist in keeping the heat very low at first, and only raising it *very gradually* as the moisture is dissipated. It would seem that the less heat that is employed the better, so that the germination is completely stopped, and the malt is thoroughly dried, so as to keep well. The grain, which at first was hard and cohesive, has become friable like a mere body of flour, and is so easily divisible that, when properly managed, a mark may be made with the kernel like a bit of chalk. At the high degrees of heat sometimes used, much of the saccharine matter is decomposed and lost; and, in some places on the Continent, malt is at present dried only by the air without any fire. The degrees of heat employed give different properties to malt, and hence we have various kinds which are used for different purposes.

Pale malt is dried with the lowest heat, and its colour is not changed; it contains the greatest quantity of saccharine matter, and affords the strongest liquor; it is always used for ale, and now partly also for porter.

Amber malt is dried with a higher degree of heat, by which it is a little scorched; and it is less sweet, because some of the sugar has been a little altered.

Brown malt is still higher dried, and the scorching has gone so far that scarcely any taste of sugar is left. It is little used except for porter.

A malt of a deep brown colour, almost black, called *patent malt*, is prepared by roasting it in an iron cylinder in the same manner as coffee; the taste is very bitter, and its only use is to give colour to porter, for it is burned so much as to be incapable of fermentation.

The best fuel for kiln-drying is good coke or charcoal. Where it can be had, anthracite or non-bituminous coal is also used, such as the Kilkenny and Swansea coal, or culm: the fuel employed ought to give no smoke. Turf is used in some parts of Ireland, and this is best when prepared as coke.

When malt is sufficiently dried, it is suffered to cool slowly, and the sootlets are removed by screening; it is then spread out again to mellow, that is, to lose its crispness, and become soft and mealy, before it is ground in the mill for the brewer.

VARIOUS ADDITIONAL OBSERVATIONS ON MALTING AND MALT.

3066. So much of the knowledge and success in brewing depends upon the malt, that we shall enter into some farther details respecting the nature and properties of that substance.

3067. We are indebted for some of the following observations to Arthur Aikin, Esq., whose extensive knowledge of chemistry as applied to the arts renders his opinion highly deserving of attention: "In the conversion of barley into malt, a small quantity of carbonic acid is given off, and probably part of the starch is changed so as to become more soluble in warm water; the taste of malt is also sensibly sweeter than that of barley meal; and hence we may conclude that a portion of the starch is converted into sugar. A remarkable change also takes place in the texture or cohesion of the particles of the starch: in the raw grain they are compacted together, so as not easily to be broken down by the teeth, whereas grains of malt, when properly prepared, may be crushed with the greatest ease. The starch of wheat is soluble in water at the temperature of about 170°; that of barley appears to be soluble at perhaps a somewhat lower temperature. Now starch, when once dissolved in water, cannot be obtained afterward by mere evaporation in any other state than a hard, tough mass of difficult solubility, considerably resembling gum tragacanth. Hence it is peculiarly requisite, in drying malt, to apply at first a very gentle heat, for if, by an accidental forcing of the fire, or negligence in turning the grain, any portion gets heated to the temperature of 170° or 180°, the water and the starch immediately combine together, and no subsequent care in drying can prevent the grains so affected from becoming hard and perfectly useless to the brewer. Such grains, as well as those of raw barley, will sink in water, whereas those of well-prepared malt will float; hence our way of judging of the goodness of malt is to throw a little into water, and ascertain how many grains float and how many sink.

"If pale, well-dried malt be exposed to a gradually increasing temperature, it first becomes slightly yellowish brown, or pale amber-coloured; with an increase of temperature the colour increases, and, by proper care, it is very possible to bring the grains to a very dark coffee-colour without charring them in the least degree. In proportion as starch is charred, that is, converted into charcoal, it becomes insoluble in water, either hot or cold; but in proportion as it is exposed to an increasing temperature, provided such temperature is inferior to that required for charring, it becomes more and more soluble, and at last forms a perfect solution of the colour of clarified coffee, even when digested with cold water. This solution gives no indication with chemical reagents of the presence either of starch or of sugar; it will remain for months exposed to the air without becoming mouldy or turbid, and when evaporated, affords a brown gum perfectly resoluble in cold water. The sugar of the malt appears to be altered by heat before the starch is materially affected, and hence an infusion of brown malt is not sensibly sweet to the taste, and is not susceptible of fermentation."

3068. From this account it is obvious, that however the high drying of malt, so as to render it brown, may develop a soluble colouring matter, and a peculiar flavour, in the same manner as in coffee, and which forms some of the causes of the peculiarity of porter, yet it does this at the expense of the fermenting principle. Brewers have long ago found this out, and instead of using only malt dried *moderately brown* for porter, as was the case formerly, it is the general practice at present to employ *pale* malt for the purpose of the fermentation, and to add a certain quantity of *patent malt* for communicating the brown colour and flavour to which the public are accustomed in this beverage.

3069. The method of preparing the brown or patent malt was discovered by Mr. Wheeler, who took out a patent for it in 1817. The heat necessary to bring the malt to the degree of brownness proper for the required purpose is about 400° Fahr. Before the general adoption of this by the brewers, the operations of the maltster were considered of very great nicety in order to produce accurately the precise degree of drying necessary for various purposes; but the use of the patent malt renders the drying of malt an affair of much greater simplicity, as little more than pale malt is made in general.

3070. Malt that has been well dried by a long-continued low heat, not sufficient to alter its colour, and therefore called pale, will afford the most saccharine or fermentable matter, and, consequently, liquor of the greatest strength; it is also the only malt fit for brewing ale, since it does not give that acerbity of taste which is the consequence of rendering the malt brown, but which occurs in porter, and which porter drinkers prefer.

3071. According to Dr. Thomson, barley loses about 8 per cent. by being converted into malt, of which 1·5 is carried off by the steep water; 3 is dissipated on the floor; 3 consists of rootlets separated by cleaning; and 1·5 is waste.

The following is a comparison of the analysis of unmalted and malted barley, showing the changes that have taken place in the operation, particularly the diminution of starch and increase of saccharine matter:

Dr. Thomson.

	Barley.	Malt.
Gum - - - - - -	5	14
Sugar - - - - - -	4	16
Gluten - - - - -	3	1
Starch - - - - -	88	69
Total - - - -	100	100

Proust.

	Barley.	Malt.
Resin - - - - - -	1	1
Gum - - - - - -	4	15
Sugar - - - - - -	5	15
Gluten - - - - -	3	1
Starch - - - - -	32	56
Hordein - - - - -	55	12
Total - - - -	100	100

3072. According to Proust, barley contains a peculiar principle which he has named *hordein*, and which has hitherto been confounded with starch; part of this hordein he supposes to be converted into saccharine matter, and part into a kind of starch possessing some properties different from the starch of barley: but this new view of the subject does not appear to be sufficiently established.

Malt may be preserved good, in a proper situation, for a whole year or more, if guarded from moisture; and it should not be too much secluded from air. If barley be subjected to the same temperature as in drying malt, it loses only 2 per cent., which is, probably, only water.

Excellent malt can be made from *oats*, which, when mixed with barley malt, affords a sprightly sweet drink; raw oats, well dried, not malted, would answer mixed with malt, and is permitted by the excise to be used in private, though not in public brewing. *Wheat* does not afford a malt so sweet as that from barley, and is not allowed in this country by the excise laws, but it is much employed on the Continent; in the Netherlands and Prussia they employ five parts of malted wheat mixed with one part of malted barley, particularly in making the white beer of Berlin. In India they make malt from *rice*, and the spirit produced from it is called *arrack*. The Chinese employ *millet* for a similar purpose. The malt from *rye* is said to afford more spirit than that from barley.

Malt is also made from *maize*, or Indian corn, and in the Philosophical Transactions we have an account of the mode of preparing it. It appears that it will not succeed in the usual manner; and that it must actually germinate in the earth. To effect this, the soil is removed from the surface to the depth of a few inches, and the maize sown quite thick upon the ground; the earth is then replaced over it, and in ten or fourteen days the shoots come up, and present the appearance of a green field; the germinating corn is then taken up, freed from the soil, and dried. This malt is very sweet, and makes a beer very pleasant and wholesome. Mungo Park informs us that in Africa the negroes prepare beer from the *Holcus spicatus*, and that the process which they employ seems to differ but little from that followed in this country; it is here worth recollecting that beer is said to have been invented by the ancient Egyptians. In all these cases it is obvious that the principle is the same; the germination of the various farinaceous seeds in malting produces sugar, the only material capable of the vinous fermentation.

The colour of liquors made from malt, when no colouring matter is used, arises from a degree of decomposition during the drying by fire; for if malt was dried in the sun, as it was formerly, the liquor made from it would be nearly colourless.

When malt is of the best quality, and well prepared, the grains should be large, clean, plump, well filled with flour, and not shrivelled, the skin thin. The grains should break easily when bitten asunder, and have a floury kernel that should give a trace like chalk: its taste should be sweet and mellow, and leave no impression of rawness, but should feel soft and mealy between the teeth, whereas raw grain is tough, and not easily broken: if the malt be hard and flinty, it is bad: the colour should be clear, and there should be no disagreeable smell.

Malt is specifically lighter than water, and will swim, but unmalted grain sinks. To try if the malt be properly made, put a handful of the unground malt into a basin of cold water; let every grain be wetted all over, and, if good, they will swim on their sides: such grains as swim endways, or sink, are not properly malted. If only 5 grains in 100 sink, the malt may be considered sufficiently good. A bushel of malt will weigh about 40 lbs., and the dealer should guarantee its weighing so much; what weighs less is not good; a sack will weigh about 160 lbs.; the value is therefore determined by its weight.

3073. *Grinding the Malt.*—Malt is ground previously to its being used for brewing. It is found best, in general, not to grind it to meal, but only so that each grain is broken or cut into three or four pieces. If ground to a fine powder, it is apt to set into a paste that the water cannot penetrate; and, except every particle of malt be exposed to its action, the whole of the soluble part will not be extracted. In large breweries the malt may be ground finer, because the whole mash is agitated by machinery driven by a steam-engine, and thus the mashing is performed quicker and more completely; but in brewing on a smaller scale, where the agitation cannot be so perfect, it is proper to grind the malt coarser, that the water may be allowed to act for a longer time, and the wort drain away through the interstices.

The usual method of grinding is by a common flour mill with two circular stones placed one above the other, but at a greater distance than for flour; but this grinds very unequally, some grains being reduced to powder, while others have the husks scarcely broken. Steel mills that cut the malt with teeth, in the manner of coffee mills, are much used, particularly in private families, and they answer rather better: they have the advantage of being always ready, whereas a corn mill may be found only at a distance, and private mills form a security against any unfair dealing with the malt. Their price varies from three to ten guineas, but, except great care be used, they are apt to grind too fine. Some use a pair of revolving rollers made of case-hardened iron for *crushing*, instead of grinding the malt, a method which some consider as superior, though it is apt to compress the flour, and prevent the action of the water. Whatever method most completely opens the husk, without reducing the kernel to flour, and allows the water to extract most completely the soluble part of the malt, will be best adapted for brewing. The malt should not be kept above a day or two after it is ground, as it is then apt to heat and ferment, and, consequently, to clot into hard lumps, that not only require to be broken, but communicate a bad flavour: but it is thought useful to keep it a day or two in a cool place, secluded from the light, to *mellow*, which, they say, renders the soluble part more easily extracted.

SUBSECT. 2.—*Hops.*

3074. *This essential ingredient in malt liquors* consists of the floral leaves of a well-known perennial plant, commonly called the *hop vine, humulus lupulus* of botanists. The hop is diœcious, that is, the male and female flowers grow upon different plants, and are o a different form; the catkins, *fig.* 547, are picked and dried for the purpose of brewing. It is a native of Britain and most parts of Europe, and is seen occasionally flowering in our hedges in June, and ripening in September; notwithstanding which, its use in beer in England is not of great antiquity; when first employed here, it was introduced from the Netherlands. There is only one species of this plant, but there are several varieties of it, the qualities of which depend much upon the soil. The southern counties of England, particularly Kent, are celebrated for the mildness of their hops; those in the neighbourhood of Canterbury and Farnham are reckoned of the best quality for porter, uniting an agreeable flavour with strength. Nottingham hops, grown on clay, called *north clay hops*, are strong, but are thought to have a rather rank flavour; they are chiefly fit for liquor that is to be long kept. In Worcestershire and Cheshire a mild hop is grown very fit for ale. They are a very uncertain article of growth, frequently failing in bad seasons, a circumstance that has a material effect on the brewing of that year.

Fig. 547.

Hops are dried nearly in the same manner as malt. They are spread upon a hair cloth, from eight to twelve inches deep, and placed in the kiln, and a steady heat is applied for eight or ten hours, until the ends of the hop stalks are quite shrivelled and dry; they are then taken off and laid out on a large floor to cool. When quite cold, they are packed up in bags and sent to market. As the smoke from any fuel would be improper in drying malt, some kind that gives none is used; as coke, Welsh stone coal, or culm, or charcoal. If coal is the fuel, a contrivance called a *cockle-oast* is used.

3075. *Hops abound in a bitter principle*, which they possess in great perfection, and for which they are supposed to be chiefly employed; this is soluble in water, and is easily communicated to the wort in boiling; they likewise contain the *astringent principle, or tannin*, which is probably the most important one, by its precipitating the great quantity of mucilage contained in the wort, and which is the principal cause of beer turning sour. They contain also a *peculiar aromatic oil*, from which they derive the odour and flavour by which ale is distinguished, and which is very apt to be dissipated and lost by long boiling.

3076. *The ostensible use of hops in malt liquors* is the rich, aromatic bitter which they communicate, and which covers the sweet, mawkish taste of the liquor produced from malt alone, together with their power of preserving the beer from acidity. But there appear to be some doubts as to which of their principles this latter effect is to be ascribed. It appears to be an erroneous view of the subject to suppose that the preserving power of the hop resides entirely in the bitter principle; and hence to imagine that all bitter substances have a similar preserving power. It is the *tannin*, or *astringent principle*, that acts in this manner, by precipitating the mucilage of the malt; and many substances are extremely bitter without possessing tannin. Modern chemistry has likewise shown that there is no such thing as a uniform, unvarying bitter principle; but that the bitter of different vegetables is of a variable nature. Many of these are violent poisons. The cause of the bitter taste of the root of squills is very different from that of the hop; and many substances may communicate a bitter taste to liquor without having the power of coagulating mucilage, and thus preventing acidity. The bitter of some vegetables, instead of preventing acidity, is itself liable to become acid. On this account it is necessary to hesitate in admitting certain substances as substitutes for hops until the chemist has given us their analysis. At the same time, there is little doubt but many vegetables may be as useful in preserving beer, although they may not possess the peculiar aromatic flavour of the hop. Some of these will be mentioned in a subsequent part of our work. Dr. Paris states that "hops contain several elements of activity not in its substitutes. Its bitter principle is a tonic, its aromatic is warm and stimulant, and its astringent qualities precipitate the mucilage in the manner of tannin, and thus remove the cause of acid fermentation." Liebig is of opinion that the oil of the hops diminishes, in a great degree, the tendency of the alcohol to be converted into acetic acid, and therefore to preserve the beer.

3077. *The narcotic principle which they are known to possess* does not reside in the bitter, nor in the aroma, as some have supposed, but in a peculiar matter. A decoction of hops, like all narcotics, produces a little exhilaration, and is said to be stupifying; this effect is succeeded by depression. It is supposed that they add to the intoxicating property of the alcohol or spirit in beer, and the difference between wine and malt liquors in producing sleep is well known. It may be fairly doubted whether the constant use of a considerable portion of such a narcotic may not be prejudicial in certain constitutions, where exercise or much excitement is wanting to carry it off. Upon the whole, however, it is universally allowed that hops render malt liquors more wholesome than they would otherwise be, considering their great tendency to acidity.

3078. *Dr. Ives of New-York has discovered that the active principles of the hop do not reside altogether in the leaves of the flower themselves*, but chiefly in a fine yellow powder, which may be separated from the hops by beating and sifting. This powder, which he has called *lupulin*, forms about one sixth of the weight of the hops, and possesses the valuable properties ten times more than the leaves; it is well known to hop dealers, who call it *condition;* and they value hops in proportion to the quantity of it which they contain.

3079. *The best hops* are of a bright colour, between yellow and green; but if they are very green, they have been gathered too young; and when very brown, they have been allowed to ripen too long on the poles, or they are over-dried, and have lost their aroma, or peculiar flavour. They should have a powerful aromatic flavour, particularly when rubbed between the fingers, should feel clammy in the hand, and should possess much of the yellow powder above mentioned. Porter brewers prefer hops of a rather brown colour; but ale and table beer brewers use pale hops.

3080. *Hops do not keep perfectly good more than a year*, and therefore it is best to procure them of the present year's growth. They soon loose their essential oil, on which the aromatic flavour which they communicate to malt liquor depends; but they do not for several years lose their bitter and astringent principles. If they are more than a year old, but still fresh, they may, perhaps, require to be used in somewhat greater quantity: if they have not been well packed, they attract damp and become mouldy, in which case they are altogether useless. The close packing in bags is supposed to preserve them; old hops are generally reckoned to be one fourth or one fifth less in strength than new.

Subsect. 3.—*Water.*

3081. It is generally stated among the directions for brewing that it is absolutely necessary that the water should be quite soft, and that, if at all hard, it will not act sufficiently upon the malt, nor make good beer. Soft water, such as fresh rain water, or the water of a river or stream, is certainly the best, as being the purest; stagnant water is entirely unfit. But the hardness of water proceeds from certain salts which are dissolved in it (see Chap. I., Book VIII., "On Water"), and it does not appear that the small quantity of such salts is injurious to the process of brewing. Mr. Donovan states that "the grains and hops left after they have been duly infused in hot hard waters, repeatedly applied, are found to be perfectly exhausted of their qualities; and that as wormwood, gentian, quassia, and columbia give out their bitterness freely to water containing salt dissolved in large quantity, there is no reason for supposing that the same water would prove less efficacious with hops. It was formerly thought that good porter could not be made except with Thames water; but this is now known to be an erroneous idea. In fact, most of the principal London porter brewers do not use the Thames water, but have this liquid from deep wells which afford it soft, but still not so much so as that of the Thames. It may be considered, therefore, that many kinds of good drinkable fresh water will do for brewing, provided it be free from impregnations derived from stagnant pools or ponds containing decayed animal and vegetable substances. With regard to the objection that is often made to pump and well water, it is to be observed that these are not always hard, and when they are not so, they are generally very pure. An absurd notion has been stated by some persons that boiling bran in hard water will make it soft: this error arises from such persons not being acquainted with the theory of the hardness of water, or, in other words, with the true cause of that quality. We refer the reader here to Chap. I., Book VIII., "On Water," where he will find that salts alone are the cause of water being hard; and these cannot be in any way affected by the bran.

Sect. III.—PRINCIPLES FOR THE OPERATIONS IN BREWING.

3082. We shall now proceed to describe the general processes employed in brewing, at the same time *explaining the principles on which they depend*, but reserving the minute practical directions for a subsequent Section.

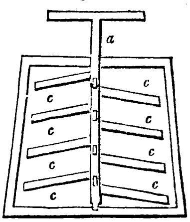
Subsect. 1.—*Mashing.*

3083. *The first operation in brewing is infusing in water*, or *drawing out the extract from the ground malt*, which extract is called the *sweet wort*, and contains all the saccharine and other soluble parts. This operation is termed *mashing.*

3084. *The heat of the water is a matter of very considerable importance;* but it is impossible to fix upon a degree that should always be employed without deviation, since the temperature must vary somewhat according to the kind of malt used, the sort of liquor required to be made, and various other circumstances which will be stated as we proceed. The heat of the water usually employed for mashing is from 160° to 180°, the best brewers generally using the lowest temperature. The water, at about this heat, is let into the mash-tub, and immediately after, the ground malt is let down upon it; or they are otherwise mixed, as will be seen in the description of mash-tubs. The malt being specifically lighter than water, it floats, and the whole requires to be well stirred together;

for if the malt were suffered to remain undisturbed, it would in time absorb water, and sink to the bottom, parting with its saccharine matter to that portion only of the water which is in immediate contact with it; hence agitation is found to be necessary for the purpose of bringing every particle of the malt into contact with fresh portions of water, and thus effecting a solution of the whole. This process was formerly performed in large, as well as in private breweries, by men who stirred up the malt in the water with long poles called *oars*, mixing the whole together in the most accurate manner, breaking all the lumps and clots, so that the water may have access to every part. In large breweries this operation is now effected by means of machinery. A vertical axis, *a b* (*fig.* 548), is fixed in the centre of the mash-tub, having horizontal wooden blades, *c*, *c*, *c*, projecting from it, which, being made to revolve, the blades succeeding each other break completely all the lumps, and prevent the malt from settling at the bottom. The saving of human labour by this means is very considerable, and the mashing is much more perfect. We have described this mode, which is one of the greatest improvements in the great breweries, not because it is absolutely necessary to do so, for it would very seldom, perhaps, be adopted in private brewing except on a very large scale; but because it is proper to know what is the most perfect mode of performing any process: the narrow wooden shovels, called oars, are all that are used in ordinary domestic brewing.

Fig. 548.



After the stirring has been continued for about three quarters of an hour, a cover must be put over the mash tun, to prevent the escape of heat, and the whole must be left quiet for the same length of time, about an hour or more, that the materials may react on each other, and likewise that the fine floury matter which had been mixed up with the water may subside; otherwise the wort, instead of being transparent, would run off muddy from the suspension of the fine particles.

3085. *It has been a common idea that during this time the water is merely taking up the soluble part of the malt;* but it is highly probable that another action likewise takes place, and that it is in the mash that a very large proportion of the starchy matter of the malt is really converted into that saccharine principle essential to fermentation, as we have stated already. This change appears not to be instantaneous, for the sweetness in the wort for the first ten minutes is inconsiderable, but it becomes gradually more and more so during perhaps two hours, notwithstanding the water is becoming cooler all the while.

3086. *Several facts appear to render it probable that the saccharine matter is not completely developed in the malt.* If cold water be left on malt for any length of time it does not become sweet, or very little so, and it will soon become sour; hence it is evident that the saccharine matter of malt is not soluble in cold water; but it is dissolved by hot water, and, once extracted by this, it remains always soluble, not only in hot, but likewise in cold water: it must, therefore, have undergone some change; and from this we see the necessity of mashing with warm instead of cold water.

3087. *Another fact proves that saccharine matter is formed in the mash tun* as well as in malting. It is now known that raw barley, if mixed with a certain quantity of malt, will give as sweet a taste to the mash as if the whole was malt, and can be made to ferment without being malted. This had long been secretly practised by the Scotch distillers of whiskey, with a view to evade the duty on malt, and, indeed, the expense also of preparing it. When the method was known to the brewers, it was resorted to by them also, producing an immense saving; but the practice was put a stop to by the excise. Private individuals are, however, at liberty to employ it for their own use. It is evident here that the effect produced upon a portion of malt is communicated to the starch of the raw barley, and this is supposed to be the result of a particular species of fermentation which we have already described as the *saccharine fermentation.* The formation of the sugar, therefore, begun in the malting, is completed in the mashing.

3088. *We shall now point out an accident to which mashing is very liable,* which it is absolutely necessary to guard against, and the nature of which cannot be comprehended without having recourse to those chemical principles which we are blending in our account. The accident to which we allude is called *setting* by brewers. When the water used for the mash is of too high a temperature, the whole often thickens and becomes of a pasty nature, which prevents the water passing through it, or the wort from draining off; in this case the whole mash is irrecoverably lost, the liquor remaining locked up in the paste. The cause of this curious phenomenon we shall now explain. We have already pointed out, that although the usual notion is that the whole of the starch of the barley is converted into saccharine malt during malting, yet that in fact only a part is so converted, and that, when the malt is ground for mashing, it still contains the greatest part of its starch slightly changed. Now it is a fact well known to every laundress that pure starch is not acted upon by water heated below 160°; but when the temperature of the water is raised to the boiling point, or nearly so, it then thickens into a gelatinous mass, from a combination with the water, which is the state in which it is brought for stiffening linen. The accident of *setting* in the mash is exactly analogous to this. It is owing to the water being heated to such a degree as is capable of *gelatinizing* the starch of the malt, or converting it into a stiff gluey paste, which prevents the water from penetrating into the body of it; consequently, it cannot have access to and dissolve the saccharine part. The nature of this danger being clearly impressed upon the mind, it will be easily perceived that we must take care that the mean heat of the mash, when mixed, should not be too great, otherwise we shall run a great risk of setting; this heat should never exceed 185° at the utmost; at 198° most kinds of malt afford a cloudy wort.

3089. *But there are some other circumstances to be understood before we can be prepared against all the accidents* and failures which may arise from an improper temperature of the water used in mashing. It is evident that, if hot water be poured upon cold malt, that the temperature of the water will be at once considerably lowered; but it is found that this lowering is not so great as if the water was poured upon raw barley ground: the fact is, that some heat (that of a few degrees) is generated by the mixing together of ground malt and water, which does not take place when raw barley is used. Every one must have observed that heat is often excited by the union of two cold substances, an example of which is seen in mixing oil of vitriol with water suddenly. Now, in producing the proper heat of the mash, allowance must be made for all this; and that might be done accurately, did all kinds of malt give the same increase of temperature; but this is not the case, for the heating produced by the malt depends in some degree upon the manner of preparing it. High-dried malt heats more than pale; and malt heats more or less in proportion to the temperature in which it has been dried. The heating from pale malt is very little, and may generally be neglected; but that from brown malt is considerable, amounting sometimes, it has been said, to 40°.

3090. *Another evil attends too hot a mash*, namely, a portion of extractive matter is taken up by the wort, causing a degree of cloudiness, which often attends the liquor through all the subsequent processes, requiring at last the use of fining in order to be got rid of.

3091. *On the other hand, there are several evils accompanying* too cool a mash. The conversion into saccharine matter will be incomplete; much starch remains unaltered; the wort so produced will be deficient in flavour, and be apt to turn sour before it runs off clear. It is more difficult to preserve a proper heat in mashing a small quantity than a large one, because in the former the heat is soon dissipated, and the mash is apt to cool too much before the fermentable substance is extracted; hence it is necessary with small quantities to employ as much heat as may be consistent with other circumstances. Sometimes it is necessary to increase the heat of the mash, which may be done by pouring boiling water into a pitcher or tin pail, and immersing the vessel partly in the mash, but not so deep that the water can escape into it; the heat of the boiling water coming through the pail will warm the mash.

3092. *After the mash has continued* the proper time it is run off by a stop-cock, or spigot and faucet, into a vessel placed below to receive it, called the *under back;* this is, in the brewer's language, called *setting the tap*, a phrase probably borrowed from the old and simple fashion of letting off the wort from the mash tun by a tap tree placed in the bottom. This draining off the wort, which, if the brewing be considerable, is best effected by a stop-cock, requires to be done with caution, lest the grains in the mash tun should be disturbed, and choke up the holes in the bottom. To avoid this, which would prove very troublesome, and risk spoiling the brewing, the stop-cock should be opened at first very little, and care should be taken that the wort runs clear; if it comes off foul, what has been drawn should be returned gently into the mash-tub, and a little time allowed to elapse till it is found to run quite clear; as soon as this is the case, the whole, or all that is required, should be drawn off; but the clearness of the wort is essential.

3093. It must be observed, however, with respect to the term *clear*, that, with all the care possible, the wort never flows from the mash tun absolutely transparent and bright, but there is always a dulness, which is to be removed by the next operation, the *boiling*. The cloudiness which the wort sometimes will, after all, retain, is frequently, no doubt, owing to the water having been too hot, by which it has dissolved a small portion of the starch, inducing a slight degree of setting, which will be known by the wort having a slimy feel; but Dr. Thomson observes that some obscurity hangs about the cause of the occasional cloudiness of the wort, which sometimes, with every precaution, will continue all through the brewing, and which cannot be removed ultimately but by fining. The wort, as it first flows from the mash tun, will be, in general, of a fine amber colour; but its tint will depend upon that of the malt, pale malts giving light-coloured worts, and brown malts giving darker coloured.

3094. *Upon the whole, the actual temperature of the mash cannot be absolutely fixed by any precautions*, which renders brewing more uncertain than could be wished, and demands some experience where great accuracy is required. But observations such as the above must form the basis upon which experience should be built.

3095. *The whole of the extract of the malt is not obtained by the process we have just described*, some of the wort already formed adhering to the malt, which will still contain a portion of undissolved extract, which requires to be farther acted upon by the warm water, as in the case of tea or other infusions.

3096. *These second and third additions of water to the malt are termed the second and third mashings.* It must be evident that the strength of the ale or beer will depend chiefly upon the proportions of the malt and water, but partly upon the management, as well as upon the sort of beer to be made. The particular mode of adjusting the proportions of the materials and other circumstances upon which the strength depends will be considered in the "*Practical Directions.*"

3097. *The first wort being drawn*, and put into the under-back, there are now several modes of proceeding, the choice of which will depend upon the kind of malt liquors required. If both ale and good table beer be wanted, the first wort alone may be reserved for the ale, as containing the most valuable extract of the malt, and the second and third mashings may produce the wort for the table beer, which is the usual practice; or these last two may be made into separate beers, the last being of very inferior quality. If it be required to make as much as possible of the best ale, then a certain quantity of wort may be still obtained from the malt of a quality nearly equal to the last, which may be added to it by the following process:

Pour, or, rather, sprinkle water, of the temperature of about 170°, on the surface of the malt in the mash tun, without stirring it, by means of a watering-pot having the holes in the nose larger than usual; or any kind of vessel, as a pail with holes in the bottom, may be suspended over the mash tun, and the water being poured into this, it may be moved about by hand and directed to every part of the mash. The tap hole of the mash tun being left open, wort nearly of the same richness as that at first obtained will flow, till the whole residue of the first wort which had been detained in the malt had run out. To know when to stop pouring on water, which should be done gradually, and at intervals, taste frequently the wort that runs out. When its sweetness diminishes greatly, which will take place almost suddenly, the tap hole is to be closed, and no more water is to be added. This wort is to be added to that already drawn. If any more water be added in the above manner, it will give a wort only fit for the table beer; its odour will be inclined to sourishness, although it be not, in fact, acid. This process is termed by the brewers *sparging*. But if it be required to make a good deal of weaker beer, as, for instance, table beer, then this last process may be omitted, and the second mashing gone on with immediately.

Before we proceed, it may be proper to mention that in the mash tun provision is made to prevent the malt which has been employed, now called *grains*, from coming off with the wort, either by a *strainer* in the inside, or by a double perforated bottom for this purpose, which will be described when we treat of the construction of the apparatus used in brewing.

3098. *Second mashing.*—There being still, as we have said, much of the extract remaining in the grains, warm water is again poured upon it in the mash tun, to make a second infusion. As there appears to be some difference of opinion with regard to the degree of temperature at which the water should be employed, it is necessary that we should resort to principles in determining this point. Richardson and other eminent brewers recommend that the heat of the water in the second mash should be 5° more than that of the first, and that of the third mash increased by 5° farther, raising the temperature in each succeeding mashing, in order to extract more from the malt. The reason for this is, in the first place, that all risk of setting is over after the first mash, and because it is desirable in the succeeding ones to obtain as much soluble matter as possible from the malt. But it has been observed by Dr. Thomson, Mr. Aikin, and other eminent chemists, that by far the greater part of the richest and most saccharine or fermentable part of the malt has been already extracted in the first mashing, which is reserved for the most delicately flavoured liquor; and that, although by this mode of proceeding, namely, increasing the heat in each mash, the second worts will acquire a greater specific gravity, yet that this gravity does not arise from saccharine matter only, but chiefly from starch and mucilage, substances which, when in excess, greatly deteriorate the quality of the liquor, and are liable to occasion failure by their turning acid. It is certain that the wort of the second mashing has but little sweetness, and a flavour and odour rather unpleasant than otherwise.

3099. *Third mash.*—The wort of the third mashing is of a greatly inferior quality, containing little else than mucilage, which, although by hopping may be made into a very indifferent small beer, is extremely apt to turn sour. Some, therefore, recommend that the water for the first mash should be 180°, that for the second 170°, and that for the third, if taken, 160°. With respect to the heat used in the first mashing, if it be too low, there is considerable risk of the wort contracting a sourness in the beginning of the brewing. In general, therefore, as Mr. Donovan admits, the higher heat is preferable. On these and similar subjects the judgment of the brewer must be exercised with reference to the object he has in view in brewing, and it is possible only to lay down principles for his guide.

3100. In great breweries, they sometimes make a fourth mash, but this is only used in what they call a *return*, which is merely used instead of water in the next brewing.

3101. *The whole of the kernel of the malt is never entirely dissolved by the hot water, even by the last mashing;* the husks, called *grains*, still contain a certain quantity, which is more or less according to the process, and form a nutritious food for cattle, pigs, &c. Grinding the malt finer would be favourable to a more complete extraction, but we have already stated the objection to this, from the difficulties of getting the water to pass through it in mashing without the aid of machinery.

3102. *The constituents of wort have been examined* by Dr. Thomson, Professor of Chemistry in Glasgow. By evaporating it to dryness, he found that it leaves behind it a yellow-coloured residuum, which has a sweet taste, dissolves readily in water, and becomes clammy, in appearance much like treacle; this cannot be procured in a perfectly dry state. He considers it to contain a good deal of the peculiar kind of sugar called starch sugar, which is similar to the sugar of the grape, less sweet than cane sugar, and which cannot be refined, though it may be granulated like granulated honey. Like the sugar of grapes, it ferments without the addition of yeast. We have already spoken of mucilage and starch also existing in the wort. The presence of mucilage with some gluten is shown by their being precipitated in flakes by the addition of alcohol or astringent matter. The mucilage is very apt to turn sour, though a certain portion of it is essential to fine ales. The existence of some unaltered starch is proved by a solution of iodine dropped into the wort producing a blue colour.

Subsect. 2.—*Boiling and Hopping.*

3103. *The next operation in brewing is to boil the sweet wort*, prepared as above described, with the hops. The wort or extract from malt may be compared to the must or expressed juice of the grape, both containing a considerable quantity of the same kind of sugar; and, in fact, it would be possible to procure a fermented liquor from the wort, either without addition, or only by adding yeast; but there are several important differences between the extract of malt and grape juice. Wort, besides being entirely deficient in the principle called *tartar* (which is found in the grape, and which will be mentioned when treating on wine), contains a much smaller quantity of saccharine matter, in proportion to the ferment. In consequence of this comparative abundance of the fermenting principle, if the wort were made to ferment at once, without boiling, as the juice of the grape does, it would very soon go through the vinous stage, and pass into the acetous, and, perhaps, the putrefactive; become *foxed*, as the brewers express it, and we should then, instead of beer, have only an ill-smelling vinegar, an effect which would be still farther increased by the large quantity of mucilage.

3104. *The chief use, therefore, of boiling the wort* is to get rid of some of this natural ferment, or gluten and mucilage, which are held in solution in too great quantity. This the boiling effects upon the principle of coagulation; for the gluten is coagulated or curdled by boiling water, in the same manner as white of eggs, and is thus easily separated from it. This coagulation, and likewise that of the mucilage, is farther assisted by the addition of the hops, which, containing an astringent principle, has a powerful property in coagulating these substances.

3105. *Another use in boiling the wort with hops* is to unite to the former the bitter and aromatic principles contained in the latter, which are necessary to cover the sweet mawkish taste of the sweet wort by itself, and give that agreeable flavour for which malt liquors are esteemed. It may, perhaps, be supposed that a decoction of hops might be added to the wort without boiling; but, as it is the boiling chiefly that effects the coagulation, this is necessary.

3106. *A third reason sometimes alleged* for boiling the wort is to evaporate part of the water, and thus render the wort stronger; but this is only in cases where too much water has been employed through error, or in consequence of bad calculation, which it is very desirable to avoid.

3107. *Wort, indeed, before fermentation, and after it, is extremely liable to acetify;* and this renders brewing an operation of great delicacy, slight circumstances being sufficient to mar its success, such as sudden changes of weather, or even thunder storms, to say nothing of the agency of witches, so much complained of in the olden time. The wort, therefore, should not remain long in the under-back, but should be transferred as quickly as possible into the copper to be boiled.

3108. *This coagulation, called breaking by the brewers, is generally accomplished* by boiling about half an hour, or nearly an hour, according to circumstances, and it is known to be sufficient by the appearance of flocculent masses swimming about and collecting in the copper; these gradually increase as the ebullition is continued, and they consist of the gluten and mucilage of the wort, which from the dissolved state have become solid by the combined operation of the boiling water and the astringent principle of the hops. When upon trial, by taking out a small quantity of the wort, it is found that the coagulation is complete, by the flaky masses subsiding to the bottom, and leaving the wort clear, the boiling is discontinued, and the wort is drawn off, in order to be cooled previously to fermentation.

As a proof of the utility of this operation of boiling, it is noticed that, if a quantity of wort be fermented without being boiled, the fermentation continues much longer than an equal quantity that has been boiled, and that the first will produce a thin liquor that soon becomes acidulous, and which is not calculated for keeping. Such liquors were probably made before the use of hops was known, and were required to be drunk very new.

3109. *The boiling must always be continued till this coagulation appears*, otherwise it will be useless, and a much longer continuance of it is injurious; about half an hour may be sufficient for extracting the soluble principles of the hop, but not always for the coagulation we have mentioned. If the boiling be continued too long, certain evils ensue; too large a quantity of the coagulable ferment may be separated, and the presence of some of this in the wort is essential to the fermentation, which then will be languid; the strength of the liquor will suffer, and perhaps the whole may acetify.

Another evil is occasioned by too long boiling, and also by violent boiling, which cannot be easily remedied, namely, the loss by volatilization of the essential oil of the hops, which contains the aroma. On this account, the hops should not be put in until the wort has boiled some time, that the rank flavour may not be extracted by too long decoction; and care should likewise be taken that the boiling should be as uniform as possible.

3110. *The greatest part of the flakes coagulated is detained* in straining the wort into the coolers; what remains is thrown out with the yeast in fermenting, and lastly, in the lees of the beer, thus freeing it from matters which otherwise would have remained in solution, or have rendered the liquor thick and turbid.

3111. *In some places a separate infusion of the hops has been made*, and afterward added to the wort, instead of boiling the hops with the wort; this has been recommended, as preserving the essential oil, which is sometimes lost in the common process, and as leaving out the rank flavour which long boiling extracts.

3112. *Among the improvements in brewing*, some of which might be adopted in domestic arrangements where expense is not an object, is boiling the wort by means of steam surrounding the outside of the boiler, instead of suffering the fire to come in contact with it; this will prevent all risk of burning the ingredients, and giving a disagreeable taste to the beer. The boiler that supplies the steam should be furnished with a safety valve, and the outside jacket or casing, between which and the copper the steam is introduced, may even be of wood.

Subsect. 3.—*Cooling the Wort.*

3113. *After the wort has been sufficiently boiled with the hops, it is necessary to cool it down to the proper temperature for fermentation;* and this must be done as quickly as possible, since the wort would be very apt to pass into the acetous fermentation were it kept long at a high temperature. The necessity of cooling the wort *rapidly*, though so important, is one of the most difficult and uncertain parts of brewing, as it requires that conveniences are had for exposing a very large surface to the air, and it is necessary, also, that the temperature of the atmosphere should be sufficiently low, on which account it is not possible to brew well in the summer, nor in a warm climate.

3114. *Cool dry weather is best adapted for brewing*, on account of the cooling of the wort; extremes of heat and cold are unfavourable, and therefore spring and autumn have been generally selected for private brewing. March and October are months well known as the fittest times of the year. In the great breweries they brew some beer in the summer as well as in the winter; but then they make use of large fans and refrigerators for cooling their worts, and even with these there is more risk than in cold weather; in winter, with a dry north or east wind, the cooling is speedily performed; but in frosty or very cold weather the fermentation is slow, except means are taken to keep up the heat.

3115. *In warm weather*, especially if at the same time the air is moist and close, the cooling is so far retarded that spontaneous decomposition of the liquor sometimes begins to take place; specks of white mould sometimes make their appearance on the surface, and communicate to the mass a rank and disagreeable musty flavour. In this state the liquor is said to be *foxed;* and the effect consists in an extremely minute species of vegetation growing in the wort, but which it would require a good microscope to recognise. Should this accident happen, it would be sure to increase in every subsequent stage of the brewing, and even during the consumption of the ale or beer.

3116. *To expedite the cooling* as much as possible, a variety of expedients are resorted to, which must vary according to the magnitude of the brewing, and the particular localities. In dry settled weather the wort is best cooled out of doors, but it must be carefully guarded from rain. When it is cooled within doors, all the doors and windows should be set open, and it is necessary to take care that the sun does not shine upon it. Thundery weather is particularly unfavourable.

3117. *The temperature to which the boiled wort is to be reduced previous to fermentation ought, if possible, to be about* 60°, or very little more. The injury, however, sustained by fermenting at too high a temperature is not by any means so great as the least de gree of foxiness; and therefore, if the weather be close and warm, and the brewer ha no other means of cooling his wort except by exposure to the air, let him ferment at 70°.

3118. In Scotland and on the Continent they ferment at very low temperatures; but Dr. Thomson observes that, when the room in which the fermentation is carried on is cold, if the wort is cooled down as low as the atmosphere, it often refuses to ferment, and artificial heat is obliged to be used before it will begin. He recommends that the temperature should never be less than 56°, except the room be warmer, in which case the temperature may even be reduced to 52°. The wort loses during the operation of cooling a considerable quantity of water by evaporation. The loss in the cooling is often more than one eighth of the whole bulk of the wort; its strength, therefore, becomes greater.

Subsect. 4.—*Fermentation of Malt Liquor in the Tun.*

3119. We now proceed to describe the principal process in brewing, that for which all that has hitherto been done is but preparatory. By this process the sweet mild decoction called wort is to be converted into a brisk lively liquor or *ale* containing a considerable portion of spirit. As the general principles of fermentation have been already fully treated of, we shall now only touch upon them as far as they are necessarily connected with our present subject.

3120. *We have said that a solution of perfectly pure sugar in water will not ferment of itself*, although one made with brown or coarse sugar ferments very readily. The sugar made from starch will likewise ferment of itself, and of course the saccharine matter of malt, as well as a solution of the sugar of grapes. In the general view of the fermentation of wort, therefore, we may suppose that the yeast employed might be omitted, because it is not absolutely necessary to this process, but seems merely to render the effect more certain and rapid, and consequently prevents the passage of the liquid into acidity, which almost always takes place when the fermentation is very slow.

3121. *In some of the counties in England it has always been a practice in private brewing to trust to spontaneous fermentation*, instead of employing yeast to begin the fermentation, as is the usual mode. Mr. Booth, who has seen this method, which appears not to be generally understood, informs us that when the wort is sufficiently boiled, it is put at once, boiling hot, into the casks, merely separating the hops without any clarification. In about forty-eight hours the fermentation is known to have commenced by the appearance of a froth or yeast which is seen to issue from the bung-hole. The quantity of yeast that comes out from the cask is not considerable, and in the course of eight or ten days the fermentation subsides. It is now found that the yeast, which has been forming all the while, has collected into a solid crust on the surface of the liquor, which has at last, in consequence of contraction as it cooled, shrunk away from the yeast, leaving a vacuity between the liquor and the crust; and it is said that this crust of solid yeast is of use in defending the beer from the air. This ale cleans by subsidence only, but requires to be kept for a twelvemonth before it is fit to drink. Only strong ale can be fermented in this manner, for weak worts would run into acidity before the vinous fermentation could be completed. A similar mode of fermentation is employed in Brussels and other parts of the Continent.

3122. *By far the most general method, however, in this country*, and which is considered as making the best and wholesomest malt liquor, is to commence the fermentation by adding to the wort a certain quantity of *yeast* procured from another brewing; and this is, accordingly, the method which we recommend, and which we shall now describe.

3123. *When the wort is cooled down to the proper temperature* by exposure in the coolers, which may be about 70° in temperate weather, according to some brewers, but with others as low as 60°, or even 50°, it is run into a strongly-hooped vessel, deep, and of a suitable size, called the *fermenting tun* or vat, or, as the brewers term it, the *gyle tun*. This should be larger than would be merely necessary to hold the wort, because a considerable increase of bulk takes place during the fermentation, in consequence of which the liquor would run over, except allowance were made for it. On this account its capacity should be one half greater than the bulk of the wort; and it should have a cover to exclude the air.

3124. *It may be proper here to recapitulate the leading facts which render this process of fermentation necessary.*

The vinous fermentation, or the production of alcohol or spirit, which forms the intoxicating part, or strength as it is called, of malt liquors, cannot be induced except through the medium of some kind of saccharine matter; and the use of malt is to supply a species of sugar, which, though not exactly the same as that of the sugar-cane, is yet equally fit for fermentation. A solution of coarse sugar in water, we have seen, will ferment of itself; but, to expedite this process, a substance called a *ferment* is added, which substance is contained in yeast that has been thrown up by some previous fermentation. When this ferment comes into contact with saccharine matter under favourable circumstances, a peculiar chemical action takes place, in consequence of which the sugar is decomposed or separated into its elementary constituents, and these are recombined in another manner, so as to give rise to two new substances, *alcohol* or *spirit*, and *carbonic acid*. The yeast itself is likewise decomposed; but the nature of this decomposition is obscure, and we may disregard it; since the alcohol and the carbonic acid themselves make up the exact weight of the sugar, we may consider it alone as supplying the alcohol. The alcohol being the liquid which we wish to form, it follows that the more sugar is decomposed the stronger will be the malt liquor; and its strength will depend partly upon the quantity of saccharine matter, or, in other words, malt or grain, employed, and partly upon the success with which the fermentation has been effected, the latter resulting, in a great measure, from the skill of the brewer. The carbonic acid gas or fixed air, separated by the fermentation, escapes through the liquor into the atmosphere, producing the appearance of ebullition, from which the process derives its name.

3125. *Having recapitulated these facts necessary to be kept in mind, we proceed to state* that, the wort being now in the fermenting tun, a certain quantity of yeast is to be added to it; and it is essential that this should be fresh and of the best quality, for bad yeast may spoil the whole brewing.

3126. *When wort is to be fermented for strong ale*, it is necessary to procure yeast from ale of equal strength. Though strong ales cannot be fermented by the yeast procured from weak worts, yet the yeast of ale will ferment any weaker beer. Weak beer ferments rapidly, but the fermentation is soon over.

3127. *Though yeast can be kept, yet new yeast is more active than old;* and it is a curious fact that, if successive brewings in the same place are inoculated with the yeast of the previous fermentations, the yeast will sometimes at last degenerate, in which case a supply must be had from another brewery. Yeast is also liable to become putrid by keeping, like animal matter; and the smallest quantity of this, or the least tendency to it, will inoculate the whole tun with its bad condition.

3128. *The best yeast* is that which is collected at the top, and which has become a dense tough froth, formed when the fermentation has been a good deal advanced. What has fallen to the bottom, or the *ground yeast*, is not so powerful.

3129. *The proportion of yeast that should be used* cannot be the same exactly for all cases, for it must depend partly upon the quality of the beer and on the season: in most cases, a larger quantity of yeast will have the same effect as a higher degree of heat in exciting the fermentation, and a smaller quantity will be equivalent to a lower temperature; but, in general, a gallon for four barrels may be stated as a general rule when the wort is from 60° to 70°; if the heat be greater, something less may be sufficient. If the fermentation is too languid, more yeast must be added to revive the action, without which the beer will not only be deficient in spirit, but have a mawkish taste compounded of sweet and bitter, be apt to fret on a change of air, and be peculiarly liable to turn sour. Great care must be taken to blend the yeast intimately with the wort.

3130. *The whole having been well mixed, and the cover put on the vat, fermentation commences* in from three to five hours, according to the temperature of the mass. A few bubbles may be seen first rising in the wort, and these collect first about the sides of the vat, where they soon form a kind of ring or line of froth: this gradually increases in breadth, advancing by degrees towards the centre, the liquor generally becoming turbid. At length the whole surface is covered by this frothy or cream-looking substance, which increases with a low hissing noise, owing to the breaking of the numerous air bubbles and the escape of the carbonic acid gas which they contain, the nature of which has been already explained.

3131. *As the fermentation increases in activity*, the froth or yeast rises higher, and is elevated partially in little pointed forms called *rocks* by the brewers. The yeast, at first white, becomes yellowish, then brownish yellow, or, rather, streaks and little masses of that colour collect upon it; these darker parts contain the bitter principle of the hop, and when it is not desirable that this shall be retained, as is the case in fine ales, the brewer skims it off that it may not mix with the liquor. About this stage of the process the brewer perceives a peculiar odour, somewhat of a vinous nature, called by the workmen by the strange name of *stomach;* and this continuing to acquire strength till the process is finished, the experienced brewer judges by it partly of the success of his operation. The froth at length becomes of a firmer consistence, being composed of a more viscid and glutinous matter, and the bubbles do not break so soon, but form larger than at first. The whole head, after this fermentation has continued some time, begins to grow flatter, the formation of froth lessens, and the dense viscid substance which had floated by its means would fall into the liquor if it was not skimmed off. This is done sooner or later, as the brewer wishes the fermentation to continue or to cease.

If he is desirous of continuing the fermentation, he will sometimes beat back the yeast into the liquor, and mix them together, which operation is termed *rousing*. If he wishes to check the fermentation, or considers it sufficient, he will carefully remove the yeast by skimming it off to preserve it for another brewing. As soon as the head of yeast ceases to rise the first fermentation is complete.

3132. *When the yeast is first added*, the wort is turbid, and has scarcely any degree of transparency; but as the fermentation advances, a gradual deposition of opaque matter takes place, and the liquor becomes comparatively transparent, as well as specifically lighter, in consequence of the spirit produced.

3133. *During the fermentation in the tub the temperature of the liquor continues to increase* till it be a few degrees warmer than when it was first put in, but the precise increase depends partly upon the temperature of the liquor at the beginning, partly upon the quantity of it, and partly upon the heat of the weather. In very large breweries it is said to rise even 12° or 15°, but perhaps not a third of this in private breweries.

3134. *Any sudden check to the fermentation is very injurious*, often occasioning a cloudiness in the beer which nothing can remove, and this same thing happens by a change in the weather; such alterations will affect small quantities much more than large ones, and, therefore, changes will be serious in small brewings that will not be much felt in those on a great scale.

3135. *A few farther remarks on the difficulties of this process or part of the art may be useful.* The smaller the quantity of wort to be fermented, the less is the heat excited by the process, and, consequently, the slower the fermentation. If the fermentation does not begin soon enough, or is too languid, the fault may lie with the yeast, which may be in too small quantity, or its quality may not be good, in which latter case it may be necessary to procure some from another brewery, though this is an evil that should, if possible, be avoided. If the quantity is too small, more may be added, from which little inconvenience can arise compared with that of an imperfect fermentation. Sometimes sifting a little flour of malt all over the surface is of use. Too languid a fermentation may also be owing to the temperature of the wort not being sufficiently high: in that case plunging a pail full of boiling water partly into the wort will raise its temperature.

If the quantity of yeast be too great, or the temperature of wort too high, the fermentation will go on too rapidly, and there will be danger of its passing into the acetous stage: when this is the case, everything should be done that will check the fermentation by cooling or otherwise. A pail of cold water plunged into the wort may be tried; the doors and windows may be thrown open. Too much yeast is liable to render the beer what is called *yeast bitter*. High-dried malt does not ferment so readily as pale malt, since the starch has become a little altered.

3136. *With respect to the extent to which the fermentation is to be carried*, this will depend upon the kind of liquor to be brewed: in ales it is not desirable that all the saccharine matter should be decomposed and converted into alcohol, because they require other qualities besides strength; it is requisite that they should have a certain degree of sweetness and viscosity; therefore the fermentation must be stopped before all these are destroyed. On the contrary, in porter, which may be called a dry malt liquor, sweetness is not wanted, and the fermentation is carried to a greater length.

Since alcohol or spirit is lighter, bulk for bulk, than water, it is evident that the more spirit there is produced by the fermentation, the lighter the wort which is fermenting will become; this lightness, which marks the quantity of alcohol produced, and, of course, that of the saccharine matter altered, is called by the brewers *attenuation*; and when they speak of the attenuation being carried far, they mean that the decomposition of the saccharine matter has been effected so much. The weight or specific gravity of wort is greater than that of water, just in proportion to the addition of the malt extract; hence the brewer has a mode of measuring this strength by means of an instrument called a *saccharometer*, and by the same instrument he can determine whether he has carried the fermentation as far as he ought, by ascertaining how much lighter it has become. This brings scientific brewing to a much greater degree of certainty than it could attain without the use of this instrument, which is now universally employed in this country by professed brewers.

But in private brewing a small difference in the strength of malt liquors is of less importance than in a manufactory, where a great part of the profits may turn upon it. Neither is it to be expected that this practice could be employed generally in domestic brewing; and therefore we have not introduced the description of the instrument.

3137. *Nothing positive can be said with respect to the length of time during which the fermentation of ale lasts*, because it varies considerably according to the heat of the weather, and the degree to which the wort has been cooled down. In ordinary domestic brewing it is generally completed in from twenty to twenty-four hours; but may sometimes require two or three days. In Scotland, in the great breweries, they ferment very slowly; for ten or twelve days, and even a fortnight or three weeks, which is considered by some as a good practice.

3138. *A small quantity of sugar is added to the malt* by some brewers when they consider the natural sugar of the malt not sufficient. This proves sometimes a useful addition, and serves to increase the strength of the liquor without the risk of running into the acetic state.

SUBSECT. 5.—*Cleansing and Barrelling.*

3139. *When the fermentation appears to have, in a great measure, subsided*, by not throwing up any more yeast, it will still go on for some time, but in a much more quiet and less obvious manner, a few bubbles of gas rising occasionally. The liquor cannot become quite clear so long as this is the case, since loose particles of the dregs, or subsided yeast, will continue to float about. There is still some fermentable matter remaining in the liquid; and the continuance of a languid fermentation would soon cause the ale to run into acidity if the wort were suffered to remain in the vat; the yeast which had risen to the surface would subside to the bottom, where part of it would be dissolved by the spirit of the beer, and it would communicate an unpleasant bitter, which is termed by the brewers *yeast bitter*.

3140. *A second fermentation is therefore necessary*, to get rid of the remaining fermentable matter; and this process is performed in casks or barrels, into which the new malt liquor is now transferred from the fermenting tun. This second slow fermentation is by the brewers termed *cleansing*, because the beer seems to be cleansed of much foul matter, which consists chiefly of mucilage and exhausted ferment, part of which subsides to the bottom, under the name of *dregs* or *lees*.

3141. *As the yeast works out of the casks*, it leaves, of course, a vacancy, which must be filled up daily by beer reserved from the fermenting tun; and when the discharge of froth has ceased, or nearly so, which will be in about a week, more or less, the bungs are to be put in, and well secured. A slight fermentation continues for some days in the closed cask; when this has ceased, the feculencies begin to subside, leaving the liquor quite bright and clear.

3142. Transferring liquor from one vessel to another, termed by the brewers *racking*, always forms a considerable check to fermentation, by getting rid of the sediment, or lees, which contains a great deal of the ferment. In this case, if the quantity of the liquor in the fermenting vat be so considerable as to fill several barrels, it is evident that the temperature will be reduced by its being divided into portions; and in cold weather this check is sometimes too considerable, since it is necessary that the fermentation shall still go on slowly in the barrels. When this is the case, brewers, a little before racking, *rouse* or stir up the yeast and wort, to revive the expiring fermentation, or even add a little yeast.

3143. *If all the previous processes have been well managed, the beer itself will absorb all the carbonic acid gas that is generated in the enclosed cask*, which will be retained by the drink from the mechanical pressure to which it is subjected; and this will constitute that appearance of briskness which beer should have when just drawn, a property owing to the sudden disengagement of the gas which has been pent up in the liquor. While remaining in this state, the barrels should occasionally be examined by opening the vent-peg a little, lest the gas should collect in too great a quantity, when the barrels might burst, an accident which has been known to happen.

3144. *In a few months ale is generally fit for use*, though some is kept for a whole year before it is drunk; and it continues to improve all that time, provided it has strength or body enough, and it is kept sufficiently cool to prevent its passing into the acetous fermentation. The slow fermentation is some security against this, since any change can be more easily watched.

3145. *It is essential that a certain portion of the saccharine matter shall remain unfermented*, that, by its slow fermentation while keeping, the liquor may be *fed*, as it is called; that is, supplied with slow and gradual additions of alcohol and of carbonic acid, to prevent that flatness and heaviness which would ensue from the loss of the latter principle. Should it happen that the beer appears to ferment too much after being barrelled, another racking may be found necessary. By repeated rackings the fermentative matter may be got rid of, and such beer at last become clear and transparent; it may, if bottled, remain for years without *coming up*, as it is technically called. The object of the brewer should be to produce an agreeable beverage, distinguished not so much for absolute strength, or quantity of alcohol, as for colour, flavour, transparency, liveliness, and power of keeping for a long time.

3146. *It is essential that the casks shall be kept well closed*, to prevent the escape of the fixed air that is formed, and the access of common air. We have stated that the slow fermentation in the casks is useful in forming continual small quantities of carbonic acid gas, and, as this is absorbed by the beer, the latter is always saturated with it; likewise, what little vacant space there may happen to be in the cask above the beer will be completely filled with the gas, even a little condensed, which will prevent more from being liberated, or even formed, because there is no space for it to expand in, on which account the slow vinous fermentation is long kept up, and so long as this does exist in any degree, the acetous cannot begin; but when the surface of the liquor is exposed to the common air, the carbonic acid flies off as soon as it is formed, and room is thus given for the formation of more; what remains, therefore, of the vinous fermentation to take place is soon finished, and then the acetous will begin; in other words, the liquor will turn sour. This effect may be easily perceived when a cask is tapped; for the beer, brisk at first, after a time gets flat, from the want of carbonic acid, and, if it is not all used quickly enough, what remains sours.

Bottling, the most perfect mode of preserving malt liquors, is, in fact, like putting the liquor into very small casks, where all the effects are exactly similar to those just described. See farther, on this subject, under "Bottling Beer," Sect. X.

Sect. IV.—PRACTICAL DIRECTIONS FOR BREWING.

3147. *Having now given a general view of those scientific principles upon which the art of brewing should be conducted*, we proceed to lay down such plain practical directions as are necessary to be attended to. We have already pointed out how much brewing requires the knowledge of its theory; but it would be difficult, perhaps impossible, to draw from the mere theory of an art the best modes of practice, since these have been the result of long experience, not by one only, but by various persons. The following practical directions have been drawn from the best sources; but we have already stated that no rules can be laid down that can serve as infallible guides in all cases; and hence we would recommend the attentive perusal of the previous section. But as there may be many persons who may wish to brew their own beer, without having leisure or inclination to pay so much attention to the theory as may be required, we have endeavoured to render this section as complete a guide as possible by itself.

Subsect. 1.—*Explanation of Technical Terms.*

3148. *In every trade there are some terms peculiar to it*, consisting of the names of parts of the apparatus used, or of particular operations. These terms, called *technical*, are frequently unintelligible to those not belonging to the trade, and throw a sort of mystery over the whole practice. This, which is, perhaps, in some degree unavoidable, impedes considerably the diffusion of knowledge by creating a kind of *cant* language, which is sometimes resorted to for the purpose of concealing the processes.

3149. *It is very desirable that these terms, often very unmeaning, should be employed as little as possible*; but in the mean time we propose to translate the brewer's into the ordinary language, or, in other words, to give an explanation of their technical expressions.

Liquor.—This is always the brewer's term for water—a word which he never uses.

Pale malt.—Malt which has been exposed to slight heat only in the kiln.

Amber malt.—Malt which has been exposed to a degree of heat somewhat greater.

Brown malt.—Malt which has been dried so much as to change the colour of the grain a little.

Patent malt.—Malt that has been roasted like coffee.

Slack-dried malt.—Malt which has been dried in the kiln less than usual.

Grist.—Malt that has been ground for mashing.

Goods.—The brewer's term for the ground malt in the mash-tub.

Mellowed malt.—That which has been exposed to the air for some time, and which, consequently, has imbibed some water hygrometrically, in contra-distinction to that which is fresh from the kiln.

Backs are large vessels of any kind intended to hold wort. The term is probably a corruption of the French *baque*, which signifies the same thing.

Liquor back.—The water cistern to supply the brewery.

Liquor copper.—Copper for heating water.

Wort copper.—Copper for boiling the wort and hops.

Mash tun, or *tub.*—Vessel for infusing the malt.

Mashing oars.—Sticks for stirring up the mash.

Mashing machines are used in great breweries for stirring the mash.

Tap-tree.—A wooden shaft for stopping the hole in the bottom of the mash-tub.

Setting tap.—Letting off the sweet wort.

Under back.—Vessel to receive the wort when let off from the mash-tub.

Hop back.—The first vessel for the wort to cool in, where the wort is drained from the hops. This is also sometimes called the *Jack back.*

Coolers.—Vessels to cool the wort in.

Gyle tun, the *fermenting tun*, or *fermenting tub.*—The vessel in which the fermentation is carried on. This is also called the *working tun*, and by the great brewers *squares*, from their form.

Pitching the wort.—Setting the wort to ferment; applied particularly to the degree of heat; as pitching at 75°.

Working.—Fermenting.

Stomach.—A strange cant term used by the workmen for the spirituous odour perceived in fermentation.

Sparging.—Sprinkling hot water on the grains, to obtain more wort after the first has been taken.

Stillions.—Vessels to receive the yeast that drains from the barrels; this name is also applied to the supports of the barrels.

Store vats.—Large vessels for keeping malt liquor to supply customers from.

Entire gyles.—When there is only one kind of beer from the same malt.

Party gyles.—A name used by the excise for making two kinds of beer from one malt.

A gyle of beer.—The whole quantity made at one brewing.

Blinked.—A species of acetification to which beer is liable.

Foxed.—When specks of white mould form in the wort as it is cooling.

Yeast-bitter.—When too much yeast has been used, and the beer is rendered too bitter.

Racking.—Transferring beer from one cask to another, to get rid of the lees or sediment.

Lengths.—A term used by the brewer to express the whole quantity of one kind of wort made from a certain quantity of malt.

Making up lengths.—Making up the whole quantity of beer of a certain strength.

Coming up.—Beginning to ferment again.

Cleansing.—The second, or slow fermentation that beer undergoes in barrels before it is finally put into the casks.

Rounds.—Large vessels like hogsheads, in which brewers transfer the porter from the fermenting vats, to undergo the slow fermentation previous to its being put into the store vats.

Attenuation is the conversion of the sugar of the malt into spirit, and the consequent reduction of the specific gravity of the fluid in the fermenting tub from this change.

Briskness of ale or beer is that state in which there is a quantity of carbonic acid compressed in it, which flies off when exposed to the air.

Flatness is the want of the last quality.

Heaviness seems to be the same thing, but with more alcohol.

Fretting means a slight fermentation, by which the beer becomes again turbid.

Feeding the beer is managing so that there shall be some saccharine left to cause a slight fermentation, which gives an addition of alcohol and carbonic acid.

Rousing.—Stirring up the beer so as to excite the fermentation.

Heat at which the tun is pitched.—The temperature at which the fermentation is begun.

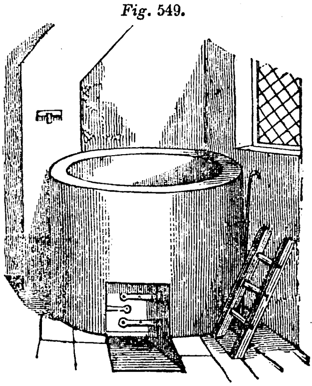
Return.—Water which has been put to the grains after all the wort has been run off, to be used for another brewing instead of water alone.

Subsect. 2.—*Description of the Vessels and Instruments used in Brewing.*

3150. There are certain vessels required in every brewery; but the exact kind will depend partly upon the opulence of those who brew, and partly upon the scale on which the operations are to be carried on. When economy is not so much an object as to have everything very complete, considerable ingenuity may be employed in fitting up the brewhouse, for which many hints may be obtained from the practice of professional brewers. In smaller establishments more simple apparatus will be found sufficient, and in many cases it may be an important consideration to reduce these to the greatest simplicity possible, and to show with how little expense and trouble brewing may be effected. The several modes have their particular advantages, and every individual must choose the style of the various implements which best suit his circumstances and convenience. In our description of the apparatus, we shall include the cheapest as well as the most complete kinds for private brewing.

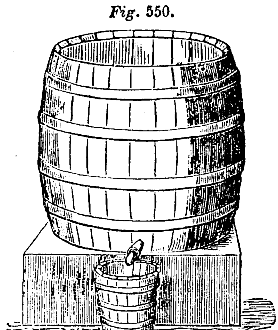
3151. *Copper.*—The water is heated in a copper fixed for the purpose, if the brewing be on a tolerable scale, or in a portable one if the brewing be very small; in short, the size of the copper must depend upon the extent of the establishment, and what is required. *Fig.* 549 is a copper set of the smallest kind. In the best arranged breweries, the copper and reservoir of water are placed at the upper part of the building, for the convenience of the liquids descending lower and lower, from one stage of the process to another, thus avoiding the labour of raising them up. But this great convenience, the advantage of which will be easily comprehended in following the various parts of the brewing processes, cannot always be obtained; and the mode of arranging the vessels must depend very much upon the situation. There is sometimes considerable difficulty in preventing the contents of the copper from burning, which, if it should happen, will give a disagreeable taste to the beer; an improvement has been employed in great breweries, of boiling by means of steam, which obviates this inconvenience.

Fig. 549.



3152. *The mash tub,* or *tun.*—This is the vessel which is to hold all the ground malt, or grist, and water enough to make the infusion of sweet wort for ale. It should be large enough to hold the whole of the wort of which the ale is made, and all the malt; there should likewise be room enough besides to mash in, which requires at least five or six inches in depth, that is, the liquor should not reach above five to six inches from the edge of the mash-tub. It is generally made of wooden staves fixed by hoops of iron or wood, *fig.* 550, or a porter barrel may be sawn in two to make this and the fermenting tub. All that is essentially necessary is to have a tub or other vessel capacious enough to hold the malt and water to be infused, with a contrivance at the bottom to let off the infusion, or sweet wort, into another vessel. For this purpose some have a cock fixed near the bottom; but in cheaper apparatus a spigot and faucet, *a b, fig.* 551, is found sufficient for those who cannot afford the other. This, in the common one, is merely driven tight into the hole in the lower part of the tun, and the peg takes out; but this simple contrivance has several defects which a cock is free from: the wood is apt to swell with the hot liquid, and then can scarcely be moved; also, in attempting to draw off the wort it will sometimes issue suddenly and scald the operator. An improvement is to have a screw cut upon the faucet, as at *d.* Sometimes, to keep back the grains, a basket, *e,* is placed within the mash-tub, into which the spigot and faucet is driven.

Fig. 550.



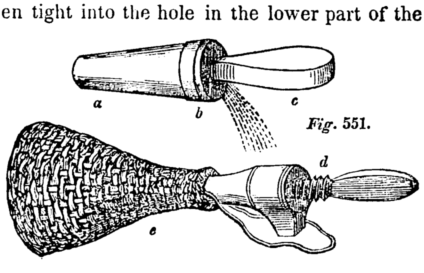


Fig. 551.

3153. *A simple and old method for the same purpose, used in many farmhouses,* is the following: In the middle of the bottom of the mash-tub, *a, fig.* 552, there is a conical hole, *b,* about two inches wide across, to draw the wort off through. Into this hole goes a stick called the *tap-tree, c,* a foot or two longer than the tub is high, and about two inches thick, and tapered for about eight inches upward at the end that goes into the hole, which at last it fills up as closely as a cork. Upon the hole, before anything else is put into the tub lay a little bundle of fine birch or heath, *d* (straw *may* do), about half the bulk of a birch broom, and well tied at both ends. This being laid over the hole, to keep back the grains as the wort goes out, put the

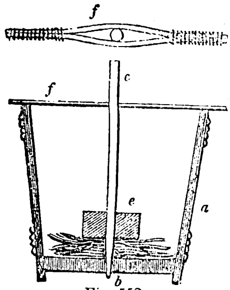
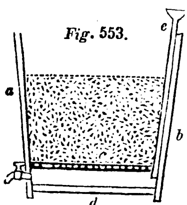


Fig. 552.

tapered end of the stick through the birch into the hole, and thus cork it up. To prevent the birch rising with the stick when you lift it up to let off the wort, a weight, *c*, must be placed upon the birch, and this is best done by making a leaden collar or ring, weighing three or four pounds, to slip over the stick, and slide down upon the birch. Some make shift with the iron box of a cart-wheel; but any contrivance will do that will prevent the birch from rising. To keep the stick at any height you may require, as you are drawing off the wort, the following method may be employed: Take a rod or branch of ash, hazel, or almost any wood; let it be a foot or two longer than your mashing-tub is wide over the top; split it down the middle, as for making hoops; tie it with a string at each end; lay it across the mashing-tub; pull it open in the middle, and let the upper part of the wort-stick come *through* it, as is represented at *f*. Now, when you raise that stick to let the wort off, let the split stick close upon it, and by its spring it will hold it up any height you wish; but this, though an old contrivance, is one which would scarcely be used if a spigot and faucet, with a wicker basket, which only cost eighteen pence, can be got; still, it is useful to know every resource. From this apparatus, brewers still term letting off the wort *setting tap*.

3154. Some recommend for a mash tun a vessel made in the following manner: A wooden vessel, *a b*, *fig.* 553, is provided with a double bottom, the uppermost one being pierced with holes. A pipe or trough, *e*, goes down from the top to the space between the two bottoms. The grist being put into the mash tun, water of the proper heat is poured into the pipe, and it descends into the space between *c* and *d*, and then ascends, by hydrostatic pressure, through the holes in the uppermost bottom, *c*, and, coming into contact with the grist, floats it, as the latter, when dry, is specifically lighter than water. In no great length of time the water begins to be absorbed by the malt, which then falls down. The use of the two bottoms is, that the wort may pass down into the space between them, and be drawn off clear, and the water is introduced below the malt, instead of the top, to avoid pressing the malt into the holes of the double bottom, and thus choking them up. The mashing tun is, in general, a little wider at top than at the bottom, though some prefer the contrary, that is, widest at the bottom, to prevent the grist from being compressed: it need not be quite so deep as it is wide across. The holes in the false bottom, if in wood, should be burned with a hot iron, and not bored, and should be a little conical, that is, wider below than above. The diameter of the holes at the upper part should not be above an eighth of an inch.

Fig. 553.


3155. As it is sometimes the case that a quantity of the grains of malt will get through the holes in the false bottom, which are difficult to get out, except this bottom be loose, some prefer the following contrivance: Four pieces of wood bored full of holes are nailed together in the form of an obtuse wedge, *fig.* 554, and this is placed over the hole by which the mash is drawn off. This simple apparatus stops the grains from passing out as effectually as a double bottom, and as it is merely put down loose, the difficulty just mentioned is obviated. It is necessary to state that this perforated wood must be fixed by a hook and eye, bolt, or some such contrivance, to prevent its floating. Its size must be proportioned to the quantity of the mash.

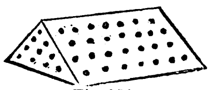
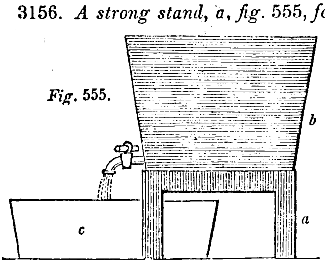


Fig. 554.

3156. *A strong stand, a, fig.* 555, *for the mash tun, b,* if large, is necessary: two stools may do for a small brewing. The stand should be high enough to admit of a tub standing under the mashing tun to receive the wort; but it should not be too high, or it will increase the labour of lifting up the water.

Fig. 555.


3157. *A shallow tub, called an under-back, c, fig.* 555, is placed below the mashing tun for the wort to run off into when drawn from the grains. Its size is proportioned to that of the mashing tun. It is best to be large enough to hold all the wort of one mashing, that the wort may not be cooled by being transferred into other vessels previous to boiling. But some make shift with it of smaller size, and collect the wort into the fermenting vat, until it can be boiled. In small brewings a good sized washing-tub will do very well.

3158. *A mash stirrer, fig.* 556, is a stick rather larger and stronger than a broomstick, with two or three small pieces of wood, eight or ten inches long, put through the lower end of it and sticking out on each side. Three or four sticks, of the size of broomsticks, may be also useful occasionally in stirring.

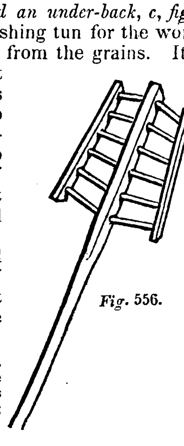


Fig. 556.

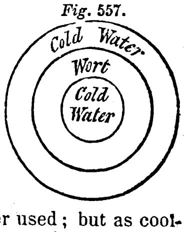
The size of the mash-tub must depend in some degree upon the mode of brewing. If one kind of beer be intended to be made at three mashes, for every firkin, or nine gallons of beer, the mash-tub should contain fifteen gallons. Thus, if two firkins of either ale or table beer be required, then the mash-tub must hold thirty gallons; and if one firkin of ale and two of table beer be wanted, the mash-tub must be of the same size. But if the brewing is proposed to be done with only two mashings, employing a larger quantity of water in the second mash, then the capacity of the mash-tub must be eighteen gallons. From these data, any one desirous of brewing may easily fix upon the size of the mash-tub when they have determined upon the quantity they intend to brew at one time. This and all the other vessels may be furnished by the cooper.

3159. An economical mode of procuring vessels for a small brewing is the following: One of the largest sized casks sold at the wine merchants may be procured; then cut off the two ends about a foot deep, which will serve for coolers; and a bottom may be put to the middle piece to serve as a mashing tub, or a porter barrel may be sawn in two to make a mashing tub and fermenting tub. It is important that the heat should be prevented from escaping from the mash-tun, and it should therefore be kept covered with thick woollen cloths, or some lid of a non-conducting kind.

3160. *Coolers* are flat tubs, trays, or other vessels for the purpose of cooling the wort before it is fermented. In small brewings, common washing-tubs will do tolerably well. Since the quicker this operation is performed the better, there ought to be sufficient provision made of these before the brewing commences, that as much surface may be obtained as possible: the fermenting tun may serve for one.

3161. In considerable breweries the coolers consist of shallow cisterns made of boards well jointed, with sides raised about ten inches all round; and the wort is put into these only about two inches in depth; several of these are placed at some distance above each other; often in the upper part of the building the sides are constructed with boards placed in the manner of a Venetian blind, so that the air has a free passage through the building. In some cases, where there is a great command of water, they make the wort traverse a pipe bent or twisted in form of a distiller's worm, or in any other convenient mode, which is placed in a cistern of cold water. In one brewery they have long used an apparatus consisting of three concentric cylinders, *fig.* 557; a stream of cold water, pumped up from a well, passes through the inner one, and also between the two outer ones; the intermediate cylinder conveys the wort, which, being every way surrounded by cold water, is soon cooled without being exposed to the air.

Fig. 557.



In domestic brewing such ingenious methods are seldom or never used; but as cooling the wort is often a matter of considerable difficulty where the space is limited, it is a proper subject for the exercise of invention. The ordinary method is to get together all the large shallow tubs or other vessels that are at hand; but in private brewhouses of a superior kind shallow fixed cisterns are used.

3162. *Care should be taken that the coolers, and, indeed, all the vessels employed in brewing, are perfectly clean,* as the least acidity or mouldiness remaining from a former brewing is almost sure to inoculate the wort and spoil the beer. To ensure this, merely washing them with hot water is not always sufficient, particularly if they have lain by without being used for any length of time. It will then be necessary to employ some substance that will neutralize and destroy any acid matter that may remain, such as potash, soda, or lime.

3163. *The fermenting or working tun,* or *vat,* in which the ale is fermented or worked, the brewers often call the *gyle tun.* In a complete brewhouse, this is a large tub kept on purpose. In brewing on a small scale, any tub will do that is clean, strong, and large enough to hold ale, and have room to spare for the head of yeast. A cask deprived of its head may sometimes serve as a fermenting tun for the ale, and the small beer may be fermented in the mash-tub.

In brewing on a great scale, it is supposed that the loss of a certain quantity of alcohol which escapes with the carbonic acid during the fermentation is an object worth attending to, and contrivances have been invented for fermenting in closed vessels to prevent it, and even for preserving the alcohol that would be lost. We may just mention that the fact of the evaporation of the alcohol is proved by hanging grapes in the gas as it escaped from the fermenting tun, by which they acquired the taste of alcohol as if they had been preserved in brandy; and it has been demonstrated that closed vessels afforded worts somewhat stronger than open ones; but, in private brewing, this loss from fermenting in open vessels must be so inconsiderable, that it cannot be worth while to do anything more than to cover the fermenting tub with cloths.

3164. *A hair sieve,* or *a wicker basket,* through which to strain the beer from the hops, must be provided.

3165. *A light pail or two* should be kept for brewing only, that they may be perfectly clean; also a wooden bowl with a handle, to carry liquor from one vessel to another.

3166. *A tun bowl,* or *large funnel,* through which to put the liquor into the barrels, is necessary.

3167. *The casks for containing the beer* must be of a size suitable to that of the family. The longer the beer is to be kept the larger the casks should be, as it thus acquires strength; but where a family is small the casks ought not to be large, as they would be so long in tap that the beer would become flat. Casks or barrels holding eighteen gallons are most convenient in general. Each cask must be well fitted with a bung, vent-peg, &c. These casks should be kept very clean, and, though they may be cleaned by good rinsing if not very foul, the only perfect mode is by taking out the heads, so that they can be well scoured with a birch broom to remove a slimy matter which forms, and which rinsing alone will not remove. This is generally done by the cooper, but any one may soon learn to do it.

The iron hoops of casks should be kept painted, to preserve them from rusting. Immediately after they are empty, the vent-peg should be fastened down, and the tap-hole stopped with a cork well fitted and hammered in, to prevent the access of air, which would soon cause the mouldiness to grow, and spoil the beer, not only of one brewing, but probably of several successive ones.

3168. *Thermometer.*—This instrument is found of great service to the brewer, and should always be employed where accuracy is required. It will be found particularly useful to those who have not had much experience in brewing, and who are unacquainted with many signs and symptoms which the practised brewer avails himself of. By it the proper heat of the mash is regulated, and of the worts when drawn from the mash tun. It points out when the worts in the coolers are of the proper temperature to begin the fermentation; and it marks the progress of this process by the increase or diminution of the heat. For this purpose there are thermometers of great length, to allow of their going through the head of yeast into the wort, while the necessary part of the scale is above the froth.

Subsect. 3.—*Construction of the Brewhouse.*

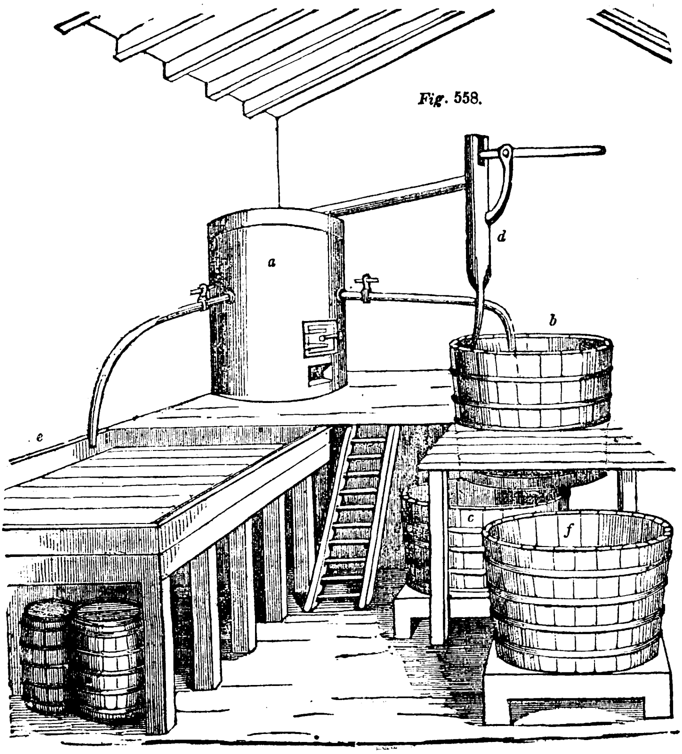
3169. *In small establishments,* if brewing is performed at home, the washhouse is frequently also the brewhouse; but, where it can be afforded, it is much better to have the brewhouse a separate building.

3170. *The complete mode of arranging a brewhouse* is to have all the parts so disposed that the liquor should not be carried from one place to another; but it should flow through pipes by descent in the various stages of the processes, so as to occasion as little trouble as possible. With this view, the water cistern should be in the highest part of the building, and below should be the copper; then, in a descending order, the other vessels, until at last the beer runs into the casks in the cellar. Beer may be conveyed to any distance by leathern pipes with screw joints.

3171. *The situation for the brewhouse* should be airy, and detached from the house. There should be a plentiful supply of water, soft if possible. It is desirable to separate the place for boiling and mashing from that for cooling and fermenting, to prevent the heat of the boiling from affecting the cooling. A yard is best for cooling, or an open shed. The mash tun and under-back are best above ground; it is a bad way to have the latter sunk below. The coolers should be large, and should communicate with each other. Fans or refrigerants are useful for driving off the steam and cooling the wort: this will also protect it from foxiness, which stillness is apt to promote. The fermenting tun should be insulated, and not touch the wall or ground.

3172. *In the great breweries,* the various apparatus for brewing are ingeniously contrived, and disposed in a very convenient manner for operations on a great scale; but, few of these being applicable to domestic brewing, we omit entering into any description of them as foreign to the object of this work; recommending, however, a visit to one of these establishments by those who are desirous of acquiring an enlarged and comprehensive idea of this manufacture.

Fig. 558.



3173. *The arrangement of a private brewery* is not unfrequently as in *fig.* 558. *a* is the copper, supplied with water from a cistern above; *b* is the mash tun, served with water from the copper by a pipe; *c* is the under-back, from which the sweet wort is pumped up by the pipe *d* into the copper, to be boiled with hops: from thence it is run into the cooler *e*, which, when the brewery is considerable, is made of boards, and is raised upon strong supports. When of the proper temperature, the wort is sent into the fermenting tun, *f*, by means of a temporary trough placed from the cooler. After the fermentation is over, the beer is drawn off into casks or barrels, and put into the cellar.

Subsect. 4.—*On purchasing the Materials for Brewing, and the Quantities required.*

3174. The general nature of the several materials necessary for brewing malt liquor, namely, malt, hops, yeast, and water, have been already described. A few words may be useful on the mode of procuring them.

3175. *Malt.*—As much of the quality of the beer must depend upon that of the malt, the safest plan is to go to a respectable dealer, on whose judgment and integrity confidence can be placed.

For the character of good malt we refer the reader to what has been said on the subject in Section V. It is best to buy it unground, and to grind it at home, as then it will be certain not to be adulterated. It is cheapest in the end to purchase the best malt; for, setting aside the risk of having the brewing fail through bad materials, the quality of the beer will be of more consequence than any saving in the malt.

3176. *The quantity of malt* must, of course, be proportioned to the strength of the beer required to be made. The average strength is such that a bushel of malt will give twelve gallons; and this may be taken as the most useful proportion in general, and the one generally employed in domestic brewing, for common ale not intended for long keeping.

Brewers reckon that one measure of ordinary ale is equal to two of table beer; therefore, from one bushel of malt may be brewed twenty-four gallons of table beer, supposing no ale to be made; or nine gallons of ale, and six of table beer, or six gallons of ale, and twelve of table beer, or any other proportion of these two kinds of beer, so that half the number expressing the table beer added to that expressing the ale shall make twelve gallons.

In private families, strong ale is sometimes made, as much as a bushel and a half to twelve gallons. If ale be intended for long keeping, it will be requisite to allow more than a bushel of malt to twelve gallons. If weaker ale be thought sufficient, less malt, perhaps three quarters of a bushel, may do. Taking these proportions as standards, every one may choose that proportion which best suits his taste and his means. In private brewing the table beer is generally made from the malt after the ale has been extracted from it.

3177. *It is to be understood that the malt is to be measured before it is ground,* because a bushel of malt produces, when coarsely ground, one bushel and a quarter of *grist*, and when ground fine the increase of bulk is more considerable. If the malt be purchased in a ground state, allowance must be made accordingly.

3178. *Hops.*—The same observations which were made on malt will also apply to this ingredient. The best is the cheapest.

3179. *With respect to the quantity of hops,* this must depend upon several circumstances: upon the kind of malt liquor to be made, the quality of the hops, the length of time the beer is to be kept, and partly upon the season of the year when it is brewed. One pound of hops to a bushel of malt is the usual proportion for ale that is to be kept; that is the proportion used in the Edinburgh ale. The stronger the ale, the more hops it will bear, and if the ale is to be kept long, it may require a little more. Much here must depend upon the taste of those who drink the liquor. In England it is the custom to use rather more hops than in Scotland: Edinburgh ales have the least. For weak ales, a pound of hops to a bushel and a half of malt may be used, or ten ounces of hops to a bushel of malt; and this may do if the ale or beer is intended for present use, and is not to be kept long. Ale brewed in warm weather may require from a pound to a pound and a quarter of hops to a bushel of malt; in cool weather, three quarters of a pound will generally do. It seems to be the fashion at present to have beer for the table much hopped, and very bitter; for this, of course, the proportion of hops must be increased.

3180. *Hops vary much in price,* according to the kind, the season, and the abundance of the crops. Hops may be grown by private individuals; but before picking, drying, &c., a duty to the excise must be paid of 1¾*d.* per pound; the using of unexcised hops renders any one liable to a penalty of 50*l.*

Subsect. 5.—*Particular Detail of the Process of Brewing.*

3181. Method and regularity is of great importance in conducting every kind of business, but is particularly so in brewing; for as the principal operations are begun and finished within the course of a short period, any neglect or hinderance is very likely to be the cause of marring, if not of spoiling entirely, the whole.

3182. *Before beginning to brew, everything necessary should be properly prepared*, and a great deal should be done on the day before the actual brewing commences: the materials should be quite at hand; the various vessels be in a proper state to be used, and should be placed in proper order; the copper should be filled, and the coals provided for the fire.

3183. *On the day for brewing*, the copper fire is to be lighted early in the morning, and while the water is heating, tubs may be filled with cold water ready to pour into the copper for the second mash. When the water boils, it is to be poured into the mash-tub, and the copper should be filled again. The nature of mashing has been fully described, Sect. III., Subsect 1; and the quantity of water employed in the several mashes must depend upon the proposed strength of the several kinds of beer to be made; but in the *first* mash, an allowance must be made for the quantity of water which the malt will absorb and retain, and so much must be poured upon the malt, over and above that of the wort required, to make up for this. Well-made malt absorbs and retains water in the proportion of six gallons for every bushel of malt; therefore, whatever be the required quantity of the first wort, water more than this, in the proportion just mentioned, must be made use of. Besides this water absorbed by the malt, something will be lost by evaporation in boiling, cooling, and fermenting, the whole of which together will amount to about one fifth of the quantity of beer required to be made. Suppose, for instance, that fifty-four gallons of beer were required to be made from four bushels of malt, then twenty-four gallons of water will be absorbed, and eleven gallons more must be allowed for waste; that is, twenty-four and eleven, or thirty-five gallons extra of water must be used above the fifty-four gallons. This quantity of water may be divided between the two mashes, according to the strength required for each.

3184. *The best method of ascertaining the proper temperature is by using a thermometer;* the heat of the water should depend in some degree upon the nature of the malt, and likewise upon various circumstances which have been already explained under the head "Principles of Brewing," Sect. III.; and it is impossible to fix upon any absolute degree of heat that should be constantly employed, different brewers varying in their practice several degrees from each other. 170° by the thermometer is that which is most generally recommended for the heat of the first mash, when pale malt for ale is to be brewed. Some brewers use a higher degree of heat, 175°, or even 180°.

3185. *When a thermometer is not to be had*, or where persons are not in the habit of using it (although this is very easily learned), the method employed by some to ascertain the right heat of the water is as follows; and, although this mode is far from being accurate, yet it is much better than none: Put the water into the mash-tub nearly boiling, and wait till the steam has gone so much off that you can see your face clearly in the water, or else draw your finger quickly through the water; and if you can do so without scalding it, the heat is right. It is very obvious that neither of these methods can be very exact; but much good ale and beer has been brewed in this manner by those who have had experience. Beginners should use a thermometer.

3186. *Another method may assist in getting a proper heat:* Mix two gallons of boiling water with one gallon of cold water, that is, water of the heat it is usually of in moderate weather, the mixture will be about 170° of the thermometer. It must be observed that 170° is the heat that the water is required to be of when the malt is added; but as the water will be cooled a little by the mash-tun, it may be run in a few degrees above this, to allow for cooling down to that point.

3187. *It is best not to put the full quantity of water into the mash-tub at first*, but only so much as will serve to wet the malt or grist thoroughly, and make a thick mash. The malt should be shaken in quickly, and a second person should stir it about well with the mashing oar or stick described above. The malt must be thoroughly broken and mixed, so that there are no clots or lumps, on the same principle as in making paste.

In this state the mash may remain for a few minutes, and, in the mean time, having got ready more water of the proper heat, the mash-tub should be filled up to the proper height by adding the remainder of the water by degrees, according to the quantity of the ale intended to be made, stirring all the while, and mixing the whole well with the oars for twenty minutes or half an hour, according to the quantity of the malt. Some sticks should then be laid over the mash-tub, which should be covered with cloths, sacks, blankets, or old carpets, to keep in the heat, and the whole suffered to remain quiet for about an hour and a half.

3188. *When it has remained so as long as is considered necessary*, the sweet or ale wort should be drawn off. For this purpose, the cock or spigot should be opened, a very little at first, to see if the wort runs clear. This must be done with caution, letting the wort run with a small stream, lest some of the grains or floury matter should come with the wort. The first gallon or so that is drawn should not be suffered to go into the under-back, but should be put into a bucket, and if it is not quite clear, it should be returned gently into the mashing-tub, and a little more time allowed, till, by several trials, the wort is found to come clear: the cock or spigot may then be opened, and the whole run off into the under-back. If the heat of the liquor has been managed judiciously, with respect to the quality of the malt, the wort will run perfectly clear. If it does not part freely from the malt, the heat has been much too high, and the malt has been subject, more or less, to the accident of *setting*, which is carefully to be avoided, since this is irremediable, and the brewing runs great risk of being totally spoiled The wort should be about the temperature of from 140° to 150° when it runs into the under-back. While the wort has been mashing and running off, as much water must be boiled in the copper as is sufficient for the second mash, scalding the casks, &c.

As the ale wort is drawn off into the under-back, it should be laded into the fermenting tub, by means of the bowl with a handle, to be ready for the boiling, if the under-back is not large enough to hold the whole of the wort; but if there is a second copper, it should be transferred into it immediately, which is the best practice.

The water that has been heating in the copper is now to be poured upon the grains for the second mash, for table beer. But to prevent confusion in our account, we will leave the second mash for the present, and follow up the process of managing the wort that is to be made into ale, and when we have got that into the cellar, we will then return to the second mash and the preparation of the table beer.

3189. *The next process in brewing, after making the first mash, is boiling the sweet or ale wort with hops.* In our "Principles of Brewing," we have shown that the chief use of the hops is to coagulate the mucilage of the wort, and to communicate an agreeable aromatic bitter to the liquor.

If there is only one copper, as soon as it has been emptied of the water that was boiled in it for the mash, the fire should be damped to prevent burning the copper, and a little water should be left in the boiler to cover the bottom.

The ale wort is next to be put into the copper, and with it the proper quantity of hops, well rubbed, and separated, or previously steeped in water; and great attention must be paid to the boiling, to prevent the liquor boiling up suddenly. The hops must be kept down with the mash stirrer, and be well broken, and at last they will subside to the bottom; but care must be taken lest the latter should stick to the bottom of the copper, which would cause them to burn to, and infallibly occasion an unpleasant taste.

No certain rules can be given for the time the boiling is to continue before the coagulation may be expected, as that will depend upon the strength of the wort, and of the hops. Strong worts will generally require from half an hour to three quarters, and weaker ones from two hours to two hours and a half. The coagulation, called *breaking*, is observed first by the liquor becoming clouded with large fleecy flakes which appear swimming about in it. When the boiling has continued for some time, it is necessary to take out a small quantity of the wort from time to time in a convenient vessel (a large glass is best); the liquor will at first appear foul and turbid, from the flakes or curdy substances. A great part of this, being heavier than the wort, will subside. When no more subsidence takes place, and the wort is clear, it is a proof that it is sufficiently boiled; and there is no advantage in continuing the boiling longer, except the wort be found too weak, and it is thought necessary to evaporate some of the water, a circumstance which it is desirable should not be necessary, since that will dissipate the aroma and fine flavour of the hop; and, indeed, this is seldom required, except when a mistake in the quantity of the water is to be rectified.

3190. *When the time for boiling has expired,* the wort must be carried to the coolers. But first it must be strained from the hops. In large breweries this is done by passing the wort into a vessel with a perforated bottom, called the *hop-back;* on a small scale, a portable strainer or wicker basket will do.

3191. *The coolers ought to be in sufficient number,* and may be placed within doors or without, in the open air, as may be convenient; a couple of sticks may be laid across one of the coolers, and the basket put upon them; then the liquor, hops and all, may be put into the basket, which will keep back the hops; the liquor should be of the same depth in all the coolers, otherwise the wort would cool unequally.

It is most convenient to have the coolers below the level of the copper, that the wort may run into them by a pipe, or an open shoot; but, if it is not convenient to have the coolers low enough, the wort may be pumped up into them, or may be carried to them in pails.

3192. *The quicker the wort is cooled the better,* which makes it very difficult to brew in warm weather; and it is very important to cool down exactly to a certain degree, since much of the success of the fermentation or working will depend upon the heat of the wort when it is put into the fermenting tun. The heat usually cooled down to is 70°, which is best ascertained by a thermometer; but those who brew without this instrument determine the heat by putting the finger into the wort. It should feel just warm, *gently lukewarm*, or as milk just drawn from the cow. It may be well to observe that the liquor will cool a little in removing it into the fermenting tun. If the wort be cooled too slowly, it is apt to contract *foxiness*, a mouldiness appearing upon the surface that gives a bad taste to the beer, which, in warm weather, is very liable, in this stage of the process, to turn sour.

3193. *When the wort is sufficiently cooled, it is put into the fermenting tun,* and now is the time to add the yeast, to excite the fermentation.

3194. *The quantity of good solid yeast to be used* should be proportioned, not only to that of the wort, but also to the heat of the weather, and of the fermenting liquor (see "Principles of Brewing"). One quart of good, stiff, fresh yeast may be used for forty gallons of good strong beer or ale wort; and one pint and a half to the same number of gallons of small beer wort. In larger or smaller quantities, the yeast may be in proportion. If the weather be cold, rather more than the quantity just mentioned may be applied; and in hot weather it will be prudent to diminish the quantity, lest the fermentation should be too rapid. If the heat of the fermentation be about 70°, one pound and a half, or one pound and three quarters of yeast per barrel may be sufficient. If the heat be about 60°, then two pounds, or two pounds and a half of yeast will be required, the quantity being increased with the lowness of the heat. The danger is the least of employing a little too much yeast; imperfect fermentation is worse. It is of great importance to have the yeast good and fresh; if it be at all tainted, it will ruin the whole brewing.

3195. *It is a good practice to set the yeast to ferment, a little before it is wanted,* in a bowl or pail, by adding to it a portion of lukewarm wort, and stirring them together, putting in more wort as the fermentation proceeds. When this mixture is decidedly in a state of fermentation, it is to be poured into the liquid to be fermented, and incorporated well with it by stirring.

3196. *The degree of heat in the wort at the time the yeast is put in* is very important to be attended to. This may be from 60° to 65° or 70° in temperate weather; but the exact degree must depend partly upon circumstances; and as the heat of the fermentation will increase after a little time, allowance must be made for this. In general, in the small way, it is safest not to have the heat too low; about 65° may be a good medium heat.

It is desirable that the place where the fermentation is carried on should be of the right temperature; if the air should be about 55° it will be proper; any cool place in summer, and any warmish place in winter. If the weather be very cold, it will be useful to surround the fermenting tub with sacks or other cloths, or to have a fire in the room. This is the more necessary, as small quantities do not maintain their heat so well as large; and one of the chief difficulties in a small brewery is the keeping up a proper heat in the fermenting tub while the fermentation is going on. When the yeast and the wort have been properly mixed together, sticks must be laid across the fermenting tub, and sacks or thick cloths laid over it, and then it must be left for some time.

3197. *The fermentation having fairly commenced is denoted* by the appearance of very small air bubbles, which in a few hours will increase and put on the appearance described in Chap. III., Sect. III., Subsect. 4. This is one of the most critical periods in brewing, and the fermentation requires very constant attention. The frothy head of yeast will keep rising more or less slowly for about forty-eight hours; but the length of time for the working cannot be precisely fixed, as it varies with circumstances. When the head of yeast has risen considerably, and assumed a uniform appearance, it will begin to sink, and then it is proper to skim it off. This skimming should be repeated every few hours, otherwise, if brownish curdy matter, which is now seen upon the yeast, and which is the intense bitter of the hop, is suffered to fall back into the beer, it will give a bitterness and rankness of flavour which the brewers call *yeast-bitter*, and it will be difficult to get the beer bright at last. The yeast collected by skimming should be put into a larger vessel than is necessary to hold it at first, as it will swell a little; it will contain a quantity of beer, which will separate from it by suffering the mixture to stand for a day or two; this beer may be added to what has been fermented, and the yeast may be kept for another brewing, and for baking.

It has been stated that the heat of the fermentation regularly increases while it is going on; at first very slowly, but at last more rapidly before it declines. While the heat continues to increase, which can be ascertained by the thermometer, we may be certain that the vinous fermentation is not over; but when the heat no longer increases, the fermentation is probably complete, and then the smell of the ale may be perceived. When the fermentation is at its height, on holding the nose below the edge of the fermenting tub, the fixed air disengaged will strike extremely sharp, so as to sting the nostrils; but at the close of the fermentation the strength of the gas diminishes considerably, so as to feel only just warm in the nostrils. The ale will then be found to have acquired its proper taste and smell; the head of yeast will be uniform and compact; and there should be no sweet taste. Should the fermentation not go on so well as could be wished, the reader must refer to the article "Fermentation," Sect. III., under "Principles of Brewing," with a view to discover the cause and the remedy.

3198. *It is an essential point to know the precise time when the fermentation has been carried far enough,* but no general rule can be given that will apply in all instances; it must vary according to circumstances, and here experience is necessary. Attention is to be paid to the head of yeast. This, when the fermentation is brisk, begins to turn speedily of a brown colour and compact consistence, so that it would fall back into the beer; at that period the fermentation is nearly complete. If the beer is intended to be what is called *hard*, the fermentation must be continued the longer; but if the beer is wanted to be *brisk*, the fermentation is stopped the sooner.

3199. Particulars of this kind steadily kept in view, with a little practice, and ordinary powers of observation, will enable any one to brew; but, after all the directions that can be given, a certain degree of practice with skilful persons is necessary.

3200. *Some allow the fermentation to go on a little longer than others;* but it must not be completed in the fermenting tun, otherwise the beer would soon be quite flat and sour. When it sends up very few air bubbles, but before it has quite ceased working, the liquor, now beer, is to be transferred into casks where the fermentation is finished. The fermenting tub may be uncovered for an hour or two before the beer is transferred to the casks, or *tunnel*, as it is called. The beer may be run off by the cock, when the yeast will remain behind; or the yeast may be removed from the top with a large flat skimmer or ladle with holes. Great care should be taken that none of the yeast finds its way into the casks, which would endanger a fresh fermentation more considerable than is required.

3201. *The fermentation is now to be completed by the slow process* in casks, called by the brewers *cleansing*, when a great deal of yeast and sediment works out of the casks that otherwise would prevent the beer from keeping. The casks or barrels, which are supposed to have been perfectly well cleaned, are placed upon low stands about a foot high, called *stillions*, with their bungs leaning a little on one side. They are filled from the fermenting tub by means of a funnel; and in general the beer is suffered to be quite cold before this is done. The casks are placed in the cellar, into which the beer may be brought down in buckets, or sent down by a pipe, and they may be kept leaning on their stands by means of wedges or pieces of brick, so that the wort that works out may run into pans placed below. It is essential to the cleansing, that the casks should be kept always quite full, otherwise the yeast will not run off, and then the beer will not be transparent. To effect this, every day, as the yeast works out, they are filled up again by some beer which was reserved for this purpose from the fermenting vat. When the casks are filled up, a few strokes with a mallet on the hoops will cause some bubbles of air to escape, and leave room for a little more beer to be added.

This cleansing of the beer may take a week or a fortnight; and what beer has run out, after being separated from the yeast, may be returned into the cask again. The pans placed to receive the yeast should be cleaned daily. If the beer works briskly, the filling up of the casks should be done every two or three hours at least for the first ten or fifteen hours; after that term, the slow fermentation will probably, in some degree, subside, and they need not be filled up so often.

3202. *When this second fermentation is over, and no more yeast works out, the casks must be righted*, or placed with their bung-holes at top, and secured in this situation by blocks. If the fermentation, instead of being as slow as is proper, is too considerable, it is sometimes found necessary to rack off the ale into other casks; but this is not favourable to its preservation.

3203. *The casks are now to be bunged up close.* A bit of linen is put round the bung, and it is hammered in tight; the vent pegs are also to be put in, but they should be opened occasionally for a few minutes to allow the gas to escape; for though a certain portion of this is essential to the briskness of the beer, yet too much will prevent its fining. The beer now remaining still, the impurities will subside, and if the brewing has been properly performed, nothing more is necessary, and the ale or beer will become clear in about fourteen days without any other attention. Some persons recommend putting a handful of hops into each cask with the beer before it is bunged down; and it is said that they will communicate their fine aromatic flavour more than those that are boiled with the wort. There is, however, some danger by this practice that the hops may stop up the cock, except some precaution is taken to prevent it. The best method probably is to suspend them in some sort of netting.

3204. *It is not advisable to bung up the casks before this slow fermentation is quite finished;* for, if this be done, the beer is liable to fret and turn sour. So long as there is a head of yeast in the bung-hole there is no danger of the beer becoming flat, since the carbonic acid gas in the cask will effectually keep out the common air. To ascertain when this second fermentation is quite over, and the cask ready to be bunged up, clear away with the finger all the yeast inside the cask round the bung-hole as far as can be reached, and then lay a piece of thick brown paper over the bung-hole, and press it down, so that it adheres by means of the clammy yeast. Look at this in a few days, and if the paper is burst, or is wet, it is a proof that some air has yet to be disengaged, and that the fermentation is not quite over. When this does not happen, the beer is ready. As to the length of time the ale or beer is to be kept before it is to be used, that must depend, in a great measure, upon taste.

3205. *Mode of proceeding with the second mash, or the brewing of the table beer.*—In describing the operation of mashing, we stated that, as soon as the water of the first heating in the copper was poured upon the first mash, more water was put to boil for the second mash to make the table beer. The quantity of this water will, of course, depend upon that of the beer to be brewed. The heat of the water is made about 5° greater than that of the first mash, in order to extract as much soluble matter as possible, the risk of *setting* being now, in a great measure, over. This mash must be stirred with the oars for about half an hour, and it should stand an hour and a half. A sample of the wort should then be taken; the wort is then suffered to run out till it cease, or nearly so. As soon as the copper is empty again (the ale wort that was in it having been put into the coolers), the small-beer wort is to be put into the copper with the hops from which the ale wort has been drained, and some persons here add a little fresh hops; this liquor is now to be boiled for an hour. In the mean time the mash-tub should have been cleared of the grains, and the basket may be placed on some sticks laid across the mash-tub; the small-beer wort from the copper should be poured into it through the basket. When sufficiently cool, it must be set to ferment in the same manner as ale, but using a larger proportion of yeast; this should be in the proportion of three half pints to thirty-six gallons of small beer. The rest of the management of the table beer is the same as that of the ale, only it should be put into the casks a little warm, otherwise it will not work in them as it ought to do. The table beer will not ferment so strongly as the ale, nor so long, and may be put into the cask much sooner—in general, the next day after it is brewed, and it will be ready to tap in a few days.

3206. *Mixing the worts of different mashes.*—If one kind of malt liquor only be wanted, the different mashes, whether two or three, are mixed together, and the strength of the mixture determines that of the malt liquor. If more than one degree of strength be required, then the produce of the several mashes are kept separate for each sort, or they may be mixed so as to proportion the strengths in any manner that may be desired. The usual practice in private families is to make the ale from the first mash, and the small beer from the second, or, perhaps, the first and second mashes are made into ale, and the third into small beer; or the first into strong ale, the second into table ale, and the third into small beer. In large breweries, the mixing of worts to make up a desired strength is a matter of nice calculation, in which the saccharometer is of essential use.

3207. *If there were as many coppers as mashes,* the wort from each mash could be boiled in a separate copper as soon as it was made, and kept at the proper temperature till they could be mixed; but when there is only one copper, as is usually the case in the small way, the produce of the first mash is obliged to be kept for some time in the under-back, or some other vessel, because the copper is employed in heating water for the second mash; and although this vessel is covered up and kept as warm as possible, yet there is a risk of the sweet wort remaining so long as to lose much of its heat, and, in consequence, of its beginning to change by a slight kind of acetification, which will be very injurious to the beer, and it is then said to be *blinked.* Two coppers would obviously prevent this accident. Blinking is also produced sometimes by the mash being suffered to remain so long as to cool too much before it is drawn off, or by the heat not being sufficiently high at first. To regulate all this exactly, a thermometer is extremely useful. To keep up the heat in the under-back, where the wort remains for some time, a worm with steam might be made to pass through it, the condensation of the steam supplying heat to the wort. A common tea-kettle, properly fitted up, would furnish steam sufficient for this purpose.

3208. *On taking a review of the processes just described,* and the multiplicity of circumstances to be attended to, it is easy to see that brewing is an operation that requires considerable skill and dexterity to manage it with complete success. The goodness of the beer will depend upon the quality of the malt and hops; on the degree of heat and length of time employed in mashing; on the mode of boiling the wort; on the proper management of the fermentation; on the precaution used in tunning, &c.; in short, every part of the process requires nice attention to the proper manner of performing it to prevent failure. Many of the difficulties can only be overcome completely by practice and personal experience; but these, as we have observed, may be considerably diminished by attention to rules drawn from the experience of others, and by studying the theoretical principles of the art: the knowledge thus acquired constitutes what is denoted by the term *skill.*

3209. *Professional brewers always keep a journal,* in which they enter regularly every circumstance respecting each brewing, such as the quantities, temperature of the water in each mash, and fermentation, all changes observed, &c. This is a very useful practice, since it not only prevents many errors, but serves as a record of the various parts of the process. Such a book would be equally useful in domestic brewing, and is much better than trusting all this to memory. Each brewing may be considered as a set of experiments, which, when registered, assist materially when the process is to be performed again. The young brewer should anxiously watch each operation, carefully mark its success or failure, and should apply to the various appearances he may observe those scientific principles which he has learned, and not whimsical and unfounded reasoning

SUBSECT. 6.—*Receipts for Domestic Brewing.*

3210. *The following are receipts by which domestic brewing has been successfully performed on a small scale,* and which will help to illustrate certain variations in the methods employed by different persons:

3211. *To brew three bushels of malt into ale alone.*—This quantity of malt will make thirty-six gallons of ale. Procure a cask that will hold thirty-six gallons or a little more, and put as many pails as will equal that quantity into the copper to boil. When brought to a proper heat, put half of it on the malt in the mash-tub, and let it remain the proper time, having covered up the tub. When the mash has remained about three hours, run the wort off. Put the rest of the warmed water on the mash to extract a second quantity of wort; let this remain an hour, and run off the wort. Add some more water to allow for what has been lost by evaporation, and what has been absorbed by the malt, to make up the quantity of thirty-six gallons. Mix the worts together; boil the usual time, and add the hops. When the wort has boiled sufficiently, cool, and, having added a quart of yeast, put the whole into the fermenting vat. The time of fermenting must depend upon the weather and other circumstances. When the fermentation is over, put the ale into the cask for slow fermentation; when this is finished, the cask must be bunged.

3212. *To make ale and table beer from four bushels of malt.*—The first mash will make the ale, and the second and third the table beer; these are to be fermented separately. To the mash for table beer ten pounds of sugar may be added. The ale may be boiled with four pounds of hops, or more if it be preferred rather bitter, and to be fermented the usual time according to circumstances. The table beer is to be treated in the same manner. After this they should be put into casks to cleanse, which will probably require fourteen hours or more. About two pints of yeast will be sufficient for the whole of the fermentation. When the cleansing is over, the casks are to be bunged.

3213. *To make ale and weak table beer from two bushels of malt.*—Choose pale malt. Add about twenty gallons of water sufficiently warmed to the malt in the mash-tub. Stir well, and let the whole remain quiet for an hour. Run off the wort clear; and it is to be observed that the quantity of wort will not equal the quantity of water poured on the mash, much being retained by the malt. Make a second mash by adding fifteen gallons more of water. Mix the two mashes together for the ale, and add twenty gallons of water for a third mash for the beer. The ale will require three pounds of hops to be boiled with it for twenty minutes or half an hour. The wort is then to be put into coolers, cooled down to 96°, and then fermented by a quart of yeast. When the fermentation is finished, cleanse as before; about twenty gallons of good ale will be obtained. The wort for the table beer must be treated similarly.

3214. *One bushel and a half of malt is a convenient small brewing,* and it will give eighteen gallons of ale, and also some table beer. Much smaller quantities may be brewed, and some have recommended even four or five gallons; but the trouble is the same, and the larger quantity will keep best. For this purpose a copper will be required that holds at least twenty-two gallons, and a mash-tub that will hold about twenty-eight gallons; also, three nine-gallon casks will be required. When two of these are empty, a fresh brewing may be begun. The expense of such a brewing has been calculated thus:

	£	s.	d.
Copper and setting - - - - - - - -	2	10	0
Mash-tub - - - - - - - - - -	0	14	0
Two pails - - - - - - - - - -	0	6	0
Sieve - - - - - - - - - - -	0	2	6
Bowl - - - - - - - - - - -	0	1	6
Spigot, &c. - - - - - - - - - -	0	1	0
Three nine-gallon casks - - - - - -	0	18	0
	4	13	0

The mode of proceeding is so exactly the same as we have described that we need not repeat it, and the quantities of water, hops, &c., may be in proportion.

3215. *Brewing on a still smaller scale may be effected*, such as was commonly performed by the agricultural labourers before the present duty was laid on malt. A nine-gallon cask of beer may be easily brewed with very few utensils, all of which will not cost more than forty shillings; a portable boiler, a mashing tub that answers also for a fermenting tub, and a shallow tub or two for coolers. If the boiler is portable, the whole of the brewing may be done out of doors.

Sect. V.—Of various ingredients sometimes added to malt liquors, chiefly for the purpose of adulteration.

3216. *Malt, hops, and water are the only materials permitted by the legislature to be used in manufacturing malt liquor for sale;* and this strict enactment was made on account of a practice which had formerly prevailed of their employing various other ingredients, some of which were destructive to health. At present the introduction of any other substances than those named above is *illegal*, whether harmless or highly deleterious. The public brewer is thus restricted from experimenting on various improvements that might be made; nevertheless, the regulation is salutary; since, were there no other reason, the ignorance of some brewers and retailers of the properties of the substances they might use, would no doubt occasion our beverages to be converted frequently into poisons.

3217. *From common report, it is generally supposed* that malt liquors which are retailed are sometimes *adulterated* by various illegal ingredients; but whether introduced surreptitiously by brewers or publicans, it is impossible to determine. On the truth of this opinion we do not pretend to decide, and we believe that many brewers as well as retailers are too conscientious to be guilty of such practices. Some substances prohibited are, in small quantities, useful in correcting defects in the liquors, and are innocuous; others, again, if introduced at all, are so with fraudulent views, to save the expense of the proper materials or for other objects, and are exceedingly detrimental; most of the latter are of an intoxicating quality, and injurious to the human constitution; these are of such a nature that, unfortunately, they can scarcely be detected even by the chemist, who has often no means of distinguishing them, when put into malt liquor, from what belongs to the hop. The bare possibility of such practices furnishes a strong argument in favour of individuals brewing their own ale and beer, by which alone they can ensure a wholesome beverage. To such a height had the evil arisen, before it became a subject of parliamentary investigation, that the providing various articles for the purpose of adulterating beer had become a distinct trade, under the title of *brewers' druggist.* At present, we had hoped this race had become extinct, but we are informed that it is still a common practice for certain persons to travel through the country to dispose of *drugs* to brewers and publicans. This prohibition of certain articles, however, does not extend to those who brew for their own consumption only, and not for sale; these are at liberty to employ any materials they choose. It is very proper, therefore, to understand the nature of the various substances which have been, and which still are, probably, employed on occasion, both to put persons on their guard and to destroy prejudices. Such of these prohibited substances as are harmless may become very proper subjects of experiment with the domestic brewer, who may be desirous of making an improved beverage.

3218. *We may divide these ingredients* into, 1, those which were employed to communicate a bitter or other desirable taste to beer, in order to qualify the natural sweetness of the malt; 2, those which were added for the purpose of increasing the intoxicating properties of the liquor; 3, those intended to correct acidity; 4, those used in fining; 5, substances used for colouring.

3219. *It was a very ancient practice to infuse, in beverages fermented from grain, certain bitter and aromatic herbs*, partly for their flavour, and partly from their supposed medicinal properties; and thus we read of *spiced* and *herb* ales. Many of these materials were of a bitter nature, which was found useful to correct the luscious sweetness of the malt, and such were found also, in general, to make the liquor keep longer. Hence it has been generally supposed that this preserving property was owing to the bitter principle; this, however, as we have already observed, does not appear to be evident.

3220. *The bitter of plants is not uniformly the same kind of substance:* all plants do not contain the *astringent* principle which coagulates the mucilage of wort, which is the part most liable to become sour. Such vegetables as possess both the bitter and astringent principles are peculiarly fitted for making beer; but none of them are found to be superior, or even equal to the hop. Some of them, however, are tolerable substitutes, and are employed in various places.

The common box (*Buxus sempervirens*) is much used in all the beer brewed in Paris at the present time, as has been lately stated by M. du Petit Thouars in a communication to the Philomatic Society. Box-wood contains a powerful sudorific principle, with a bitter taste, which has lately been separated, and is known by the name of Buxiana (*Bull. Univ.*). In some parts of France, as well as in Germany, the top of the *common broom* is employed; and this, as well as *heath*, has been used from time immemorial in Norway, Sweden, and the north of Scotland. All these possess the astringent principle. In England, *mugwort* and *wormwood*, though less proper as preservatives, being chiefly bitters only, have been used formerly. It is said that the foreign bitter, quassia, and likewise gentian, are employed at present in the porter breweries.

Quassia is the wood of a plant that grows in the West Indies, and the decoction is much used in medicine as a useful tonic. The active principle is intensely bitter, and is called *quassina*.

Gentian is the root of the *Gentianea lutea*, a plant which grows very abundantly in the Alps, Pyrenees, and Apennines. The bitter extracted from them is intense, and proves an excellent tonic, being found particularly applicable in such diseases as require the combination of bitters and chalybeates, as in cases of direct debility. It is in no way poisonous, but it contains a saccharine principle which causes it to ferment rapidly and spoil; therefore it does not contribute to the preservation of beer, though it gives it bitterness; and it is a mistake to suppose that it is a good substitute for hops.

Calamus aromaticus is a plant of a spicy, bitter taste, formerly used in aromatic tinctures for medicinal purposes, and which has been employed to supersede hops; it grows in this country, and is collected for the use of brewers and distillers.

Wormwood and *horehound* are likewise used, it is said, to diminish the quantity of hops.

Catechu, absurdly called Terra Japonica, has been used with success by some brewers for the purpose of more effectually precipitating mucilaginous matter in beer, which it does from containing a powerfully bitter and astringent principle. It is an innocent substance, employed in medicine as a tonic, and is an extract prepared in India from a plant called Acacia Catechu; it is there chewed with the betel nut.

Aloes are said to have also been used; but they are very improper, being powerfully cathartic.

3221. *But the most objectionable of the substances used in adulterating malt liquors* are those narcotics intended to increase their intoxicating quality. These are all pernicious, and the following list is truly frightful; it is to be hoped that they are now seldom employed:

Nux vomica is the fruit of a tree called *Strychnus Nux Vomica*, which grows in the Indian Archipelago. The seeds, which contain the active principle, are extremely bitter. They contain a considerable quantity of *strychnia*, the most deadly known poison except Prussic acid. Strychnia is so intense a bitter that one grain of it dissolved in eighty pounds of water produces a bitter solution. A sixth part of a grain is sufficient to kill a dog.

St. Ignatius's bean, or *bitter bean*, is the seed of an East Indian plant (*Strychnus St. Ignatii*). It contains 19 parts in 1000 of strychnia.

Cocculus Indicus is the berry of the *Menispermum cocculus*; it contains a bitter, intoxicating substance, called *picrotoxine*, and so violent a poison that ten grains will kill a dog in a very short time. A great deal is brought from India; and no other use is known for it except in the adulteration of beer. It is certain that this has been employed in porter from evidence given before a committee of the House of Commons.

Grains of Paradise is another similar substance, said to be largely employed for the same purpose.

Opium is a substance, the narcotic qualities of which are well known; it appears in the list of intoxicating ingredients.

Tobacco is said to be used in beer in some way, from its narcotic or other properties. It is very injurious when taken into the stomach.

Bohemian rosemary and *henbane* are two poisonous substances, said also to be used.

Some other substances are said to be employed by brewers occasionally, to give some particular flavours or to correct defects, as *ginger*, *coriander seed*, *caraway seeds*, &c.

By the use of these narcotics, weak malt liquor has been made to imitate strong porter, constituting a beverage extremely improper. It is true that a very small quantity of any of these poisons may be taken internally without danger, and are even employed in medicine; they should, however, be confined to the materia medica, and only used under the direction of a skilful physician, but by no means mingled with our common drink; and there is little doubt but that the stupifying effect of some malt liquors is owing to their adulteration with some of these deleterious ingredients. Unfortunately, too, very few of these poisonous vegetable drugs can be detected by the chemist, and are only recognised by the stupifying and injurious effects which they produce. Mineral adulterations can be detected, such as copperas, sulphuric acid, lime, soda, potash, &c.

That great quantities of these deleterious ingredients are imported, we learn from official returns, from which it appears that in one year there were brought into the kingdom no less than 154,864 lbs. of cocculus indicus, 140 tons of quassia, 218,624 lbs. of gentian root and nux vomica.

3222. *Various materials employed to correct the acidity* of beer and other liquors will be described when treating on the management of the beer cellar, Sect. VIII. These are all alkalies and alkaline earths, and are in themselves harmless, as *carbonate of soda*, *chalk*, *whiting*, *egg shells*, *pounded oyster shells*, and *marble dust*.

3223. *Substances used for fining* are described in Sect. IX., "Fining;" they are, *isinglass*, *white of eggs*, and *hartshorn shavings*.

3224. *For colouring*, only *burned* or *roasted malt* is allowed to be used by the brewer: this has been already described under "Malt."

Burned sugar was employed by the brewers formerly, and may still be in domestic brewing. There are two modes of preparing it. One is to burn the sugar in an iron vessel till it becomes a thick sirup, perfectly black and extremely bitter. The other method is to boil the sugar to a middle state between sweet and bitter. To both these preparations it is necessary to add lime-water before they are suffered to cool in the pot, in order to bring them to a proper temper, as without this they would become hard, dry, burned substances; but no water must be put to them before they are sufficiently burned. *Liquorice* is probably also used for its colour.

3225. *Beer heading.*—Among the adulterations of porter ought to be reckoned what is thus termed. One of the qualities of good porter is, that it should bear a fine, frothy head, since professed judges of this beverage would not consider it as perfect without this requisite, although it might possess all the other properties of good porter. Genuine porter, fresh drawn, when poured from one vessel to another, exhibits on its surface a close, creamy foam or head, which, when blown aside, instantly closes again; but if the porter is too weak, perhaps from an adulteration with small beer, this head is deficient. Some publicans have endeavoured to conceal this poverty by laying on the surface of the beer, when just drawn, a spoonful of an artificial heading made by whisking a solution of isinglass in sourish porter. This contrivance, however, does not effectually answer its intended purpose, as it may be distinguished from the genuine head by its not closing of itself when blown aside. A kind of heading that cannot be detected in the same way is made by adding to every barrel of beer half an ounce of a mixture composed of *green vitriol* (sulphate of iron), *alum*, and *salt*. This imparts also a degree of astringency to the beer, which porter drinkers sometimes prefer. So small a quantity of these salts is, perhaps, not injurious to health; the same salts are found in many mineral waters used as medicine; yet we should object to any mineral water, however weak, as a constant beverage; and, besides, this enables the publican to conceal a real defect in his beer. The law prohibits this practice.

3226. *To detect Sulphate of Iron in Beer.*—Fill two wine-glasses with the suspected beer; place them in a good light, and into one of these put a few drops of a decoction of galls; stir this well, and observe if the colour of the beer is changed on comparing it with the other glass; if the colour is blackened by the addition of the galls, this is a proof that the beer contains iron; and if the beer remains for four-and-twenty hours, probably the iron will be more distinctly manifested by the deposition of a blackish sediment.

Salt is likewise sometimes put into ale on account of the taste, which pleases some palates, and it is said to excite thirst. It does not appear to be a useful addition.

Sect. VI.—On the various kinds of malt liquor.

3227. *A great variety of fermented liquors have been prepared from malted grain in different periods* and in various places; but our object at present is only to consider such as belong to this country, briefly touching upon those which are made upon the Continent. Perhaps we cannot render this subject more intelligible than by prefacing it by a slight sketch of the history of our malt liquors, without attempting the depths of antiquarian research, for which, indeed, like many of our domestic habits, the materials are extremely scanty.

Subsect. 1.—*History of Malt Liquors.*

3228. The particular mode in which barley and other farinaceous grains were originally employed in fermentation is unknown.

3229. We are informed by Herodotus and by Diodorus Siculus that the Egyptians prepared a drink from barley not much inferior to wine; and we are told that this material was used because the vine did not grow in Egypt, a circumstance rather extraordinary, since it was so well known in Palestine, and is found in Egypt at present. However this may be, it is easy to account for the use of barley for fermentation in those European countries which were not favourable to the growth of grapes. Tacitus, Pliny, and other classic writers bear testimony to the existence of an intoxicating beverage made from malted grain among the ancient Germans and Gauls, and this was, no doubt, at the same time generally known among the Celtic nations in the north of Europe: it is not certain what grains were used, if any, besides barley.

3230. The possession of barley, or any of the farinaceous grains, supposes agriculture; and in ancient Britain, while only a small portion of the land was cultivated, mead produced from honey appears to have been long a general and favourite beverage. Raw barley does not readily ferment of itself, a decoction becoming rather sour than vinous; hence the process of malting was employed, and the addition of bitters is of great antiquity. The name for ale, in the ancient British language, was *cwrw*, which still remains in Wales. The term ale appears to have come from the Danish *oela*. The English word beer is synonymous with the German *bier*, and may be traced from the Saxon *bere*, barley: a variety of that grain is still called *bere* in Scotland. The French *bierre* and the Italian *birra* were derived, no doubt, from a similar source, and perhaps all may have had their origin in the Hebrew בר, corn, pronounced *ber*. The drinks in general use among the early Anglo-Saxons appear to have been mead and beer: ale and alehouses are mentioned in the laws of Ina, king of the West Saxons, in 728. Wine was not introduced into this country till a date somewhat later. The grape appears to have been cultivated at an early period in the monasteries, and after the Norman conquest it became more general among the nobles and higher clergy; but the other classes adhered to their ancient beverage, which became more plentiful, and more within the reach of the mass of the population, when, from the abolition of the feudal system, and the more settled condition of the country, agriculture was more attended to. The vineyards were neglected about the time of the Reformation, when many of the ecclesiastical gardens were destroyed. Ale then became the general and favourite drink.

3231. A variety of substances were added to the ale of our ancestors, as we have stated, for the purpose of overpowering the sweet, mawkish taste of the liquor fermented from barley, as well as to take away that tendency to acidity which is possessed by all malt liquors. The use of honey in brewing is of great antiquity, both here and on the Continent; this is still found an excellent addition in domestic ales, and it is said to be used by some public ale brewers in Scotland and England. Dubrunfaut, in some experiments on brewing, found that he could make a beer, much resembling the famous beer of Louvain, by fermenting wort without hops, and with the addition of honey. Bitter herbs were formerly infused in ale, not merely for ordinary beverage, but were added in great variety to compose what was called *herb ale*, a favourite medicament of those times: this was compounded by our ancient dames, as well as by the *leeches* of that day, who were the principal herbalists and apothecaries; but probably most of these additions were made to the ale after it was brewed, and were not considered as essential to its formation.

3232. A kind of malt liquor called *mum* is mentioned among the ancient drinks of this country as remarkable for the number of its flavouring ingredients. *Spiced ale* is continually referred to; and coriander, caraway, and other seeds were often added; also ginger, orange peel, orris root, &c. Many of the bitter substances, as wormwood, quassia, gentian, &c., continued long to be employed by our public brewers, until all but hops were excluded by the Legislature.

3233. We learn from Beckmann that the first notice of the use of hops occurs in the beginning of the fourteenth century, when it appears that they began to be regularly employed in the breweries of the Netherlands. They were introduced into English brewing in imitation of the Flemings, and were first imported from the Netherlands in 1524. But though their efficacy was admitted in the conservation of beer, yet they were long supposed to contain qualities noxious to the constitution, among which it was said that they "dried up the body and caused melancholy." Accordingly, we find in the household regulations of Henry VIII. an order to the brewer not to put any hops into the ale. They are first mentioned in the English statute book in 1552.

3234. In 1557 the national taste had somewhat changed in their favour, and Tusler, in his treatise on Husbandry, thus sings their praises:

"The hop for his profit I thus do exalt,
It strengtheneth drink, and it flavoureth malt;
And being well brewed, long kept it will last,
And drawing abide, if ye draw not too fast."

Their use was general in 1600, and their mode of cultivation was pointed out by Walter Blythe in 1653, in the reign of James I. It is evident from this that the beer of the previous periods had been very different from what it is at present. Soon after the introduction of hops into England, so little did they suit the general taste, and such was the public opinion respecting their deleterious qualities, that, about 1650, the Common Council of the City of London petitioned Parliament against two nuisances: one of which was "Newcastle coals, and the other hops; in regard they spoiled the taste of drink and endangered the health of the people." Hops were also petitioned against in the reign of Henry VI., as "a wicked weed."

3235. It is therefore probable that ale had originally but a small quantity of bitter, and was either not calculated for keeping, being drunk very new, or that it was prepared with honey without bitters, as is practised in the south of France and other places, and perhaps bottled or kept in some kind of close vessels, being rather a species of barley wine than like our modern ales. We find it stated in the "*Maison rustique*," 1616, that "the generall vse is by no means to put any hops into ale: making that the difference between it and *beere*, that the one hath hops, the other none: but the wiser huswiues do find an error in that opinion, and say the vtter want of hops is the reason why ale lasteth so little a time, but either dyeth or soureth, and therefore they will, to euery barrell of the best ale, allow halfe a pound of good hops." Thus the use of hops seems to have advanced gradually, partly from finding that it preserved the beer from turning acid, and partly from a taste for it now becoming habitual. Many of the herbs formerly thought to give an agreeable flavour would not now, perhaps, have many admirers, which is not surprising, since few persons like porter who are not used to it. It is curious to observe that the mode of brewing in Scotland was formerly nearly the same as that followed on the Continent (see Subsect. 3, "Scotch ale," and Subsect. 4, "Account of the Beers on the Continent"). But this agreement is the less remarkable, when we consider the correspondence in the architecture and many circumstances in their habits, owing to their political connexion. The invention of porter, which was quite peculiar to England, has produced a great change in the taste of the public with respect to malt liquors in South Britain.

SUBSECT. 2.—*Porter.*

3236. *Porter is a malt liquor peculiarly English:* the chief difference between it and ale is, that the former derives a dark colour and astringent taste from the use of brown or highly dried malt; from its having more hops than ale; and from the saccharine matter having been more exhausted in the fermentation, or, as the brewers say, having the attenuation carried farther, so that porter, as contrasted with ale, may be considered as a *dry* malt liquor. From these circumstances this beverage has been preferred in England, being considered as more wholesome than ale, when made, as it ought to be, from pure malt and hops.

3237. *The origin of a beverage so extensively used in the British dominions* is curious enough, and is thus stated by Malone:

"Before the year 1730, the malt liquors in general use in London were ale, beer, and twopenny, and it was customary for the drinkers of malt liquor to call for a pint, or a tankard of half and half; that is, half of ale and half of beer, or half of beer and half of twopenny. In course of time it also became the practice to call for a pint or tankard of *three threads*, meaning a third of ale, of beer, and of twopenny, and thus the publican had the trouble to go to three casks, and turn three cocks for a pint of liquor. To avoid this inconvenience and waste, a brewer of the name of Harwood conceived the idea of making a liquor which should partake of the united flavours of ale, beer, and twopenny. He did so, and succeeded, calling it *entire*, or entire butt; and as it was a very hearty and nourishing liquor, it was very suitable for porters or other working people: hence it obtained the name of *porter*."

It would be no easy matter to ascertain what was the precise quality of the porter of that time, but it was very probably different in some respects from the beverage of the same name made at present, in consequence of changes in the ingredients and the mode of manufacture, likewise in the taste of the public, and also from enactments which have restricted the ingredients within narrower limits than they were once confined to.

The distinctive character of porter being its brown colour and acerb taste, derived from the highly dried malt, the depth of colour was supposed to indicate in some degree the strength of the liquor, and, while brown malt alone was employed, this was the case. But in consequence of the taxes on malt and the high prices it rose to during the late war with France, brewers paid more attention to the subject, and they found that the heat used in rendering the malt brown destroyed some of the saccharine matter, and thus that the deep colour of porter was produced at the expense of the most valuable part which gave strength to the beer. They were induced, therefore, to use pale malt for the fermentation, as producing more strength, and, in consequence, being less expensive; but as the beer from this was deficient in that flavour which had been produced by the use of brown malt, and which was so much valued by porter drinkers, and as the porter was paler than before, in order to conceal these defects, they had recourse to various colouring substances and drugs of various kinds.

3238. *In consequence of a general complaint on this subject, an act was passed, in* 1816, by which all ingredients whatever, except malt and hops, were forbidden to be used in the making of malt liquor by the manufacturing brewer, as we before stated; and likewise all other substances to produce an artificial colouring, the chief of which had been burned sugar. Soon afterward, however, a discovery was made that in malt roasted almost black, in the manner of coffee, though the fermentable matter is totally destroyed, yet a large quantity of brown soluble colouring matter is produced; and as this substance comes within the letter of the act, a patent was taken out for it, and it is at present the practice among many, we believe most, of the brewers, to use a quantity of this to give the porter a deep colour.

This roasted malt is perfectly innocent, but gives no additional strength to the beer; and a dark-brown colour is in this case no indication of the strength of the liquor. Some brewers, however, we are informed, still employ only a mixture of pale and high dried or brown amber malt.

3239. *In the ordinary mode of brewing porter* the products of all the mashings are mingled together, and they constitute what is called *entire* beer. It is fermented with more rapidity than ale, and more of the saccharine matter is decomposed, since the liquor is not to be sweet: hence it is more liable to pass into the acetous stage, and requires to be put into cleansing barrels the moment it has arrived at a certain point. As, notwithstanding, it still contains much unfermented matter, it requires slow fermentation for a considerable time to convert it into alcohol; and some time ago this was thought to be best done in large masses. Accordingly, the brewers had immense store vats for this purpose, in which the beer remained for twelve or eighteen months; some of these vats held above 6000 barrels of porter; and that of Messrs. Meux held 18,000, and was said to have cost 10,000*l*. The porter, during its long repose in these vats, became spontaneously fine, and by a slow fermentation had all its saccharine matter decomposed, so as to be in the state of dry wine. The bitter also became less perceptible, and, from being kept so long, the beer was at length nearly what is technically called *hard*, that is, it was brought to the verge of acidity, without being at all acid.

3240. The explanation most to be depended upon of the terms *hard*, *stale*, *mild*, and *entire* porter may be found in the information given by Mr. Barclay, the celebrated brewer, to the committee of the House of Commons, in 1818. From this it appears that every publican has two kinds of beer sent to him by the brewers; one is called *mild* beer, which has been sent exactly as it has been brewed; and the other is called *entire*, which is a mixture of beer brewed for keeping, or what has been termed *hard* beer, waste beer from various sources in the brewery, and what has been returned by the publican, together with some beer of better quality; this is put all together into a vat and kept till it is bright. As there are various tastes, some prefer mild or fresh beer, and others the hard or stale beer, and some mix them: but it is supposed that the public taste is changed from what it was formerly, most persons now giving the preference to *mild* porter, what is called *stale* being too frequently almost in the commencement of the acetous stage, which renders it unfit for certain constitutions.

Here it may be proper to mention that when this is found to be the case, a slight degree of acidity can be corrected in a very easy and convenient manner by a little carbonate of soda, which is now kept for this purpose in every apothecary's and druggist's shop, and sold for about 2*d.* per oz. About a quarter of a small tea-spoonful, or less, put into a half-pint glass of stale porter, produces, when stirred, an immediate effervescence, and destroys the acidity of the porter. Too much soda will give an unpleasant alkaline taste, but the neutral salt formed by its union, and the acetous acid of the beer, acetate of soda, is by no means hurtful, being slightly laxative. This is particularly proper for persons inclined to dyspepsia who drink porter.

3241. *What is called brown stout* is, or ought to be, a superior kind of porter; but nothing can be inferred from its mere colour, that being artificial: it is about twenty shillings a barrel dearer than common porter. *Dublin stout* is an excellent kind of porter, which is thought to be quite equal to the London porter, and is a proof that good porter may be brewed wherever sufficient care is taken. *Porter for bottling* is also a superior kind, about ten shillings a barrel dearer.

Porter is scarcely ever attempted to be brewed in private establishments, though, if required, any one skilled in other malt liquors would find no great difficulty in preparing it.

Subsect. 3.—*Ale*

3242. *Ale is sweeter than porter*, and London brewers' ale is stronger. The ale from various London brewers differs in some particulars of strength or flavour; and the same is the case with what is brewed in different parts of the country: thus, Wiltshire ale is remarkable for being hard, as are the ales of the west of England generally; but those who are accustomed usually prefer it.

3243. *Burton Ale.*—This ale, so named from the place where it is made, Burton-upon-Trent, is in high repute in this country, and is exported to different places on the Continent. It is the strongest of our ales, being about 25 per cent. stronger than brown stout. It is of a somewhat thick, glutinous consistence, and agreeably sweetish taste. A small quantity of it produces inebriation with those persons who are not accustomed to it. Its colour is pale, and it is made from the very best pale malt and hops. Much of its intoxicating quality has been attributed to cocculus indicus; but of the truth of this assertion we have no positive knowledge.

3244. *Scotch Ale.*—The Scotch, particularly the Edinburgh ales of the present day, made partly on the old plan, are esteemed equal, if not superior, to any in Britain; and certainly some of the best Scotch ales have a flavour extremely vinous, and approaching the nearest of any of our ales to some of the light French wines. They are particularly mild in their flavour and pale in colour, and the taste of the hop does not predominate. One great advantage which they derive from the smallness of the quantity of the hops which they contain is, that it does not form a disguise for injurious ingredients, as is the case with the larger proportion used in English ales; and hence, if no better reasons could be assigned, it is said that the Scotch ales are less liable to adulteration than those of England. But, on the other hand, they are more difficult to keep long; and the fine Scotch ales are therefore generally bottled.

The principal difference between the manner of brewing Scotch and English ale is, that the former is fermented with a much lower heat than the latter, usually as low as 50°: this fermentation is slow; it continues for a fortnight, or even three weeks. The fermentation is carried nearly as far as possible in the fermenting vat, and hence it soon becomes fine, and is then put into casks, and is seldom racked.

3245. *It appears to have been the ancient practice in Scotland*, as it is still in some places on the Continent, to put the new fermented ale quite hot into casks, where the fermentation was carried on slowly, the bung-holes being left open, or loosely stopped with covers of clay. The ale was then sent out in this fermenting state to the customers in casks or in flagons; but it was afterward always bottled, whether strong or weak, and was generally ready in the course of a week. The low degree of temperature at which the fermentation is carried on confines the brewing to the colder parts of the year; and during four or five of the summer months no strong ale is brewed. The ale of Preston Pans is the finest and most vinous of the Scotch ales.

3246. *In Edinburgh, Dr. Thomson informs us, it was the custom formerly for the brewers to "send out the small beer in casks* the moment it was mixed with yeast, and before it had undergone any fermentation whatever." It fermented sufficiently in the small casks in which it was sent to the customers, who generally bottled it, which made it clear and very brisk, and extremely agreeable.

3247. *Welsh Ale.*—Mr. Donovan informs us that there is nothing peculiar in the process of making the excellent ale of that country. They brew rather small quantities at a time, use good malt and hops, spare neither, and take but one extract from the malt.

3248. *Windsor Ale.*—It is said that this contains a considerable quantity of honey and liquorice, which gives it additional strength. The honey is put in just before the liquor is run off into the coolers.

3249. *India Pale Ale.*—This ale was first prepared for the India market, but has lately come into general use here. To make it keep in a warm climate, it has more than the usual quantity of hops, and is, of course, much more bitter than the ordinary ales. It has been recommended by some physicians as being proper for certain invalids, with whom the usual ale does not agree. It is said that some brewers, in preparing it, merely add an infusion of hops to some of their already brewed ales.

3250. *Table ale and table beer* are weak ales, and in domestic brewing are generally the result of the second and third mashings: strength is not so much required as the right proportion of bitter, and perfect soundness and transparency. They are very wholesome beverages when in their sound state, and, when bottled, are excellent.

In London, professional brewers who brew ale and table beer are distinct from those who brew porter, and some brewers confine themselves to the manufacture of table beer only. They make this malt liquor from the best pale malt, or amber and pale malt. They usually draw six barrels of beer from one quarter of malt. The quantity of hops is from four to five pounds per quarter of malt. Being sent out in small casks, by proper management it may be drunk fresh and in good condition; it is not calculated for long keeping.

Subsect. 4.—*Some Account of the Beer made on the Continent.*

3251. It may be interesting to state a few particulars respecting the kinds of malt liquor made by our Continental neighbours, who differ from us somewhat in their taste on this subject.

3252. *The beer commonly drunk in Paris* is very different from any generally used in London. The French, accustomed to light wines, make their beer upon a somewhat similar principle. They wish rather for a refreshing than an intoxicating beverage; and their beer is admirably adapted to the purpose for which it is intended—a cheap refreshment at the theatre or promenade. It contains but little alcohol, and is more remarkable for its briskness than strength: being bottled when new, it ferments in the bottle; a great quantity of carbonic acid is generated there, which, when the cork is drawn, flies out with great violence, like our spruce beer. Good table beer, bottled with a little sugar, comes pretty near to it. In many parts of the Continent they prefer this light beer.

3253. *Malt liquor is a beverage much more common in Flanders and Germany than in France;* the best beer is brewed from malted wheat mixed with malted barley; the first grain gives a peculiarly agreeable flavour. We have an interesting account of the Flemish beer from Mr. Richardson, a late celebrated English brewer. At Brussels they have two sorts of beer; one of a brownish-amber colour, called *picterman*, strong and tolerably transparent, of a taste between bitter and sweet, but which, from not being well manufactured, is very liable to turn acid in warm weather. The other sort of beer, called the "*bierre blanche de Louvaine*," or *white beer of Louvaine*, is found throughout the Netherlands, and its manufacture constitutes the principal trade of Louvaine. The white beer is sweeter than the picterman, and much weaker. It is pale and turbid, and of the strength of table beer. Being bottled when it is new, it is extremely brisk. This is much relished by the Flemings, who consider it as a very wholesome and refreshing beverage; and although Mr. Richardson brewed for them some excellent beer in the English mode, which they praised highly, yet they continued to adhere to their accustomed beverage, which had pleased the palates of their ancestors, and which, though less scientifically made than ours, had less intoxicating effect. A similar beer is made at Berlin.

The white beer of Louvaine is made from *air-dried malt*, which was probably the original way of preparing it before kilns were employed. In Flanders and in Germany they dry their malt by spreading it on the floors of large lofty rooms which are attached to every brewery; and the process can only be performed in the summer months, when the temperature is sufficient for the purpose. The fine ales were probably first intended to imitate the brisk white wines as nearly as possible, and, consequently, the paler and clearer the malt, the fitter it was for the purpose. The proportion of hops in the Louvaine beer is very small, and the fermentation is carried on at a low temperature; yet, in some places on the Continent, beer is not fermented before it is barrelled, but, after mashing and boiling, is put hot into the barrels, in which it ferments spontaneously. Brown malt seems to be peculiar to England, where porter originated.

3254. *In Germany a great deal of malt liquor is drunk*, made wholly from malt and hops. *Bavaria is celebrated for its beer.* Liebig states, in his work on "Chemistry applied to Agriculture and Physiology," that the Bavarian beer possesses the property of not becoming acetified, even *when kept in vessels half filled.* "This valuable quality is obtained for it by a peculiar management of the fermentation of the wort." "The wort, after having been treated with hops in the usual manner, is thrown into very wide flat vessels, in which a large surface of the liquid is exposed to the air. The fermentation is then allowed to proceed, while the temperature of the chambers in which the vessels are placed is never allowed to rise above from 45° to 50° Fahr. The fermentation lasts from three to six weeks; and the carbonic acid evolved during its continuance is not in large bubbles, which burst upon the surface of the liquid, but in small bubbles, like those which escape from an acidulous mineral water, or by a liquid saturated by high pressure. The surface of the wort is scarcely covered with a scum, and all the yeast is deposited on the bottom of the vessel in the form of a viscous sediment." In this practice the principle appears to be, to render the fermentation very complete, and to exhaust entirely the ferment, or to render it incapable of exciting fermentation of any kind, and, of course, arresting any progress that might be made to acescency. It is farther stated that the various kinds of beer manufactured in Bavaria are distinguished by different flavours, which are given by allowing small quantities of the herbs and blossoms of particular plants to ferment along with the wort. The price of beer in Bavaria is regulated by law every year, according to the price of barley, and there is but one strength of beer made, the duty on malt amounting to half its value. The strength is a quarter of malt to three barrels and a half, or rather less, of beer. The summer beer, when made, is first put into large open barrels used for the slow fermentation, during which time small casks are filled from them, and sent out daily to the publican for immediate consumption. The winter beer is put into closed casks, and is as bright as wine, and extremely brisk. The beer of Augsburgh is remarkable for having a pitchy taste, communicated purposely by pitching the inside of their store vats.

3255. *Prague is also famed for beer*, which is reckoned next in quality to the Bavarian. The beer vaults of Prague are of the very best kind; and, as the floor of the cellar is always covered with a thick layer of ice, on which the casks of beer are placed, the beer is sent out to be drunk in a chilly state.

3256. *In Brunswick* a remarkably strong beer is made, called *Mumme*, and large quantities of this used to be imported in the latter end of the sixteenth century, when it was mentioned in the excise laws. This German beer was made in the towns of Lubeck and Rostock, which were famous for its production. So great was the trade in it, that 800,000 barrels were annually exported under the name of *Lubeck beer*. The city of Rostock contained 250 licensed breweries; and the most considerable part of the Duke of Mecklenburgh's revenue arose out of the excise laid on the beer brewed in these cities. This strong Lubeck beer was produced by using double the usual quantity of malt of wheat, with oatmeal and beans; but besides these, it is said that there were in it also infusions of fir and birch tops, majoram, pennyroyal, wild thyme, elder flowers, seeds of cardamom, and barberries; so that it appears to have been analogous to the herb ales of our ancestors. In the excise laws, mention is made of a similar *mumme* having been made formerly in Ireland.

3257. *The national drink and the ordinary household beverage of Russia* is the far-famed *quass*, which is made by fermenting an infusion of barley malt, rye malt, and rye flour that has been roasted in iron pans. It is extremely popular from the emperor to the peasant; but, except when flavoured with fruit, it is "sour, weak, watery, and unpalatable." Of this, George Jubervill, one of our poets in Queen Elizabeth's time, says:

> "Such liquors as they have, and as the country gives,
> The one called kuas, whereby the Russie lives,
> Small ware, water-like, but poor in taste."

SECT. VII.—VARIOUS KINDS OF CHEAP BEER MADE OF OTHER INGREDIENTS BESIDES MALT AND HOPS.

3258. *Beer may be made without barley.* Not only can any farinaceous grain be converted into malt by the process of germination already described under "Malting," but any substances containing either starch or sugar may be made to afford beer with the addition of hops, or some similar bitter substance containing the astringent and bitter principles. The various substances containing these constituents would no doubt require each a peculiar management; but it is important to know what substitutes may be used in various countries, or under peculiar circumstances. To understand this, we should keep in mind what has been stated above, that the only use of malting is to convert the starch of the grain into sugar, and thus to produce a cheap kind of it. Whenever we have starch, it is possible to produce sugar by some process or other; and whenever we have sugar, we can ferment it into spirit or alcohol. The chief peculiarity of ale and beer is that, in addition to the spirit, they are flavoured with an aroma or essential oil from the hop, and likewise with an astringent bitter from the same plant, which is supposed to assist its preservation or keeping; and though we might not be able to produce from other materials a beer exactly like that from malt and hops, barley, or some farinaceous grain, yet beverages nearly analogous may be made with any material containing sugar, and any bitter nearly resembling hops. Many such beers have been made, and found very agreeable and useful. We shall give examples of them.

3259. *Sugar Ale and Beer.*—Cane, or common sugar, is somewhat different from the sugar of malt; but it may be fermented equally well into a beverage which some have even preferred to malt liquor. One great advantage of this beer is, that the process of making it is much more simple, and more easily performed, no malting or mashing being necessary; the apparatus is also much less complicated. To make ale, procure a ten gallon cask, set it on its bottom, and fit the head in. Put a cock into the side, one inch above the bottom, and make a hole in the head, and close it with a bottle cork. Put a pound and a half of hops into any convenient vessel, and pour on them eleven gallons of boiling water; or, if there be a copper large enough, boil the hops in the water for five minutes; strain off the hops, and add fourteen pounds of sugar to the strained liquor; mix one pint of good yeast with this, and put the whole into the cask through the hole in the top; it will soon ferment, and the yeast will appear through the hole in the head; as this works out, let it fall back again into the hole. It will require, in summer, about three weeks or more to complete the fermentation, and as this slackens towards the latter part, the cork should, for the most part, be kept in the hole, to prevent the access of too much air, which might be apt to occasion sourness; but the cork should now and then be removed, to give vent to the fixed air that collects. When the fermentation has stopped, and the sweet taste of the sugar is barely perceptible, the cork must be driven in tight, and in four days the beer will be fit for draught or for bottling. Care must be taken to ferment sufficiently, but not so long as that the liquor becomes flat, as it would then soon sour. White sugar will afford a liquor of the purest flavour and palest colour, but brown sugar will answer. If a deeper brown colour be wanted, which many would think a disadvantage, it may be given by burned sugar. The drink will fine itself, and the grounds will settle in the space below the cock, for which purpose it will be best to have room enough to prevent the beer from drawing off foul.

Mr. Donovan describes this beer in terms of high praise. He states that "there is a purity of taste belonging to it quite different from the indescribable jumble of tastes so perceptible in common ales, and a light sharpness combined with tenuity, which is much more agreeable than the glutinous or mucilaginous softness of even the best ales. But it has one advantage which places it above all competition, and that is, its lightness on the stomach; this, when compared with the sickly heaviness of malt ale, is really remarkable. The whiter the sugar, the lighter the ale will be; and age greatly conduces to the same end, provided that the drink is sound, which is best ensured by bottling." It is scarcely necessary to observe that the strength may be increased, or diminished to that of table ale, by using more less of the sugar and hops.

It is reckoned that ten pounds of Muscovado sugar are equal to a bushel of malt.

3260. *Beer from Malt and Potatoes.*—We are told by M. Dubrunfaut that he made a beer as follows, which, when bottled, very much resembled the brisk beer so much used in Paris: Potatoes were grated to a pulp; this was well mixed with boiling water, and some ground barley malt was added. The wort being drawn off after mashing, it was hopped in the usual way; yeast was added, and the whole fermented. The proportions are not mentioned, but any one acquainted with brewing would find out how to supply this. Here the starch of the potatoes is converted into sugar in the mashing through the means of the malt, in the same manner as in the case of raw barley.

3261. *Beer from Treacle alone.*—Get 14 lbs. of treacle and 6 oz. of hops; boil them together for two hours in 11 gallons of water; when cooled sufficiently, add a proper quantity of yeast; let it work in a tub covered up for 16 hours; when the working is over, put it into a cask; let it work there, as usual, for two or three days; then bung it down, or pour it from the lees, and bottle it. The beer will be fit to drink in a week, and be as strong as porter. It will cost only 1½*d.* per quart. If not sufficiently fermented, it will be apt to be too sweet. The great defect in treacle beer arises from the want of mucilaginous matter in proportion to the saccharine part of the treacle. A better kind is made from treacle and barley. A little ginger may be added, if wished. If required to be of the strength of table beer only, use more water in proportion to the other ingredients.

3262. *A very wholesome and palatable ale has been made by using mangel wurzel instead of malt.* After the roots are well washed, and the tops cut off, they should be scraped, that the outer rind may be taken off: they are then sliced, and boiled till they are soft. The liquor is squeezed out from them by some kind of press, and it is boiled with hops, in the proportion of six ounces of hops to nine gallons of juice. This is next worked with yeast in the usual way. The roots will keep during most of the winter if put into a cool place. Ten pounds of the root should afford a gallon of juice; but if fifteen pounds is allowed, the ale will be strong. Two pounds of treacle to a firkin will be an improvement; or one third malt and two thirds mangel wurzel may be used as still better.

3263. *Spruce Beer.*—This name is given to a very wholesome effervescing beer made from molasses and the extract of the spruce fir. *Brown spruce beer* is prepared in the following manner: Add to eighteen gallons of boiling water from twelve to fourteen pounds of molasses, and from fourteen to sixteen ounces of extract of spruce, commonly called essence of spruce. Suffer the mixture to cool, and when lukewarm, add to it one pint of yeast, and ferment the mixture. In warm weather less yeast will suffice. While the fermentation is going on, remove the yeast by skimming, and when the fermentative process begins to become languid, which usually happens in two days, let the beer be put into stone bottles, and the corks tied down with pack-thread. Sugar is preferable to molasses, and if malt wort of an ordinary strength be substituted for the water, a spruce beer of a very superior flavour is obtained. Some ferment it in a cask before bottling it. Spruce beer is, in fact, a treacle or sugar beer flavoured with essence of spruce instead of hops. *White spruce beer* is made in a similar manner, by substituting for molasses white or brown sugar. This drink is considered as an anti-scorbutic; and, in cold countries, ships that intend to brew their own spruce beer should carry the yeast in bladders or closed casks.

3264. *Most of the above-mentioned kinds of beer,* though extremely useful as cheap substitutes, and extremely wholesome, will not be considered, in general, as equal to good beer made from malt and hops only; yet, when well made, the difference is less than most persons might imagine, and the economy is very material. Great care should be taken not to suffer them to become sour, by keeping them in a very cool place, as beer in the least acid is extremely prejudicial to health.

Sect. VIII.—Management of the Beer-Cellar, and Storing of Beer.

3265. *In order that the temperature* of the cellars in which malt liquors, as well as others are kept, may be as uniform as possible, vaults are constructed for this purpose underground, as the changes of heat from the seasons are observed not to operate beyond a very few feet below the surface of the earth. This attention is the more necessary for beer, as this liquor soon comes to a state of fermentation by a heat above 55°, sufficiently great to exhaust its remaining fermentability, and then it will become vapid and sour, for the reasons which have been already stated. If, on the other hand, the temperature of the cellar should ever descend to the freezing point, and the beer should become frozen, it will be separated into distinct substances; the water and mucilaginous part will pass into the state of ice, and its small portion of spirit will collect in the centre, where, even if it should remain perfect till the returning heat again dissolve the ice, the other parts of the liquor never again combine with it in the same homogeneous fluid which it was before, its flavour is totally lost, and it remains fit only for distillation, or to be converted into alegar, a kind of vinegar.

3266. *The ancients used a very simple method for preserving their liquors* from change of temperature. They kept them in large earthen-ware vessels holding several gallons, which they placed in holes dug in the earth, thus burying them beneath the surface until the liquor was sufficiently meliorated by age; and with us store vats are sometimes sunk in the ground; but there are inconveniences attending this on account of leakage.

3267. *Great attention is paid to the construction of cellars* in various parts of Europe, particularly the north, and if more care was taken in this respect here, much would be saved of the liquor that is now spoiled, and much of the sickness prevented which is caused by the use of acid liquors, which lay the foundation of more diseases than most persons suppose.

3268. *Malt liquors owe more of their effects to the carbonic acid gas united with them than wines;* and if it be so necessary to prevent this gas from escaping from brisk wines, we should bestow the same, if not more, attention upon ale and beer, if we wish to drink them in perfection. The confinement of the carbonic acid is the chief circumstance necessary for the preservation of malt liquors, after the requisite care has been taken of their fermentation.

3269. *From the time that air comes into contact with beer*, the latter proceeds more or less towards acetification; and for this reason, when the consumption is not sufficient to exhaust a large cask in a few days, the beer should be kept in smaller casks, proportioned to the weekly use of the family; for when part of the beer is drawn off, the air must come in contact with the whole of its upper surface, which, as casks are generally laid on their sides, is of large extent, in proportion to the quantity; and, according to the surface, the increase of acid will be more or less rapid.

3270. *Beer, to keep long in cask, should be brewed of good strength with that view.* The weaker it is, the more likely it is to turn sour, the tendency to acetify depending upon the smallness of the quantity of alcohol or of hops, each of which has a preserving power; and the production of acid is, in general, chiefly owing to the mucilage left in the liquor.

3271. *As soon as the casks are brought into the cellar*, the bungs should be drawn, and they should be filled up full with fine beer, skimming off from time to time the head that will arise in consequence of its being rolled over. After being attended to in this manner for two or three days, the casks should be bunged tight, and a hole bored with a gimlet near the bung, with a vent-peg or spile fitted to it, which should be left slack for a day or two.

3272. *In warm weather the beer is apt to ferment*, and a hissing may sometimes be perceived at the bung-hole or the vent-hole: when this is the case, the vent-peg may be loosened a little every day till the liquor has become quiet. The bungs and vent-pegs should be frequently examined in warm weather.

3273. *Tapping the Casks.*—Most persons at all accustomed to a cellar know how to tap a cask. In driving in the cock with a mallet take care to drive straight, for if put in crooked it is very likely to leak. When the greatest part of the beer is drawn out of a cask, it is necessary to tilt it, or make it lean forward a little, by means of wedges, which is called *stooping:* care must be taken not to shake the beer, lest it get thick.

3274. *The proper management of the vent-peg is of great consequence;* and it is necessary that the principle upon which it operates should be clearly understood.

It is well known that it is impossible to draw beer from a cask of which the bung is closed, except there is a small hole in the top of the cask, stopped occasionally by a peg. If there be no such hole the beer will not flow, because no air can get in to supply the place of what comes out. If a hole was constantly left open, all the carbonic acid disengaged from the beer would escape, and common air get in, which would soon cause the liquor to turn flat, and then sour. Therefore, upon putting the cask into its place, a small hole is bored in the top with a gimlet, and a peg fitted to it. On drawing a small quantity of beer for the first time from the cask, the peg is taken out, and air admitted, and then the hole is closed by the peg. After some time, when more beer is to be drawn, the peg is not to be taken out, for by this time some fixed air will have been disengaged from the beer, and will occupy the upper part of the cask, exciting a considerable pressure on the surface of the liquor in the cask, *fig.* 559. The beer will therefore flow out until the elasticity of the included air is brought down to that of the common air outside the cask. But it will flow somewhat longer than that, for the force which the beer by its own weight will exert to come out will occasion the air in the cask to be in some degree rarefied; but when it becomes so much so that its elasticity is less than a counterbalance to the pressure of the atmosphere upon the aperture of the cock, the beer will cease to flow. It is necessary, then, to take out the peg, and the air may be heard rushing in to fill up the vacancy made by drawing off the beer. As soon as the noise ceases, the peg must be carefully replaced; for, if left out, the beer would be spoiled. When the peg is replaced, some more may be drawn as before; but the flowing of the beer can only proceed to a certain point, and then it is necessary to take out the peg to admit air, and so on, till the whole is drawn off. It is evident, therefore, that the surface of the beer in the cask is constantly covered with a stratum of air; at first, this is chiefly carbonic acid, which will preserve the beer; but by degrees, as this escapes, and the proportion of common air increases, the beer will first become flat, and ultimately sour, if it remain long enough before it is consumed.

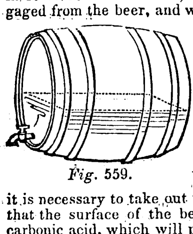


Fig. 559.

3275. *Beer, when once fit for use, should not be agitated.* The removal or disturbance of a cask of beer is always injurious, though none of the sediment called *grounds* or *lees* of the fermenting tub may have been put into the cask; but as some yeast is gradually produced by the slow fermentation, and is deposited in the form of lees, little motion will stir this up, and render the whole contents of the cask muddy; besides, such lees are liable to induce a new fermentation, which tends to spoil the beer. If it be required to transfer the beer into another cask, it must be done very carefully, without disturbing the sediment at the bottom. This is best effected by means of the siphon. It is also requisite that the cask should be tapped at such a distance from the bottom as to allow the beer to flow clear of that sediment which may have collected there.

Beer is sometimes injured during thunder-storms, and has been turned hard or sour—an effect not easily explained, although probably connected with the electricity of the atmosphere at the time; or, as some suppose, it may be occasioned by a tremulous motion induced by the thunder. To guard as much as possible against the agitation of the beer by this cause, the casks should not touch the walls or ground, but be placed upon wooden supports, which should be pitched and painted, to prevent rotting.

3276. *When beer has become hard in the cellar*, and it is desired to destroy this quality, some mix with it an equal quantity of new beer, and others add hops in the proportion of half a pound to a kilderkin, or, rather, boil the hops in some beer, strain the liquor, and put this in the casks, and then bung up; this in a few weeks will render the beer much more palatable. A better mode is to prepare a small quantity of fresh wort, and, after filtering it through a flannel bag, add it to the ale that is hard or flat in the proportion of a quart to a barrel; this will renew the fermentation in some degree, and give the ale briskness.

3277. *Methods of correcting the Acidity of Beer.*—Even after much care in brewing, malt liquors will sometimes become acid. On the first signs of acidity, it is necessary to do something to check, by the method just pointed out, what would, if neglected, ultimately cause the whole to turn sour.

Every degree of sourness in beer proceeds from a commencement of this acetous fermentation. If the change in the beer is perceived before it has gone too far, and when but a small quantity of acetous acid or vinegar is formed, it is possible to neutralize this, and to prevent for a time the formation of more.

The substances proper for neutralizing acids are alkalies and alkaline earths. The alkali usually employed for destroying the acidity of beer is carbonate of *soda*, and carbonate of *lime* is the only alkaline earth made use of. If carbonate of soda is used, it should be added very gradually, otherwise the effervescence will be too violent; its action may be observed by putting a little to some of the beer in a glass. The quantity must depend upon the degree of acidity of the beer; too much will communicate a very unpleasant taste. Marble reduced to fine powder (which is carbonate of lime) answers better; it dissolves slowly in the beer, of course giving out its carbonic acid as slowly. The lime dissolved forms, with the acetous acid of the beer, acetate of lime, which is slightly bitter, but harmless. There is another advantage in marble powder, which is, that there is no danger of putting too much; for no more lime will be dissolved than the acetous acid can take up, and the remainder will lie at the bottom of the cask without producing any effect.

Egg-shells and pounded oyster-shells have been recommended for this purpose; and they answer equally well, for these substances are likewise carbonate of lime, and exactly of the same composition as marble.

3278. *The machines now so much used for raising beer from the casks* in the cellar by the working of a piston and handle in the bar of a public house, are a great improvement; they prevent great waste from spilling and from pilfering, and might be advantageously employed in large domestic establishments; but care should be taken that their pipes are not made of lead, since, when that is the case, and beer should remain in them, it would dissolve some of the lead, and produce a poisonous liquid. Pipes of pewter are safe.

3279. *The late Mr. Bramah had a patent for a method of keeping beer or other liquors from the contact of air while on draught*, which deserves notice among the methods of preserving beer. This invention was intended for public houses of extensive custom, and was combined with the plan of elevating the liquor as it was wanted from the cellar by mechanical means, which is now practised so generally by other contrivances. To effect this purpose, a cylindrical cask of wood, *fig.* 560, was fitted with a piston, secured like that of a steam-engine; and on the top of the piston-rod was placed a box heavily loaded with stones, so as to press the piston down with force to the bottom of the vessel. The liquor was forced into this cylindrical cask beneath the piston from another vessel by a small forcing pump, till the piston was elevated to the upper part of the cask, and then the weight at top reacting on it, forced it to ascend in the pipes to the bar of the public house, where, on turning a cock, it was drawn as required. The piston in this apparatus, being always in contact with the liquor, preserved it effectually from the air till drawn off to the dregs. The chief difficulty, in the construction of this apparatus, would be the getting the piston to fit tight against the sides of the cylinder. It is evident that a common cask would not answer, not being perfectly cylindrical. Means have been invented, of late, for turning casks inside by a lathe prepared for the purpose, and have been used in some manufactories; and the cylinder or cask might be prepared in this way, or it might be made sufficiently round and smooth by a good joiner; but a cooper is not used to work of this kind. Some cork fitted round the edge of the piston would probably keep it sufficiently air-tight. The round form is not necessary, square or any other shape would answer.

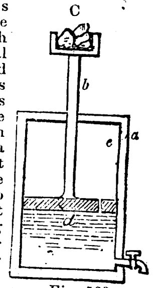
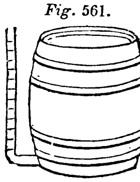


Fig. 560.

3280. *A method of preserving malt liquors* in the cellars was patented by Mr. Wynn, and is now sold by Thorn and Pedley, Castle-street, Leicester Square, London. This consists in an apparatus for generating carbonic acid gas from marble and sulphuric acid; this gas is then conducted into the upper part of the vessel from which the malt liquor is drawn for consumption, and the space in the vessel, left vacant by drawing the beer, is kept constantly filled with the carbonic acid gas, and, of course, all the common air is excluded. Such beer or ale will continue to the last as brisk as it was at the beginning of the draught.

Fig. 561.


3281. *A very useful contrivance has lately been made*, by which one may see, by simple inspection, how much liquor of any kind has been drawn from a cask, and how much remains in it, which can save all the trouble of gauging. A glass tube, *fig.* 561, is fixed in a perpendicular position, and connected with the lower part of the cask; and it is obvious that the surface of the liquor in the cask and in the tube will always be exactly level. This tube is graduated so as to show the quantity of liquor at any time in the cask. To graduate the tube, a certain quantity of liquor or water is put into the cask, and a mark made on the tube where the fluid stands; then another similar quantity is added, and another mark made on the tube; and in this manner, by pouring in equal quantities into the cask, and marking the place where the fluid stands in the tube, a scale is got on the tube which will correspond with the equal quantities in the cask.

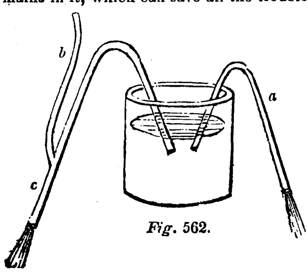


Fig. 562.

3282. *For transferring beer or other liquor from one vessel to another, a siphon* is sometimes found convenient, as by it the liquor may be decanted without disturbing the sediment, and also the liquor can thus be transferred without making any aperture in the lower part of the vessel. A siphon is a bended pipe, whose legs are of unequal lengths. For common purposes, the siphon of the form *a*, *fig.* 562, may be employed. To use it, the short end must be placed in the liquor to be decanted, and by sucking with the mouth, or other method, through the other end, it must be raised in the tube so as to run out; and it will then continue to run of itself until the vessel is emptied. But as sucking by the mouth is on many accounts inconvenient, the same effect may be produced by inverting the siphon, and filling it with the liquor; then keeping the two ends stopped with the finger or otherwise, introduce the short end into the liquor; unstop the ends of the siphon, and the liquor will flow. Sometimes the siphon is made of the form *b*, with an additional small tube to suck out the air by at first; a cock at *c* is then necessary, to shut till the tube is full, and it is then opened to allow the liquor to flow. Siphons of this kind are much employed by brewers and distillers. In the siphon it is essential that the leg through which the liquor flows shall be longer than the other, as the whole action depends upon this; for it is the greater weight of the fluid in the longer leg that overbalances that of the shorter leg. Small glass siphons are sold of both forms, *a* and *b*, and are found extremely useful for decanting many liquids, where it is desirable to draw the fluid from the top instead of the bottom, and where any disturbance would be injurious.

Sect. IX.—Fining Beer.

3283. *When malt liquor, properly made, is left to itself, all the floating impurities generally subside in time*, and the fluid remains clear and transparent. But sometimes this does not happen, or not sufficiently soon. In this case it is necessary to employ some method of hastening this subsidence of the floating matter that occasions its muddiness. The means of effecting this is called *Fining*.

In London, beer is often sent to the publican as soon as the fermentation is over, and before it has had time to become clear; it is then usual to send along with it a quantity of liquid called finings, and the publican puts a portion into each cask. Various substances are used to mix with beer to occasion the precipitation of the impurities, and rendering it clear and transparent; but the most usual of these is *isinglass*, and it is the only substance which the Legislature permits the public brewer to employ in fining.

But isinglass will not answer for fining, if dissolved in hot water; if added in this manner, it will coagulate and fall to the bottom without carrying the feculences with it. For this purpose it is dissolved in vinegar, or in very old, stale, or sour beer; and when it is once dissolved it is reduced by adding some mild beer to the solution. It should be stirred about well, and after this it must be strained through a hair sieve or coarse cloth: a brush is useful in forcing it through the sieve, when it should be of the usual consistence of beer, and it should be transparent. The quantity employed may be from a pint to a quart per barrel; but this proportion must necessarily vary according to the degree of foulness of the beer.

To try whether the fining will act properly, it is necessary first to make an experiment with it. Put some of the beer to be fined into a large half-pint vial, or tall clean glass of any kind holding this measure, and add to it a little of the finings prepared for use, taking the weight of what you use. Observe the effect which it has upon the beer. This effect will probably be, that the feculences will begin to collect in large fleecy masses, which will gradually rise to the top, leaving the beer perfectly clear. But the quantity of finings so employed may be more than is really necessary, and it is not desirable to have more isinglass in the beer than can be avoided. Make, therefore, another experiment with the same quantity of beer, but with less of the finings; and if the effect does not take place satisfactorily, of rendering the beer transparent, the first proportion must be adhered to. If with the smallest proportion of finings the beer is cleared, make another experiment with still less, and satisfy yourself that you have ascertained the least proportion of finings that will act decidedly, before you put the whole of the finings into the cask. To fix upon the right quantity of finings for the cask, ascertain how many half pints there are in the cask; say there are 200: then multiply the weight of the finings in the successful experiment by 200, the product will be the weight of finings for the beer. Many persons may not be disposed to take this trouble, but it is a more certain mode than mere guessing; and those who desire to be accurate will not object to it.

3284. *Fining should never be used but in case of necessity*, as any addition of this kind to the beer promotes acetification, an effect which the brewers well know, as they never add it to the liquor till they are just going to part with it; besides this, the stirring up the liquor is injurious, from risking a renewal of fermentation. Beer that has been fined, unless the cellar be particularly cool, is liable to turn sour, especially if it be of no great strength. Transparency, or *fineness*, as it is called, is essential to the keeping of beer; but this property should be the result of good brewing, and should not be produced by art.

3285. *The mode in which the fining operates* is, by entangling and combining with the floating undissolved substances suspended in the liquor, after which the action of the alcohol coagulates it in the same manner as it does whites of eggs; and the whole being specifically lighter than the liquor, it rises to the top, and, as is the case in some wines, it floats as a scum. This coagulated matter falls to the bottom if specifically heavier.

3286. *Several other substances may be used instead of isinglass*, although none answers better. Gelatin prepared from any material, as hartshorn shavings or ivory turnings, will give a jelly that will do. Albumen also may be used, as whites of eggs, or the serum of bullocks' blood. The sounds of cod-fish, being also the swimming bladder of that fish, is of the same nature as isinglass, and when well dried and treated as above described, will answer nearly as well for fining; but, when the quantity used is considerable, they are apt to leave a fishy taste in the beer. Mr. Donovan states that alum has been found to be a good substitute for isinglass; about an ounce in powder, dissolved in a hogshead of beer, will effect this purpose, without communicating any taste, or having any prejudicial effect.

3287. *Ropiness in beer* is a disease which sometimes occurs, and is supposed to be owing to ill-made malt; sometimes from an injudicious mixture of unmalted barley, or, perhaps, from too much mucilage being left in the beer. It is difficult to cure. Mr Black directs the beer to be put into a vat with a false bottom, and to add per barrel four or five pounds of hops taken gradually away after the first boiling of the wort; to this may be added about ½ lb. per barrel of mustard seed. The beer should be roused as the hops are gradually introduced, and in some months the ropiness will be cured. The beer should be drawn off from below the false bottom.

Sect. X.—Bottling Malt Liquor.

3288. *All kinds of malt liquor are much improved by bottling;* and this is, at the same time, accompanied by the advantage of its keeping in a brisk state. The liquor is improved and mellowed by the slow fermentation it undergoes; and the carbonic acid which is disengaged, being confined, is absorbed by the liquor: upon withdrawing the cork, and, consequently, the pressure, the imprisoned air escapes suddenly, and occasions the appearance of *briskness*.

3289. *To succeed in bottling malt liquors,* it is necessary to be particular as to their state at the time it is wished to bottle. The custom is, to leave a small portion of the saccharine matter unattenuated, or in a state fit for very slow fermentation in the bottle. But the fermentation should be *nearly* completed, for if it is not, too much air would be generated, and the bottles would probably burst: again, if the liquor is quite flat, it is of no use to bottle it, as, the fermentation being over, it would then turn sour. On drawing out the vent-peg of the cask, if the liquor spirts out with violence, it is evident that the fermentation is still going on; but if the liquor appears still, yet on tasting is found to be in good condition, and brisk, then it is ready for bottling. Should the beer appear a little too brisk and frothy while bottling, the bottles may be left open for a few hours, and filled up as the froth works out; but they should be filled only within an inch of the cork. It must be observed that, if the corks are driven in while the liquor is still working much, there is always a danger of the bottles bursting. Great care should be taken to bottle exactly at the proper time. When a cask of beer is to be bottled, it is usual to loosen the bung and leave the beer exposed to the air for a short time, as a day or two, to *flatten it*, to prevent the bottles bursting; but there is great danger if the beer stands exposed too long, it may contract a tendency to acidity.

3290. *The corks should be of the best quality;* there is no saving in cheap corks: soak the corks in a little of the beer; and when the bottles are corked they should be laid on their sides, that the beer, by swelling the corks, may make them quite tight. Should any of the bottles begin to burst, the whole should be set upright. They should be kept in a regular temperature. If the beer is in perfect order (and it should not be bottled except it be clear), there is no occasion for any addition; but if it be a little too flat, or if it is wanted to *be up*, as it is called, very soon, a lump of sugar may be put into each bottle, or four or five raisins, or a tea-spoonful of rice: these, by giving rise to a new fermentation, will make the beer very brisk. The warmer the weather, or the warmer the place where the bottles lie, the sooner will this fermentation begin, and the beer be ripe and fit for use. Strong ales may be kept in bottles of glass, without the risk of forcing out the cork or bursting the glass, but weak ales undergo a much more violent and unmanageable fermentation than strong ones; hence table beer in warm weather may burst the bottle, while strong ale will not be affected. In some kinds of beer, where there is much fixed air generated, and where glass bottles would not be sufficiently strong, earthen-ware bottles, called *stone bottles*, such as those used for spruce beer, will be best, and the corks of these require to be tied down with string or wire. Great care should be taken that the bottles are perfectly clean; and one great advantage of glass is, that its transparency enables this to be easily seen.

3291. *When a small cask of ale or beer of any kind is half consumed*, it is a good practice to bottle the remainder, which otherwise would get too flat; but in this respect attention must be paid to the time when it is required to be fit to drink. Beer of any kind to be bottled for exportation should be brewed of good strength to ensure its keeping.

Sect. XI.—Strength of malt liquors.

3292. The strength of malt liquors depends, like that of wine, upon the quality of alcohol or spirit of wine which they contain.

Experiments by Professor Brande on this subject have given the following quantities of alcohol in 100 measures of various malt liquors, and therefore the numbers exhibit their relative degrees of strength:

	Parts of alcohol by measure.		Parts of alcohol by measure.
Home brewed ale	8.30	Another sample of London porter	4.20
Burton ale	6.25	Another do.	4.44
Another sample of do.	8.88	Do. bottled	4.75
Edinburgh ale	6.20	Brown stout	5.00
Dorchester ale	5.50	Another sample of do.	6.80
London ale	5.80	Small beer	0.75
Scotch ale	5.75	Another sample of do.	1 28
London porter	4.00		

CHAPTER IV.

ON WINES.

Sect. I.—general principles of making wine.

Subsect. 1.—*Introduction.*

3293. Few of the articles used in domestic economy require to be well understood more than wine, both on account of its expense, and its effect on health; yet there are few with respect to which accurate knowledge is less generally diffused, owing, probably, in a great measure, to this not being a wine-making country: hence the various circumstances of its manufacture are but little known.

We propose to divide this subject into several sections. In the first, we shall treat of those theoretical principles upon which the production of wine, whether foreign or domestic, depends. *In the second part*, we shall enter into a description of the properties of those foreign wines which are most generally known in Britain. *In the third*, we shall consider the methods of fabricating wines from our native British fruits, or what are usually termed *domestic* or *home-made wines*, and particularly the most perfect, those made from grapes. *In the last*, we shall treat of the business of the wine-cellar, and the adulterations of wine.

3294. *Wine having been made long before chemistry was known as an art*, its discovery did not depend upon this science; nor is it to be supposed that much chemical knowledge is possessed by all who make good wines at the present day. The art of wine-making attained a degree of perfection, no doubt, chiefly in consequence of an infinity of trials made by persons who had sense and intelligence sufficient to take advantage of observations made during the various processes they employed, and who could mark certain effects, although they could not describe the rationale of them. In countries where the necessary materials are abundant, and other circumstances are favourable, this is comparatively easy; and good wine is often made, like good beer, by persons who acquire a certain skill which they do not know how to communicate, but which is the result of what is sometimes denominated *mere* practice, although, in fact, it is practice guided by sagacity and careful observation. The experience of such persons generally dies with them, and similar knowledge can only be obtained by going over the same ground again, and by the repetition of numerous experiments, many of which must necessarily be unsuccessful.

3295. *It is the business of science to shorten this labour* by recording the precise results of the several trials, and, by pointing out the natural causes that have acted in producing them, lead the way to a more certain mode of practice. By studying the scientific principles of any art, we obtain in a short time a degree of knowledge that otherwise could be acquired only by long experience, and with this advantage, that it is unattended with those prejudices which are usually possessed by those who have devoted much of their time to practice only, unaided by the lights of science.

In Britain, our climate being unfavourable, the art of making wine is little practised; it is, therefore, more difficult to gain experience, and we have the more occasion to profit by that of others. France has long preserved a superiority in the fabrication of wines, although for many ages the art of wine-making had been conducted according to empirical rules; but it was in that country that chemistry first investigated the theory of the best modes of its manufacture, and brought it to the highest state of perfection.

3296. *To the discoveries of Lavoisier, and the labours of his successors, we are indebted* for the clear and satisfactory basis on which the doctrine of fermentation is now established; and the names of Chaptal, Thenard, and Gay Lussac stand pre-eminent among those who have successfully studied this subject, and applied modern chemistry to the improvement of wine.

Among us, the writings of Dr. Henderson and Dr. Macculloch have contributed to diffuse scientific knowledge respecting wine; and, in his recent work, Mr. Redding has collected numerous interesting particulars. To these authors, among others, we willingly acknowledge our obligations.

SUBSECT. 2.—*Of the Grape-vine, and the Chemical Composition of the Grape.*

Wine, properly so called, is the produce of grapes only; and we refer the reader to some account of these in Book VII., Chap. IX., "On Fruits."

3297. *To make good wine, it is necessary that the grapes should have much saccharine matter*, and to produce this requires a great deal of solar influence; no other quality can compensate for the deficiency of sugar: hence the cultivation of the vine depends much upon climate.

The production of good wine from vineyards is limited to a zone extending in breadth from the thirty-third to the fifty-first degree of north latitude. Coblentz on the Rhine is the most northerly point; and Shiraz in Persia, and the Isle of Cyprus, the most southern. In the most northern parts of this zone the grapes are deficient in sugar, and the wines are often harsh and austere, like those of the Rhine and Mozelle; and in the southern part the grapes have a superabundance of sugar, and are deficient in other necessary principles; hence only sweet wines can be made there, or what are called *vins de liqueurs*, such as those of Malaga; in this part the grapes are often dried into raisins. The best wines are made in the centre of the zone, as those of Burgundy, Bourdeaux, and Oporto. But it appears that the ripening of fruits, particularly of the grape, does not depend altogether upon latitude; for a portion of the banks of the Rhine, where excellent wine is made, has the same latitude as the south of England, where it has been found very difficult to ripen the grape sufficiently in the open air, on account of the greater humidity and cloudiness of the atmosphere, which lessen the action of the sun's rays.

3298. *Grapes ripen best, and become sweeter, on a southern exposure*; and the sides of hills, with this aspect, are found to be the most favourable situations. On the banks of the Rhine, in the Apennines, in Hungary, and many other places, vines are planted in terraces formed on steep hills by means of low stone walls built along the sides; and into the cavities thus formed earth is conveyed: these walled terraces rise above each other, and thus form a kind of steps, like magnificent staircases, surrounding the hills.

The walls answer several purposes: by upholding the earth, they afford a soil for the roots of the vine, and they retain the water which flows down the hills, without, however, allowing it to stagnate; likewise, the reflection of the sun's rays from the sides of the hill increases the heat considerably, and causes it to accumulate on the vines: the walls are also convenient for fixing poles to train the vines upon.

3299. *The season likewise makes a difference in the quality of grapes.* In dry seasons the sugar will be more abundant, but the juice less in quantity; in wet seasons, on the contrary, the juice will be plentiful, but will contain much water and mucilage, with little sugar. Grapes, when quite green, are austere or styptic; next, they are acid, and become sweeter as they grow ripe.

3300. *The vine will grow in any soil that is not very wet,* but it flourishes most in one that is dry and light; and though it thrives with great luxuriance in rich soils, and produces abundance of grapes, yet this fruit is not so fit for wine as that which grows on poorer land. It is generally the case that the grapes fittest for the table are the least so for making wine, which is often obtained of good quality from fruit of a harsh and austere taste. It is generally thought that the best soil is one that is of a light calcareous or loamy nature; but even sandy, gravelly, and stony are found to answer well.

Volcanic soils are particularly well calculated for a vineyard; thus some of the best wines of Italy are made in the neighbourhood of Vesuvius, and the famous Tokay is also the produce of a volcanic district. The vine likewise grows well in the debris of granitic rocks, as is the case with that which produces the celebrated Hermitage. It appears even that the chemical composition of the soil is of less importance than its physical character. It has been observed that a black soil is particularly favourable from its absorbing heat.

3301. *The manner of training varies* in different countries. In Italy and other warm climates they are suffered to run up to a great height, and are trained on high trellises, or are allowed to spread with the utmost luxuriance, and to hang in festoons from tree to tree, the effect of which is described by travellers to be highly beautiful and picturesque. But in by far the greater part of Europe the vines are trained on low wooden props. The French and Germans, who excel in this branch of economy, prefer the low training, in which they cut the vines down to a few feet or less; and, although the fruit is diminished in quantity by this management, its quality is much improved by its obtaining more of the sun's heat through reflection from the ground. Those who have known vineyards only from the descriptions of poets are extremely disappointed in first viewing the stunted appearance of those in France and Germany. In the sandy parts of Spain the vines are even allowed to trail upon the ground. The modes of planting, propping, pruning, and renewing the vines have also a great influence on their produce in wine.

3302. *The varieties of the vine are innumerable,* differing in the size, colour, taste, and perfume of the fruit: of all fruits, perhaps none is so much altered in its nature and the proportion of its ingredients by the circumstances of climate and soil; no species of grape succeeding equally well in all climates. Good varieties degenerate by being transplanted from a warm to a cold climate; and, on the contrary, the grape is sometimes improved by being carried from a cold to a warm one.

The same climate, soil, and mode of culture often produce wines of very different qualities. Situation and aspect alone, all other circumstances being the same, make a very great difference. The same vineyard, for example, according as its different parts have a northern or southern aspect, will produce wines of opposite characters; as also will the same hill at its summit, middle, and bottom. In cold countries the southern slope of a rising ground is the most favourable situation, and in warm climates the east is found to be generally the best. Grapes form a very uncertain crop, and are much affected by wet seasons, hail-storms, and mists.

The principal varieties of grapes which are chiefly cultivated for foreign wines are the red and white Chasselas, or Muscadine; the Auvergnat; the Frontignac, or Muscat grape, white, red, and black; the Damask grape; the sweet water; the raisin grape; the malmsey grape; the malmsey Muscadine; the black Hamburg; but there are many more varieties, impossible here to enumerate. Wine-growers seldom confine themselves to one kind of grape, several being usually mixed together in the vintage; but in some choice wines only one sort is used.

3303. *The number and variety of wines* are almost infinite: every kingdom, every district, and sometimes each vineyard, producing a wine having some distinctive property, from which it receives a particular name. Thus we have the wines of Portugal, of France, and of the Rhine, each of a peculiar character; and the Tokay, Hock, and Constantia wines are each the produce of particular vineyards, their qualities depending on the varieties of the grape, as well as on several local circumstances, and the modes of manufacture.

Some have maintained that the vine ought not to be manured, when the production of wine is the object, from an idea that the manure affects the flavour of the wine: this opinion is maintained by many French wine-growers; and in the port-yielding district of the Alto Douro in Portugal, the use of manure is forbidden by law. But it is not clear that the practice of manuring is injurious; for in Germany, particularly on the Rhine, it is employed very freely: this is likewise the case in the vineyards near Bourdeaux, where the clarets are made. Liebig recommends the prunings of the vines themselves as the best manure. It is certain that the flavour of wine is affected by circumstances apparently inappreciable; scarcely two vintages afford exactly the same quality of wine, the vintage of some particular year, as that of the comet year of 1811, sometimes excelling all others.

3304. *Grapes differ considerably in their constituents from other materials employed for fermentation.* The juice of the grape not only contains a larger proportion of saccharine matter than that of other fruits, and is consequently capable of producing a greater quantity of alcohol, making a stronger liquor; but it differs also in the nature of its acid, which is chiefly the tartaric, that being almost the only acidulous principle existing in it, particularly the mature grape ripened in a warm climate, such as Spain, Portugal, or Madeira.

3305. *The abundance of tartaric acid in the grape is one of the principal causes of its excellence as a material for wine.* Other fruits employed for this purpose, as gooseberries, currants, elderberries, &c., contain chiefly the malic, citric, and acetic acids, which are partly combined with potash, forming malate and citrate of potash, and partly in a free state; but these salts, being soluble both in water and in alcohol, necessarily remain in the wine that has been prepared from the fruits, nor can they be separated; hence all the wines made from other fruits, except the grape, contain a quantity, generally considerable, of free acid, which is injurious, at least to certain constitutions; and as the acids are not palatable, they are usually concealed by a large quantity of saccharine matter, as we shall afterward find when the processes of making these wines are described.

The tartaric acid, on the contrary, does not exist in the grape in a free state; but it is always combined with potash, constituting bitartrate of potash; and this is the substance known by the name of *tartar.* This tartar is most abundant in the juice of unripe grapes, called often *verjuice*, and has an austere taste; it lessens in quantity as the grape approaches to maturity, when the sugar increases in the same proportion.

The tartar is held constantly in solution in the grape juice; but as soon as the fermentation commences, and alcohol is evolved, a portion of the tartar is precipitated, or thrown down in the solid form, because it cannot be kept in solution by alcohol; and the latter has diminished to a certain degree the solvent power of the must. The precipitation of the tartar takes place upon the bottom and sides of the containing vessel, to which it adheres as a hard crust in a crystalline state, called the *lees* of the wine. A small quantity of tartrate of lime is also found united to it, and exists even in the purified tartar, or common cream of tartar; hence it follows that, if the grapes are of the best quality, containing tartar, they have but little or no free acids; and if the fermentation has been well conducted and complete, the resulting wine will be quite, or almost entirely, free from acid of any kind; and it is this circumstance chiefly that renders the grape superior to every other fruit for producing a wholesome wine. But wine is never perfect until it has subsequently undergone the *very slow fermentation*, which brings it to its highest point of perfection, when a still farther quantity of the tartar subsides, and constitutes what is called the *crust* when bottled, the quantity of which usually gives an idea of the quality and age of the wine.

All grapes, however, are not entirely without other acids besides the tartaric; but they seldom contain any of these in considerable quantity, and in that case they are less fit for the production of good wine.

Besides the essential principles of the grape, namely, sugar, tartar, and natural ferment, it contains some mucilage, and an aromatic essential oil in minute quantity, to which the delicate perfume or aroma of the wine made from it is owing.

3306. *The vintage should never commence before* the grapes have arrived at their full maturity, except in cold countries, where sometimes the season is so late before they can be ripe that there is danger of their spoiling if they are not quite ripe; yet brisk wines can be made from them. In the manufacture of the best wines, they are careful to avoid the two extremes of gathering the grapes not sufficiently ripened, or so ripe that they begin to spoil. In warm countries, in the manufacture of sweet luscious wines, the grapes are permitted to hang on the tree till they shrivel, or they are gathered and half dried in the sun.

3307. *When they are to be collected,* a sufficient number of persons are employed, so as to be able in a single day to gather all that is necessary to fill the fermenting vat. The unripe or decayed fruit should be carefully separated, a circumstance which is often neglected in manufacturing the inferior wines, and in the fabrication of wine for distilling into brandy. In making Champagne, however, they prefer having a certain proportion of unripe fruit. For the rich sweet wines, the juice is concentrated by leaving the grapes exposed to the sun for a few days; but, in general, the fruit is taken at once to the press. In the richer and best wines also, where a very delicate flavour is expected, all the stalks are removed; but in the strong, rough wines a certain proportion of the stalks are kept, as they give strength and astringency. In the preparation of port wine they are always used; but in the manufacture of the more delicate wines of Bordeaux they are generally excluded. The practice of different countries differs much in this respect, and in weak wines they are apt to communicate a harsh and austere flavour.

3308. *The bruising the fruit*, or *pressing*, is performed in various ways in different countries, according to the care bestowed in the manufacture. In many parts of France, the grapes are put into tubs with perforated bottoms, and men tread them with their *sabots*, or wooden shoes, the juice running out into the vat or tub placed below. This mode is imperfect; and where the vintage is conducted in the best manner, presses are made use of for this purpose, by which the process is performed more uniformly and completely. The skins and refuse, after the grapes have been pressed, constitute what is called the *marc*.

3309. But before we proceed to describe the manufacture of wine we must explain the principles upon which its formation depends.

Subsect. 3.—*Sketch of the Theory or general Principles of Wine-making.*

The theory and process of fermentation having been already treated of at some length in Book VIII., Chap. II., we shall confine ourselves here to a concise recapitulation of those particulars respecting it which are requisite towards a connected view of wine-making.

3310. *It was observed that when any sweet vegetable juice, whether a decoction of malt, juice of the grape*, or that of other fruit, is exposed to the ordinary temperature of summer, say from 50° to 70°, it soon begins to exhibit that intestine motion termed fermentation, and distinguished by the production of alcohol, which remains in the liquid, and of carbonic acid, which chiefly escapes in the form of gas.

3311. If a decoction of malt be fermented, the produce is *ale* or *beer;* but if grapes or other sweet fruits have been employed, *wine* is the result.

3312. It has been shown that the process of fermentation depends essentially upon the presence of two substances at least: saccharine matter, and another vegetable principle termed a leaven or ferment, the nature of which appears to be extremely analogous to, if not identical with, gluten or vegetable albumen. These two substances, which exist more or less in all sweet vegetable juices, act upon each other, and occasion a decomposition into their elementary principles; and when these unite again in other proportions, they give rise to the two essential products of fermentation above mentioned, alcohol and carbonic acid. The phenomena of fermentation and the liquid resulting from it vary in some degree according to the relative proportions of the saccharine matter and the ferment.

3313. *When the juice of the grapes*, or *must*, as it is termed, is put into the vat, at a temperature of 60°, it soon begins to ferment spontaneously: no yeast is added, as in the case of beer or ale, because the natural ferment contained in grapes is sufficient to excite and keep up a sufficient fermentation. We may mention it as remarkable, that although expressed juice ferments so readily, yet this process never takes place in the juice before the fruit is bruised. The fact is, the sugar and the ferment are contained in different parts of the grape, and they never come into contact except the fruit is broken.

The general phenomena of fermentation have been so particularly described when treating on that subject at large, and again under "Brewing," that we shall not detain the reader by repeating it in detail. The appearance of air bubbles, and of a gentle ebullition, together with the turbid state of the fluid, are the same in all cases: a portion of the exhausted ferment, now rendered insoluble, rises to the surface with another portion not exhausted, constituting the yeast, the remainder falling to the bottom in the form of lees. The gas which escapes is known to be the carbonic acid.

3314. *In the ordinary methods of making wines there are two periods in the fermentation. The first or primary fermentation in the vat* is the most considerable, in which the principal part of the sugar and ferment are decomposed; and, of course, alcohol produced. After this first effort of the fermentative process, the usual phenomena disappear, and the effects sensibly diminish; the process should now be stopped, otherwise the liquor would advance to the acetous state of fermentation. While this fermentation was proceeding, yeast being thrown up, and tartar and mucilage precipitated, the liquor had become muddy; but as the fermentation lessens, and these impurities have gradually subsided to the bottom as lees, the new fluid, or wine, becomes clearer, and the vinous taste is perceivable. But though the operation has apparently ceased, it has not in reality; and it mus be continued longer before the wine becomes perfect. It is said that the fermentation is most perfect where large quantities of must are operated upon. Lately, it has become the custom to increase the fermentation, when it is required, by the addition of *starch sugar*, which is of the same kind as that of the grape.

3315. *After the first fermentation has continued for a sufficient time*, according to the kind of wine to be made, it is then racked off or transferred to casks to suffer a slow fermentation, generally termed, not very correctly, the *insensible fermentation;* but care must be taken not to pour off the lees which have settled to the bottom, nor the yeast on the top.

When first put into the casks, the wine still contains a portion of fermentable matter, which, though not sufficient to produce the very visible effects of ordinary fermentation, is yet sufficient to occasion a slower state of this process, which continues a longer or a shorter time, according to circumstances.

During this second fermentation in the casks, the wine becomes turbid, and there is a slight internal motion in the fluid ; yeast is thrown off by the bung, and the casks are kept always full, that it may pass out upon forming. The management of this second fermentation must depend upon various circumstances, chiefly the kind of wine to be manufactured.

3316. *When the fermentation in the casks has continued till the wine is properly depurated* by throwing off the yeast, the bungs are driven in tight, and the wine is left to deposite its tartar, which it does in consequence of an extremely slow fermentation, which often continues for a long time, during which the wine is ameliorated by a more intimate combination of the alcohol with the acid and mucilage; this frequently requires several years in the wood.

3317. *Another effect of this prolonged insensible fermentation* is the gradual increase of the quantity of alcohol, and the farther separation of the insoluble salt, the bitartrate of potash, called *tartar*, which subsides, adhering to and lining the bottom and sides of the casks as lees. As the taste of tartar is harsh and disagreeable, it is evident that the wine will be improved by being deprived of it, and hence old wine is preferable to new. There is, however, sometimes a danger in putting the liquor into the casks before it has had sufficient time to ferment in the vat. If the unfermented matter is in too large a quantity, it will ferment violently in the casks and become turbid, and, if it be put into bottles, will probably break them. Again, if the fermentation has been carried too far, there is a chance of the liquid souring and turning to vinegar.

A portion of the colouring matter, as well as tartar, is also precipitated, adhering to the sides of the cask ; the wine is mellowed, and the aroma and flavour that are peculiar to it become more apparent. These changes are sometimes accelerated by various artificial means, especially by the agitation of the lees, which always contain a portion of the ferment, and by the assistance of artificial heat. Hence the reason why certain strong and austere wines are so much improved and mellowed by being exported in the lees to a warm climate, as is the case in carrying Madeira to the West Indies, or in subjecting it to the effect of local motion of any kind with heat, as is now practised in the island of Madeira. On the contrary, the lighter and more delicate wines are injured by the motion even of removal to any distance, and, therefore, can be drunk in perfection only in the countries where they are grown.

3318. *To prevent this renewal of the fermentation*, therefore, after a certain time, when most of the lees has been thrown down, and it is thought the wine has acquired a sufficient degree of maturity, it is poured off into a clean cask, which process is technically called *racking*, which is a method of transferring the fluid without disturbing the sediment.

3319. After this, should there appear to be any risk of the fermentation beginning again, a process is employed called *sulphuring*, which consists in burning sulphur matches within the cask ; the sulphurous acid gas thus produced is absorbed by the wine, and this has the effect of stopping the fermentation. In some places this latter process is varied by strongly impregnating a small quantity of wine with this gas, which they then call *stum* wine, which they put into the cask for the same purpose.

3320. Sometimes, after these operations are finished, the wine is not completely clear, and requires to be *clarified* or *fined* by isinglass, whites of egg, or substances of that kind. Finally, the whole is completed by bottling.

3321. *The fermentative process, as well as every part of the manufacture of wine, requires great attention* united to experience and skill, and it varies exceedingly in different places ; so that, although the subject has received considerable elucidation and improvement from the labours of Chaptal and other eminent chemists, particularly in France, where, perhaps, the best wine-makers in the world are to be found, yet the French themselves allow that there is still much to be done before fixed rules can be given ; and our object here is rather to touch upon the prominent facts in the manufacture of foreign wines than to enter into minute details.

Subsect. 4.—*Distinctions in Wine which arise chiefly out of the Manufacture.*

3322. *Perhaps the most obvious division of wines* is according to colours, as *red* and *white*; but another arrangement, generally received, considers them as, 1, *dry and strong*, as Port, Sherry, and Madeira ; 2, *dry and light*, as Hermitage, Claret, Burgundy, or Hock ; 3, *brisk, effervescing, and sparkling*, as Champagne ; 4, *sweet*, as Malmsey, &c. ; to which we may add the *Vino cotto*, or boiled wines.

To understand well these distinctions, it is necessary that we attend to some circumstances in the manufacture which give rise to them.

3323. *The colour of wine is owing to the following causes :* If the skins of the grapes or marc are entirely excluded from the fermenting vat, a *white wine* is always obtained, the juice of almost all grapes, black and red, as well as green, being colourless. Champagne is made from a red grape so deep in colour as to approach to black, and sherry is made from a mixture of white and coloured grapes. The colour of *red wine* is derived from permitting the wine to ferment in contact with some of the marc, the colouring matter of the grape residing altogether in the skin, with the exception of the grape called *Tintilla*, from which Tent wine is made, in which the juice is coloured. This colouring principle is soluble in alcohol; therefore, when the alcohol is developed by the fermentative process, the must becomes coloured in consequence of the action of the spirit upon the marc. The wine is also more deeply coloured, from a higher degree of pressure given to the husks of the grapes. The colour of red wines varies from a light pink to a deep purple tint, approaching to black; the clarets hold the intermediate rank between these two extremes; and Dr. Henderson observes that, "on exposing red wine in bottles to the action of the sun's rays, the colouring matter is separated in large flakes, without altering the flavour of the wine." The colour derived from the skins of the grapes alone is not generally very deep; and the high-coloured wines of France and Portugal are often rendered so by colouring ingredients, particularly by mixture with an intensely deep-red wine called *vino tinto*, and sometimes by elderberries and colouring drugs.

Part of this colouring matter is often precipitated by long keeping in the bottle, as is the case with port; and hence one of the tests of the age of port that has been kept in the cellar is the paleness of its colour, though this is sometimes produced fraudulently. Some white wines are nearly colourless, but the greater portion have a yellow tinge; and the pale yellow wines, when long kept, acquire more or less of a bright amber hue, and sometimes a tinge of brown. Certain wines, as those of Moldavia, have even a greenish colour.

3324. *Agreeable flavours are occasionally given to wine* that do not belong to the grape by means of aromatic substances, such as orris-root, elder flowers, raspberries, &c. The nutty flavour of some Madeira wines is given by almonds. The ancients relished the flavour of resin or pitch in their wines, a taste which continues among the modern Greeks, but would be intolerable in this country.

3325. *The distinction of dry, brisk, and sweet wines* depends upon the mode of conducting the fermentation. To explain this part of our subject, we must recall to the reader's recollection a few of the leading facts respecting this process.

We stated that the formation of alcohol, which constitutes the distinctive property of every vinous fluid, was the result of the mutual action of saccharine matter and the fermenting principle on each other; and that wine consists of a combination of this alcohol, water, a minute quantity of the essential oil of the grape constituting the peculiar aroma, and sometimes colouring and astringent matter.

3326. *Dry wines* are those where the saccharine matter and the ferment were so exactly balanced that they have decomposed each other by their mutual action, and no sweetness is perceptible, a certain quantity of sugar requiring a certain proportion of ferment for its decomposition. This is considered to be the most perfect class of wines, as the best Burgundies and ports. Such perfectly fermented wine is free from acid, and is not liable to change in any moderate length of time.

3327. *Sweet wines* are those where the saccharine matter was in too large quantity to be decomposed entirely by the ferment, or where the process of fermentation was interrupted before its completion; consequently, some of the sugar remained unacted upon, and in a free state in solution in the wine. Of this class are the rich malmsey and Muscadine wines, as Malaga, &c. In making sweet wines, boiling the juice is sometimes resorted to, because by the heat a part of the ferment is coagulated and rendered ineffective; and, therefore, the whole of the grape-sugar is not decomposed during fermentation, owing to the deficiency of this principle. If the grape-juice be deficient in sugar, some cane-sugar is added, or, what is better, starch-sugar, which is the same as that of the grape.

3328. *Brisk or effervescing wines* have had the fermentation checked before it was completed, the wine being transferred into bottles before the whole of the carbonic acid had separated, a portion of which, being formed by the continuance of fermentation in the bottle, is there absorbed by the wine, and retained in a condensed state; this, when freed by withdrawing the cork, is disengaged with noise and violence, giving the appearance described by the term briskness, such as is seen in the common Champagne.

From the above description, we may see that it is easy from the same grape juice to make any of the three classes of wine, by certain management in the manufacture, for which more particular directions will be given when we treat of the making of domestic wines.

3329. *What is termed the bouquet of wines* is that agreeable aromatic odour which is perceived on drawing the cork of any of the finer wines on their exposure to the air. In some of the Burgundies and other French wines, it is highly rich, and does not seem like a single perfume, but rather as the union of several. This aroma, so much valued in some wines, cannot be accurately described by words, and must act upon the senses to be comprehended. It appears to depend upon a fugacious principle, probably some extremely volatile oil, which the chemist has not yet been able to separate, perhaps from the quantity being too minute. In the sweet and half-fermented white wines, this is immediately derived from the fruit, as in those from the Frontignan and Muscat grapes; but in the more perfect red wines, as in claret, Hermitage, Rivesaltes, and Burgundy, it bears no resemblance to the natural flavour of the grapes from which they are made, and is altogether the product of the vinous process. This delicate aroma, when it exists, considerably enhances the quality and value of the first wines, and it is dissipated and lost by too rapid a fermentation. Liebig has lately described this volatile substance, the produce of the fermentation, as a peculiar ether, which he has named *œnanthic ether.*

The wines of warm climates have no odour; those of France have it in a considerable degree, but the perfume is the most intense in the best Rhenish wines.

3330. *The flavour of wines*, called by the French *sève*, is different from the *bouquet;* the former indicates the vinous power and aromatic savour which are felt in the act of swallowing the wine, whereas the latter affects the organ of smell rather than that of taste. In the red wines of Medoc and the Graves, these, the sève and bouquet, are developed only in the old wines. A fictitious bouquet is sometimes given to new wines by means of orris root.

3331. *It is not an uncommon thing for the manufacturers of wine to mix two or more wines together*, in order to produce one of better quality, by correcting the defects of each other. By this mixing, the fermentative process is partially renewed, and the mixture is said to *fret;* hence the practice is called *fretting in.* Mixed wines appear to unite into one durable and homogeneous liquor only in consequence of this kind of fermentation.

3332. *Boiled Wines*, or *Vino Cotto.*—In our account of the wines of the ancients (Sect. II., Subsect. 11) we shall find that it was their practice to concentrate the must by boiling; thus increasing the relative quantity of sugar and fermenting principle by reducing the water. This method is still followed in some parts of Europe, as in Greece, Italy, and Spain. The richest grapes of the Muscadine species are chosen for this purpose; and after having been exposed for a few days to the sun, they are pressed in the usual manner, and the juice boiled till it is reduced to one third. It is then skimmed and put into vessels to cool, after which it is barrelled up. These wines are very pleasant to the taste, of a deep amber colour, delicate and generous. Mr. Redding states that Corsica is famous for such wines, which are treated so judiciously by boiling, that in the north of Europe they are taken for Malaga or Canary. When very old, they are often passed off for Cyprus, Tinto, or Malaga of the best kind, as the owner may wish them to seem. But many boiled wines, as they experience very little fermentation, scarcely deserve the name of wines, and are little more than boiled must; of this kind are several varieties of the *vino cotto* of Italy, particularly near Bologna.

Sect. II.—DESCRIPTION OF FOREIGN WINES.

3333. It is not our object to attempt the complete description of the vast number of wines produced in various parts of the world; we shall confine ourselves to such as are imported into Britain, or have acquired such celebrity as to be pretty generally known among us. This subject may be considered as so much the more important, since immense sums are annually expended in the purchase of foreign wines, yet an accurate knowledge respecting the true merit and value of the various kinds is little diffused, and money is sometimes injudiciously expended on this class of luxuries. It will be most convenient to treat of the wines of various countries separately.

Subsect. 1.—*French Wines.*

3334. France, owing to her fine climate, and the great fertility and variety of her soil, is eminently calculated for the manufacture of wine. In that country, also, scientific principles have been applied to it with great success. Not only is wine produced in France in the greatest abundance, but likewise in the greatest variety, from the light Champagne and Burgundy to the luscious sweet winds of the south, and the *vins ordinaires* of the several districts.

3335. But notwithstanding the celebrity of French wines, which are transported to every part of the world, and the acknowledged skill of the manufacturers, it must not be supposed that they are to be indiscriminately approved of. A large proportion of French wines is of a very inferior character, and it is only from the first establishments that the finest wines are to be procured.

Although in France there are only a few departments in which the vine is not cultivated, yet certain wine districts have acquired greater celebrity than others, either on account of the superiority of their produce, or from their being more conveniently situated for exportation.

Those departments which compose the ancient provinces of Champagne, Burgundy, and the Bordelais at present furnish the greatest abundance of the best French wines. Some of the sweet wines of the southern departments are excellent; but the wines of the northern parts of the kingdom, as those of the Moselle, are, in general, very indifferent.

3336. *It is generally supposed, in England, that French wines are too cold for the constitution*, and particularly for those who have been accustomed to port and sherry. There is probably some truth in the observation, when the ordinary French wines are taken into the account; but the objection will not apply to the stronger wines of that country, even when they are quite free from brandy. It is observed by Dr. Henderson that France furnishes some of the best wines in each class, and unquestionably excels every other region of the globe in the manufacture of red wines in particular.

3337. *During the period when England had possession of several provinces of France*, French wines were imported into this country in great abundance from Gascony, Guienne, Touraine, Anjou, and Poitou; and in the beginning of the reign of Henry II., a considerable trade in wine with Bordeaux commenced; but the Gascon wines exceeded in quantity all the others. It would appear, from the large quantities imported, and the low price at which they were obliged, by royal enactments, to be sold, that foreign wines must have been pretty generally drunk in England at that time among the wealthy classes. The province of Guienne remained in our possession near three hundred years. Richard II. was born in Bordeaux, the capital, while it belonged to England; and the province was given up only in the reign of Henry VI. So cheap were French wines in England in the reign of Henry VIII., that those of Gascony and Guienne were forbidden to be sold at above eightpence the gallon.

The wine trade with France was in the most flourishing condition under Edward III., when, as Froissart relates, upon one occasion a fleet of above two hundred merchantmen came for wines from England to Bordeaux, then the seat of the Black Prince's government. In the same age the wines of the Rhine and Moselle appear to have been largely imported. It was upon Gascony that the English chiefly depended for their favourite supplies of clarets and other light wines, which seem to have resembled generally the modern growths of the same country.

3338. *Champagne Wines.*—This, the most celebrated of French wines, is the produce chiefly of the province of that name, and is generally understood, in England, to be a brisk, effervescing, or sparkling white wine, of a very fine flavour; but this is only one of the varieties of this class. There is both red and white Champagne, and each of these may be either still or brisk. There are the sparkling wines (*mousseux*), and the still wines (*non-mousseux*). The brisk are, in general, the most highly esteemed, or, at least, are the most popular in this country, on account of their delicate flavour, and the agreeable pungency which they derive from the carbonic acid they contain, and to which they owe their briskness.

There is a great difference in the quality of these wines, according to the particular vineyards at which they have been made. The finest wines are produced in the sloping grounds on the north bank of the River Marne, where the soil is extremely calcareous; and they are mostly white wines.

3339. The very finest of the sparkling Champagne is that of *Ay*, five miles south of Rheims; its delicious aroma has been compared to that of the pineapple. This place has long been highly distinguished, and our ancestors took no small pains to secure to themselves the choicest productions of the vineyard; for it is said that Francis I. of France, Pope Leo X., Charles V. of Spain, and Henry VIII. of England, had, each of them, a vineyard at Ay, their own property, and on each vineyard a small house occupied by a superintendent. *Sillery* is a white Champagne, and the best of the still kind; it has more body and spirit than the sparkling varieties, and is very highly esteemed. This wine derives its name from the Marquis of Sillery, the original proprietor of the soil, and is produced from vineyards not far from Rheims; it is, perhaps, the wholesomest of all the wines of Champagne, the fermentation being more perfect. It will keep for years, whereas the sparkling wines soon spoil. Almost the whole of it goes to Paris and England.

The red Champagnes are seldom brought to England; but a few of them rival the rich wines of Burgundy. That of Clos de St. Thierry, near Rheims, is of a quality between Burgundy and Champagne, and is very highly prized by the connoisseur. There are also rose-coloured Champagnes; but these are less in request.

In selecting Champagne wines, many consider the briskness and effervescence as a test of their excellence; but a good judge will prefer a liquor of moderate briskness, as the aroma evaporates with the froth. Champagne is best to be iced a little before it is used, which tends to repress the effervescence, though, when it is kept cool, this is unnecessary.

The manufacture of Champagne in the best manner requires considerable skill, and is a matter of difficulty and uncertainty: it is always bottled; and the breakage is generally so great as to amount to from 10 to 20 per cent. loss. Cellars of immense size are cut in the chalk of the district where it is chiefly made, in which the temperature is very equable.

3340. Champagne intoxicates speedily, probably in consequence of the large quantity of carbonic acid which it contains, and of its alcohol being in a very volatile state; the excitement produced by it is of a more lively and agreeable character than that which is occasioned by any other kind of wine; but its duration is shorter, and the exhaustion which follows is less.

Dr. Henderson remarks that the general opinion of its being apt to occasion gout is at variance with the fact that this complaint is very unfrequent in the district where it is made, but he likewise observes that it is prejudicial to those habits which are liable to gout from other causes.

The price of Champagne in France varies considerably, according to the scarcity or abundance of the crop. On an average, the best Champagne is sold to the dealer at 3 francs a bottle. Transportation to Paris and the Octroi bring the price to about 3½ *francs*; and at the restaurateur's it costs 6 francs.

3341. *Burgundy—Vins de Bourgogne.* The choicest wines of the ancient province of Burgundy are certainly the first in the world for richness of flavour, perfume, and fulness of body, although they are not so popular in England as Champagne. These wines are both red and white. The red is most highly esteemed; but the most exquisite of these are so delicate they can scarcely bear exportation, though, like Champagne, they are always bottled; and, to have them in perfection, they must be drunk in the country where they are made. What we call Burgundy in England is seldom of higher quality than the second or third rate wines. The best of these wines are produced in so small quantity, and are so much in request in France, that they fetch there very high prices, and do not answer much more than the home demand; consequently, a very small proportion comes into our market.

The finest Burgundies are produced in the department of Cote d'Or, in Upper Burgundy, and a great deal is made round the town of Beaume. There is rarely more than one kind of grape grown in this part, namely, that called *noirons*, the colour of which is black when ripe, and quite round. From Beaume the best wine can be procured; it is sent in bottles above ninety miles to Auxerre, whence they pass, by means of the rivers Yonne and Seine, to Paris, and then down the Seine to Havre and London.

The first in quality of these wines is the Romanée Conté, but it is seldom met with genuine out of France. Next is the Chambertin, which, it is said, was the favourite wine of Louis XIV., as also of Bonaparte. The Clos Vaugeot is inferior, but more abundant. There are many other excellent wines of this class, scarcely known in England, and others are of an inferior description: hence our wine merchants, who are not such good judges of their quality as the French, are very liable to be imposed upon in purchasing them. In the second class of red Burgundies are the Maçon wines, also Chambolle, Muscigny, and Volney.

The white wines of Burgundy are less excellent, and in smaller number than the red, but still some of them rank very high for their fine flavour, particularly the Mont Rachet, La Perriere, La Goutte d'Or, Les Charmes, and Chablis; these are not dear, yet are little known in England.

3342. *Bordeaux Wines.*—All those wines called in England *clarets* are the produce of the country round Bordeaux, or the Bordelais; but it is remarkable that there is no pure wine in France known by the name of claret, which is a corruption of *clairet*, a term that is applied there to any red or rose-coloured wine. Round Bordeaux are produced a number of wines of the first quality, which pass under the name simply of *vin de Bordeaux*, or have the designation of the particular district where they are made, as Lafitte, Latour, &c. The clarets brought to the English market are, in general, prepared for it by the wine-growers by mixing together several Bordeaux wines, or by adding to them a portion of some other wines; but in France, the pure wines are carefully preserved distinct. The genuine wines of Bordeaux are of great variety, that part being one of the most distinguished in France; and the principal vineyards are those of Medoc, Palus, Graves, and Blanche, the produce of each having characters considerably different.

The red Medoc wines are of the very first quality, and are known by the designations of Lafitte, Latour, Chateaux Margaux, &c. When in perfection, they possess a rich, red colour, a bouquet resembling the perfume of violets and raspberries, are very agreeable, and are strong without readily intoxicating. The Lafitte is reckoned to have the finest flavour. The Margaux wine is next in rank. The Latour is the strongest of the Medoc wines, having the fullest body, but wanting the great softness of the others; it is, however, the principal one brought to the English market.

The Medoc district consists of a large plain lying on the north of the city of Bordeaux, and situated between the River Gironde and the seacoast of the Bay of Biscay. The vines grow on hills, consisting of a light, sandy, and calcareous loam, intermingled with flint pebbles. The quantity of the best wines made annually does not exceed eighty tons, far too little to supply all the places pretending to sell them; what is usually bought is, therefore, at least, of the second quality. So rare are the first-rate wines, that a bottle of the best Lafitte, Chateaux Margaux, or Haut Brion, costs, even in Bordeaux, six or seven francs. Some of the vineyards of the Lafitte have lately been purchased by an English house. Medoc wines of the second and third rate qualities are Leoville, Poulliac, Rauzan, &c. All the Medoc wines bear a sea voyage, and are rather improved by it.

3343. *The vins de Graves* are so called from the gravelly soil on which they are produced, to the east and west of Bordeaux: they are both red and white, but the latter is most celebrated and best known in England. Some of the red approach to the flavour of Burgundy, though inferior to the first of the Medoc wines.

Another class of white Bordeaux wines, well known in England, consists of Barsac, Sauterne, Beaume, &c., which have the advantage of keeping long and having considerable dryness.

The Palus wines are inferior to those of Medoc. They are strong and rough when new, and are often employed to mix with Medoc wines, to give them strength and body; but some of them, when old, have a rich bouquet. It is stated by Mr. Redding that there is a particular manufacture known by the title of *Travail à l'Anglaise* for preparing claret for the English market; in this, to each hogshead of pure Medoc wine is added three or four gallons of Spanish wine of Alicant or Benecarlo wine, half a gallon of stum wine, and sometimes half a gallon of Hermitage, which is of a very superior quality. This mixture undergoes a slight fermentation, called fretting in, and is then exported as claret. It is fortunate if this escapes being mixed with brandy. But the French wine brokers at Bordeaux, familiar with the qualities of the first growths, and anxious for the reputation of their wines, will supply claret with no other addition than Hermitage, providing a proper price be given.

The Bordeaux wines, when genuine, may be considered as among the most perfect which France produces. The fermentation, in general, being more complete than in any other, they are much less disposed to acidity and other disorders than the wines of Burgundy; they have less aroma and spirit, but more astringency, in consequence of which they are considered as the safest for daily use. The wines of Basseins and St. Eulalie d'Ambarres, near Bordeaux, furnish a wine that is generally purchased for the French navy, because it keeps well, and improves greatly at sea.

Besides the wines of the Bordelais which we have mentioned, there is a prodigious number of second and third rate wines made in this district, many of the latter unknown here by name, and seldom sent out of the country. Notwithstanding the late act by which the duties on French and Portuguese wines are equalized, and much reduced, yet Mr. M'Culloch, in his "Dictionary of Commerce," considers that the wine trade will not be placed upon a fair footing till the duty is imposed on an *ad valorem* principle. At present the same duty is paid on an inferior and cheap wine as on the choicest Burgundy and Champagne; and the effect of this is to exclude all low-priced wines from the English market. Bordeaux is, commercially speaking, nearer to London than to Paris; and, were it not for this system, the cheap wines of the Gironde, Languedoc, and Provence might be bought at a less price in England than in most parts of France, as was the case some centuries ago. Mr. Porter states, in his "Progress of the Nation," that there are good light wines produced in France that could be imported at sixpence per bottle without the duty, which is at present about one shilling per bottle.

3344. *Various other French Wines.*—Besides those wines of which we have given a short description, and which are best known in England, France produces a multitude of others, in almost every department, of various degrees of merit, and which it would far exceed our limits to specify. The celebrated *Hermitage* is the produce of vineyards situated on a hill of decomposing granite on the Rhone, twelve miles from Valence, in Dauphiny. It derives its name from some hermitages, now in ruins, to be seen upon the rock. The hill is so steep that the vines are planted on terraces, and the exposure is to the south. Red Hermitage is distinguished by its full body, deep purplish red, being the richest in colour of all French wines, and of an exquisite flavour and perfume resembling that of the raspberry. There is also a white Hermitage, which is considered as the finest white wine produced in France; its odour is like no other wine; its taste is rich, dry, and luscious. Of the wines grown in the Lyonnais, on the Rhone, the most noted is *Cote Rotie*, which bears a near resemblance to Hermitage, and is remarkable for the excellence of its colour, strength, and perfume.

As the climate becomes warmer near the shores of the Mediterranean, the vines grow with greater luxuriance, and many of the red wines of Languedoc and Roussillon are extremely fine, and of great body. Much of these strong wines of the south are sent to Bourdeaux to mingle with the poorer wines, to make up those for exportation.

3345. Some of the red wines of Roussillon are nearly of the strength and flavour of those of Oporto without brandy, and have been brought to England at two thirds of the price. A few years back some good Roussillon wine was imported and sold under the name of *Masdeu*: it is difficult now to get it here of the same quality; and it is said that most of it is carried to Oporto and shipped there as port, being thus charged at double or treble the price it ought to be.

3346. It is here also that those luscious sweet wines called *muscatel* are made of Muscadine grapes, such as those of Frontignan, Lunel, Rivesaltes, &c. The latter affords, perhaps, the finest Muscadine wine known.

The white wine called *Chablis* is grown at the village of Chablis, about two miles from Auxerre.

3347. All the vineyards between Fontainebleau and Paris are on the southern sides of the hills, which always furnish the best situations for vineyards. The Parisian wine-merchants, when they wish to have genuine wine, take care to secure it before it gets into the hands of the country merchants, who mix it with their old stock, or with the strong wines of the south, to make *more Burgundy*. This practice explains how almost all the inns in France pretend to have the choicest wines, notwithstanding the smallness of the quantities of each actually grown.

SUBSECT. 2.—*Wines of Germany, Hungary, and Switzerland.*

3348. The parts of Germany where good wines are produced are more limited than those of France. Those imported into England are chiefly from the banks of the Rhine.

3349. *Rhenish Wines.*—The choicest vintages of that country are confined to a small district called the *Rhingau*, on the right bank of the Rhine, including a space of little more than nine miles in length and four in breadth, from Basle to Mentz. The banks of the river there present favourable soils or exposures, being confined between high and steep banks, extremely suitable for the grapes, which are raised in terraces, and yield a profusion of excellent wines. North of Coblentz the wines are of little comparative note.

The first of the Rhenish wines for fine flavour and absence of acidity is the *Johannisberg*, produced on the south side of a hill of that name, a little below Mentz, which was originally planted by the monks of the abbey of Johannisberg. The choicest of all is called Schloss-Johannisberg, from a vineyard at the castle formerly belonging to the Bishop of Fulda, and now the property of Prince Metternich. Little of this comes into the market, and its superiority to the other wines of Johannisberg is accounted for by the care bestowed on the cultivation of the grape. But other vineyards in Johannisberg give wines of the first class.

The produce of the *Steinberger* vineyard is considered by some as next in rank, and is the property of the Grand-duke of Nassau. It is strong, with much sweetness and delicacy of flavour. It sells on the spot for eleven shillings a bottle. *Rudesheim* and *Graefenberg* are also among the first of these wines. Of second quality, are those of Marcobrunner, Roth, Konisbuch, &c. The true *Hock* is so called from the vineyards of Hockheim, a little town, not on the Rhine, but on the Mayne, a few miles from its junction with the former river; but this is always classed with the Rhenish wines, being nearly of the same excellence. Indeed, not only the wines made near Hockheim receive, in general, the name of Hock with us, but likewise, generally, those of the Rhine, the Mayne, the Nahe, and even the Moselle.

3350. The wines of the Rhine form a class different from all other wines. Some of the lighter kinds bear a considerable resemblance to the vins de Graves; but they are, in general, drier than any French wines. They are generous, finely flavoured, and are characterized by a delicate aroma that is peculiar to them. Though they do not contain much alcohol, yet, from the completeness of their fermentation, they will keep longer (continuing to improve by age) than the potent wines of the south with double the alcoholic strength. From a peculiar tartness which they possess, it is generally thought in England that these wines are acid; and the inferior kinds, no doubt, are so to a certain degree; but Dr. Henderson and others observe that this is by no means the constant character of Rhenish wines, many of which, in good years, have not any perceptible acidity to the taste; at least, not more than is common to them with the growths of warmer regions. It would appear, from their dryness and brightness, that the saccharine matter and the leaven have completely acted upon each other, and that the latter is all precipitated. Dr. Henderson is of opinion that they owe their durability to this circumstance, and to a considerable proportion of tartar, which they retain for a long time, the greater part of which is at length precipitated. In bad seasons, however, there is no doubt but that the inferior wines contain a portion of malic acid, in consequence of the grapes not having arrived at a state of full maturity.

The most celebrated of these wines are fermented in casks, by which the fine aroma is preserved, and then, after being repeatedly racked, are kept for years in very large vessels to mellow. Every one has heard of the tun of Heidelberg, which held six hundred hogsheads, and other prodigious vessels of that kind, in which wine has been kept even for centuries; and it is necessary that these should be always full, more new wine being added when any is drawn off, which, it is thought, contributes to their durability. For the more delicate wines, however, smaller vessels are preferable. It was, until lately, the custom in Germany to bury earthen vessels filled with wine at the birth of every child, not to be taken up till its marriage. Old Hock, though generous and durable, is considered as less heating, and, at the same time, more exhilarating than many other wines.

3351. *The Moselle wines* have, within the last few years, become very fashionable in England, and, when iced in the summer, are extremely grateful. They have a great analogy with those of the Rhine, and are generally classed with them, though inferior. The most celebrated are the Brauneberger, Wehlen, &c. Some of the good Moselle wines are cheap, and may be imported into England at three shillings a bottle.

Franconia and Suabia supply some white wines, which often pass for those of the Rhine; but in Austria the wines are very inferior, and extremely acid. The red wines of Germany are not of a superior kind, and have nothing to recommend them.

3352. *Hungarian Wines.*—The good wines of Hungary are limited to a few districts, although there are abundance of vineyards in the kingdom. By far the most celebrated of the Hungarian wines is Tokay.

3353. Dr. Bright informs us, in his "Travels in Hungary," that it "is raised in the last chain of the Carpathian Hills, in the neighbourhood of the town of Tokay. The district containing many vineyards extends over a space of about twenty English miles. Throughout the whole of this country it is the custom not to collect the grapes till they have become dry and sweet, like rasins, while hanging on the trees. They are gathered one by one; and it is from them alone that the prime Tokay, or, as it is termed, Tokay Ausbruch, is prepared, which in 1807 sold for 100 florins the cask of 180 halbes on the spot. They are first put together in a cask, in the bottom of which holes are bored to let that portion of the juice escape which will run from them without any pressure. This, which is called Tokay essence, is a sirupy liquor, and generally in very small quantity, and very highly prized. The grapes are then put into a vat, and trampled with the bare feet, no greater pressure being permitted. To the squeezed mass is next added an equal quantity of good wine, and the mixture is allowed to stand for twenty-four hours to ferment, and is then strained. The juice, without farther preparation, becomes the far-famed wine of Tokay, which is difficult to be obtained, and sells in Vienna at the rate of £12 per dozen. The greater of these vineyards is the property of the emperor; several, however, are in the hands of the nobles."

3354. The Vignerones prepare the grapes while on the vine in the same manner as the Italians do theirs for their famous Lacryma Christi: they go every morning through the vine rows, and give each bunch of grapes arrived at maturity a twist, and hang it over an adjoining branch of the vine, that the twist may not come out. This partially interrupts the ascent of the sap from the roots, and occasions them to dry, yet without wholly cutting off the sap, as this would cause them to dry too quickly, and concentrate the juice so that it would not flow on a moderate pressure. There are four kinds of wine made from the same grapes, Essence, Ausbruch, Masslach, and common wine, or vin du pays. The essence is thick, and seldom perfectly clear, very sweet and luscious; it is chiefly used to make up the other kinds, and when mixed with the masslach, forms a wine equally good with the ausbruch, and often sold for it. The principal ausbruch wine, of which presents are made to foreign ambassadors, and which is drunk at royal tables, is made up with essence.

3355. Another species of Hungarian wine, called *meneser*, is said to equal Tokay; next to that in value come the wines of Œdenburg, Rusth, St. Gyorgy, and Ofen, followed by a great many others, whose names are as various as the hills which produce them. It is interesting to remark that all these wines are produced upon soils originally volcanic. The vines are kept cut down close to the ground. Dr. Henderson well remarks that the Tokay essence corresponds exactly to the sirupy wines of the ancient Romans, and that the Tokay ausbruch, a dry, sweet wine, appears much the same with their wine called *passum.* But Dr. Townson, who travelled into Hungary, notwithstanding the encomiums passed upon Tokay, is of opinion that much of it does not surpass many of the sweet wines of Spain. Cracow in Poland is the chief deposit of old Tokay, and it has been sold as high as eight ducats a bottle. Hitherto the Hungarian wines have been little known in England, from the difficulty of transportation; but the improvements now making in the navigation of the Danube may probably be the means of introducing them in greater abundance into the British market.

3356. The Buda wine is very like Burgundy, and perhaps equal to some of it. It is said to have been a favourite wine at the court of London in the reign of James I. The Sexard wine on the Danube, between Buda and Esset, is strong and deep-coloured, cheap, and of good quality. These wines may be imported by the way of Trieste.

3357. *Swiss Wines.*—Switzerland produces some good wines, but they are not exported. Red wines are made at Schaffhausen, Bode, and Erlach in Berne: that of Neufchatel resembles Burgundy. In the Valteline they have an excellent red wine, much resembling those of France. Fine red wine is made in the country of the Grisons, and one which is white, called Chiavenna. In Valais they make some good wines, but others are very indifferent. The canton of Vaud produces dry wines resembling Rhenish.

Subsect. 3.—*Wines of Portugal.*

3358. From the climate of Portugal, one might expect its wines to be excellent; yet great part of the red wine imported from that country under the name of *port* is well known to be of a very inferior quality. It will be useful to trace the cause of this.

3359. Before the revolution in 1688, great quantities of French wine were imported into England, to the extent some years of 20,000 tuns. Besides Portugal, Spain and Italy at that time came in for a considerable share of our wine trade; and Spanish wines were imported from Gallicia, Alicant, Malaga, Barcelona, Benecarlo, and other places; Italy supplied us from Leghorn and Florence.

3360. When the war with France broke out in 1689, England was deprived of the supplies of Bordeaux claret, which, previous to that time, had been the wine chiefly drunk in this country. Recourse was had, as a substitute, chiefly to the red wine of Portugal, which then appears to have been imported for the first time, but which has ever since been the principal wine used in England, so as to have even changed the public taste in a remarkable manner.

In addition to this cause of difficulty in procuring French wine, the British government imposed a *discriminating* duty of £8 a tun upon it, and in 1697 raised it to no less than £33 a tun—a blow, it is said, then aimed at the French nation, in consequence of Louis XIV. having espoused the cause of the exiled family of Stuart.

It is very probable that this excess of duty would have been repealed when the excitement which gave rise to it had subsided, had it not been confirmed by the famous commercial treaty in 1703 with Portugal, which was negotiated by Mr. Paul Methuen, hence called the Methuen treaty, through which we bound ourselves to charge one third higher duties on the wines of France imported into England than on those of Portugal, the Portuguese, by way of compensation, binding themselves to admit our woollens into their markets in preference to those of other countries, at a fixed and invariable rate of duty. This, at the time, was considered as highly advantageous to this country, not considering that by this vindictive policy we gave the Portuguese a complete monopoly of the British market, at the same time that we excluded one of the principal equivalents which the French had to offer for our commodities, and thus deprived ourselves of commerce that would have been far more extensive than that with Portugal, besides provoking France to a retaliation that has been injurious to both parties.

The high duties thus imposed upon the wines of France became almost prohibitive, while the comparative cheapness of the wines of Portugal afforded a strong motive for their introduction. Previously to this time there were few vineyards on the banks of the Douro, and the wines sent to England were chiefly those of Lisbon or the adjacent country. But the increased demand for Portuguese wine led to the extension of vineyards. Several British supercargoes had settled at Oporto, and it is said that they first encouraged the proprietors of lands in the Upper Douro to devote themselves to the cultivation of the vine. But as the demand for the wines of that territory continued to increase, and the produce of the new vineyards were necessarily often of inferior quality, the growers and dealers resorted to various expedients for supplying the deficiency in the quantity required for exportation.

Originally the Portuguese wines were sent to England pure and unmixed with brandy, but soon after this treaty was concluded the Portuguese began to adulterate their wines, mingling brandy with the must during the fermentation, either from an impression that it was necessary to make them keep for exportation, or from some other causes less excusable. It is said, also, that an English factor, who resided at Viana, near Oporto, discovered and taught the use of the elderberry in deepening the colour of their wines. At that time Florence wine, which is highly coloured, being much drunk in England, a deep-red colour was thought necessary for the English taste; and hence, no doubt, have followed numerous expedients for giving artificial colour to wine.

About the middle of the last century, this practice and other adulterations became so prevalent that a considerable diminution took place in the consumption of Portuguese wine, and the trade of the growers, consequently, suffered in proportion. Many complaints of the adulterations of the wine were made, even by the English merchants themselves settled at Oporto; and some of these, in conjunction with the proprietors of the vineyards near Oporto, succeeded, through the influence of the Marquis of Pombal, in obtaining, in 1756, a charter from the Portuguese government to sanction a joint-stock company, with the avowed object of securing the reputation of the wines of the district by preventing all adulteration, and to protect the commerce. This charter granted to the Oporto Company the monopoly of a certain extent of territory on the River Douro, in which Oporto is situated, in which alone all wine intended for exportation was permitted to be raised; but, in fact, these vineyards were those belonging to the monasteries and the principal gentry of the country; and the absolute disposal of these wines was placed in the hands of the company, who were allowed to fix the prices to be paid for them to the cultivator, and likewise that for which they were to be sold to the foreigner; all mixture of these wines with others without the boundary being prohibited, however useful that might have been to the quality of the wines.

By this a complete monopoly was obtained by the Oporto Company, as far as England was concerned, of the best wines of Portugal. Some of the reasons for granting such a charter, such as checking the adulteration, were sufficiently plausible; but the injurious effect of this monopoly, and the injudicious conduct of the company, has been a subject of severe animadversion; and it has been confidently stated by almost all writers respecting it, that they have eventually been the means of retarding the improvement of the wines of Portugal instead of ameliorating them.

In Portugal, although the climate, soil, and situation are eminently well calculated for the growth of the grape, yet its cultivation is, in general, unskilfully managed, except in a few places: of these the principal are the vicinity of Lisbon and Oporto.

The wine country, or district of the Cima de Douro, or Upper Douro, granted to the Oporto Company, and from which we have our port, commences about fifty miles from Oporto. The wines produced here, the whole of which were purchased by the company, were divided into those destined for exportation to the English market, together with those consumed in Portugal, and such as were used by the distillers of brandy, and for supplying the taverns in Oporto the latter are seldom mixed with brandy. Wine that is the pure growth of the Douro, unsophisticated by any admixture of brandy, and that has not passed through the hands of the Oporto Company, is of a full mellow body, great mildness, and exquisite flavour; but the best of this wine is scarcely known in England. The very first growth of the Upper Douro is said to be produced at Pezo da Regna, and, when not brandied, resembles some of the Rhone growths of France, or the Cote Rotie. It has been frequently asserted, and is generally believed, that such wines will not bear sea carriage, or that they will not keep any length of time, without a certain portion of brandy, and also that the quality of the wine is much improved by this admixture. Whether this practice was originally begun in consequence of such opinion, or merely to please the English taste, cannot easily be determined; but it is maintained by Dr. Macculloch, Dr. Henderson, and others who have paid most attention to the subject, that brandy is not at all necessary to the preservation of wine that has been properly manufactured, and that, if mixed with wine, it never completely incorporates with it.

Dr. Henderson remarks that, "if the saccharine principle has been fully decomposed, and the superabundant leaven carefully separated by sulphuring and other means—or if a greater proportion of sugar exist in the must than the ferment can possibly decompose—the wine produced may be kept in close vessels, without any risk of alteration, during a long term of years." But he observes that in wines imperfectly made, and inclining to acescency, the change may be retarded by brandy. But, in checking one evil, another is brought on; "for it is very certain that, when the addition is made after the full fermentation of the must, no perfect incorporation of the two fluids will take place; but the flavour and perfume of the wine will become completely obscured; and the adventitious alcohol, combining with the aqueous part of the liquor, will occasion a gradual separation of the extractive and colouring matter, leaving merely a mixture of brandy and water with a slight vinous tinge. That this is the case must, I think, be evident to every one who has observed the progress of the decomposition incident to the inferior port wines, which can never be said to be in condition, but which, after a certain period, lose what little flavour they possessed, and become more or less tawny, while lighter wines, that contain no adventitious spirit, remain quite unchanged." This addition of brandy explains one of the methods by which many fraudulent wine-merchants produce the deposition of the crust on the sides of the bottle, which is supposed to indicate the years the wine has been bottled.

The power given originally to the Oporto Company, of fixing the price of the wine purchased from the grower, had a pernicious influence upon the quality of the wines of the Douro. They were usually fixed, by a fiat of their own, to two rates of prices, one for the wine for exportation, and another for that for home consumption; and they paid the cultivators the same price for these two kinds, whatever was their quality. To save the trouble of tasting the produce of each farmer, and paying him in proportion to its value, the whole of the small quantities was put together into one batch or repository for exportation, in order that they might be enabled to supply their customers in England with wine of the same or a standard quality; and, after the wines had been purchased of the great farmers, the agents bought up small quantities, even if inferior, to mix with the rest. The largest vineyards belonged to the monasteries, and the Jesuits were the best skilled in the making of wine. An acre of vineyard yields about three or four pipes. The wine growers had, therefore, no motive to exert superior skill and ingenuity, but contented themselves with raising, at the least possible expense, the greatest supply of such wine as was required for exportation, for which the company gave the highest price. All emulation was thus effectually extinguished; and the proprietors who possessed vineyards of a superior quality invariably mixed their wines with inferior growths, so as to reduce them to the port standard, and increase the quantity of average wine. "In this way," says Dr. Henderson, "the finer products of the Douro vintages have remained, in a great measure, unknown to us; and port wine has come to be considered as a single liquor, if we may use the expression, of nearly uniform flavour and strength, varying, it is true, to a certain extent in quality, but still always approaching to a definite standard, and admitting of few degrees of excellence. The manipulations, the admixtures, in one word, the *adulterations*, to which the best of the wines of the Cima de Douro are subjected, have much the same effect as if all the growths of Burgundy were to be mingled in one immense vat, and sent into the world as the only true Burgundian wine. The delicious produce of Romanée, Chambertin, and the Clos Vougeot would disappear, and in their place we should find nothing better than a second-rate Beaume or Macon wine."

Not only, however, did the Oporto Company deteriorate the quality of their wine, but they also raised the price to an enormous height. In the year 1755 a pipe of red port might have been bought in the wine country, at the first hand, for from 2*l.* to 3*l.* per pipe; but, on the first setting up of the wine company, they raised the price to 8*l.* or 10*l.* per pipe. As the charter granted to the Oporto Company gave the sole privilege of exporting the wines of the Douro, they were secured against all competition from other English merchants, notwithstanding the Methuen treaty; and enjoying a complete monopoly of the British market, in consequence of the high duties on French wines, they filled their pockets at our expense; and at the time, says Fleetwood Williams, when they were shipping wine for England at 40*l.* a pipe, they have frequently sent the same quality of wine to other countries at 20*l.*!

The late alterations in the duties on wine, by which those on French and Portuguese wines are equalized (all wines now paying 5*s.* 6*d.* a gallon except Cape), will, no doubt, do much to repair the evils which have been complained of. The Oporto Company has undergone considerable modification, and many of its obnoxious privileges have been abolished. It remains to be seen how far these changes will improve the wines we have been describing. At present, since the injurious effects of brandied wines begins to be understood, intelligent port-wine merchants have endeavoured to bring over port wine with as small an admixture of brandy as possible; and, as taste improves, there is no doubt but that the genuine flavour of pure wine will be preferred to the fiery compound that is yet so general.

3261. *There are upward of forty varieties of the vine cultivated in Portugal;* but the most common or general sort used for the fabrication of port wines is called there the *Uvo Bastardo,* or bastard grape. It is of the smallest sort, round, about the size of an English sloe, grows quite close in the cluster, and has a remarkably thick, tough skin. In some seasons the skin is thicker than in others, and when it is thickest the wine is deepest coloured, and most astringent. The juice itself is colourless, and the deep red of the wine and its astringency are owing to the husks and stalks of the grapes during fermentation.

3362. *At present* we are informed that the farmers in the wine countries of the Douro, and also the merchants, are in the constant habit of mixing their wines, and giving to them those colours and flavours which render them acceptable to the consumers in the foreign markets where they are sold. This they make no secret of, the flavouring and colouring ingredients being thrown out of doors when the useful part has been extracted; nor do they consider this as an abuse, but as a part of the manufacture, in the same manner as with us, the distiller compounds his spirits for cordials. But most, if not all, the substances so employed are harmless, and it is only after the wine gets into the hands of fraudulent dealers that it receives noxious ingredients. Port, while in the wine country, is often coloured, when it is pale, by vino de tinto, or even by elderberries; thin-bodied varieties are blended with full and rich-bodied wines, to bring the whole to the market standard, and are strengthened by old Benecarlos wine of Spain, or the red Roussillon of France.

When the wine arrives in this country from Oporto, it is of a dark purple or inky colour, has a full, rough body, with an astringent and rather sweet taste, and a strong flavour and odour of brandy. After it has remained some time longer in the wood, the sweetness, roughness, and astringency of the flavour abate; but it is only after it has been kept also several years in bottle that the odour of the brandy is completely subdued, and what remains of the genuine aroma of the wine is developed. During the process of melioration, a considerable portion of the extractive and colouring matter is precipitated on the sides of the vessel in the form of *crust.* In some wines this change occurs much earlier than in others, particularly in those which have been manufactured with white grapes and coloured with elderberries.

3363. Several of the other vines of Portugal, although they do not find their way to this country, are described as excellent, plentiful, and as equal, if not superior, to those of the Douro. Among these are the growths of Torres Vedras, Monçaon, and Lunego. In general, these lighter red wines resemble the secondary growths of the Bordelais, and are inferior to port. A red wine called Colares Port, grown near Cintra, is sometimes imported into England. Tolerable red wines are also occasionally shipped at the ports of Viana and Figuerra, from which England used to be supplied previous to the introduction of the Oporto wines.

3364. The *vino tinto,* which has been mentioned above, is a thick, sweetish, black-red wine, formerly, and even at present, much used in deepening the colour of the red wines of Portugal, and seldom drunk alone; it is made from the wild vine, commonly called the *claret grape.*

Some excellent white wines are likewise produced in Portugal. *Bucelles,* grown a few miles above Lisbon, when pure, is much like *Barsac;* but, when it comes to us, is much brandied. *Carcavellos* and *Setuval* are sweet wines from the province of Estremadura, and known in England by the name of *Lisbon,* because they are shipped at that place; the first receives its name from the village of Carcavellos, near the rock of Lisbon; it is richer and dearer than common Lisbon, which is a pleasant-tasted wine, formerly much used as a table wine.

3365. *White port,* now little known, much resembling red port, except in colour, is the produce of the red and white grapes of the Douro, expressed together, and prepared in a similar manner to the red port, except that the marc, or skins and foot-stalks of the grapes are not fermented with the must. It is a wholesome, not unpleasant wine, mostly drunk in the country where it is made, or distilled into brandy.

Subsect. 4.—*Spanish Wines.*

3366. Spain, from the warmth of its climate and excellent soils, has many advantages for the manufacture of wine. The red wines are in general much inferior to those of France; but the Spaniards excel in the preparation of dry white wines, particularly of the sweet kinds, which are great favourites in Spain, and were formerly so in England. The vast abundance of wine in that kingdom, and the facility with which it is everywhere obtained, renders the inhabitants careless about the means of preserving it, and the wines are usually kept and carried about in goat's skins smeared with tar or pitch, which communicates a taste often so unpleasant that they are scarcely drinkable by strangers. Casks and bottles are very little used, partly through the poverty of the people, and because skins are more easily transported by mules on bad roads. The hole by which the original owner of the skin was taken out is sewed up; so are the legs, which serve as handles to carry it by, with the exception of one, which is tied by a string, and is used as a spout to draw off the liquor. The universal use of these skins (called *bota*) in Spain is one of the first things to attract the attention of a stranger, and gave rise to one of the most diverting adventures in the Don Quixote of Cervantes. Cellars are scarcely known, except in monasteries and large towns; but in the houses of the better classes, where the wines are kept in wood, they are often found of excellent quality.

3367. The finest wines are made in Andalusia and Granada, where great care is bestowed on the cultivation of the vine, and it is in the former province that the wine known among us by the name of *sherry* is produced. The term sherry is a corruption of *Xeres*, being made at Xeres de la Frontera, a few miles from Cadiz. The wine district is here six square leagues, and about 17,000 pipes are exported annually. Many of the principal vineyards in Xeres are in the hands of British and French settlers, whose agents superintend the manufacture of the wines. The grapes, which are white, are left to hang in the sun till they are partly shrivelled, and are exposed to it for forty-eight hours after they are gathered; at the same time, some quicklime is thrown over them, for the purpose of mollifying the fruit by neutralizing the acid, lessening the coarseness of the skin, and rendering the extraction of the juice easier and more abundant. After the grapes have lain a sufficient time they are put into a press, and there some brandy is sprinkled over them. The juice being extracted from the marc, brandy is again added, and the must goes through a regular fermentation; it is afterward put into casks and racked, when, again, another addition of brandy is made.

3368. *Wine-merchants distinguish several kinds of sherry*, as pale and brown, and there are various degrees of each.

Sherry, in general, is of an amber colour, and when good it has a fine aromatic odour, with something of the agreeable bitterness of the peach kernel. When new, it is harsh and fiery, and requires to be mellowed in the wood for four or five years. The wine-merchants of Xeres never exhaust their stock of finest and oldest wine, but keep it for adding a portion to what they dispose of at the highest price.

Sherry has of late got much into fashion in England, from the idea that it is more free from acid than other wines; but some careful experiments on wines do not fully confirm this opinion, and it is found that the *best* Madeira and port are equally free from acid. Two dry sherries are highly esteemed in Spain, *Amintillado* and *Manzanilla*, and they are said to be entirely devoid of brandy, and equally free from acid; but they are seldom brought to this country, though they deserve to be. The Amintillado, when genuine and old, fetches a high price, and is sometimes added to improve the ordinary sherries by its nutty flavour.

Pale sherries are made from the same grapes as the brown: the latter are coloured by an addition of some cheap must or wine which has been boiled till it has acquired a deep brown tint. The pale sherries were, some time ago, preferred in England, being supposed more pure; but the brown are now getting most into fashion. The inferior sherries exported to England are often mixed with a cheap and light wine called *Moguer*, and are strengthened in the making by brandy; but too frequently they receive adulteration by the London dealers. It is even asserted by Dr. Macculloch that a third of all the so-called sherries consumed in England is the produce of the home presses!

3369. The fine climate of Granada renders the vintage in that province extremely abundant as well as certain, furnishing the Muscatel, Bloom, and Laxias raisins.

The hills round Malaga are covered with vines, and no less than 10,000 presses are said to be at work during the vintage. The most celebrated of the wines are white, but there is also a sweet red wine called Tinto de Rota, so called from Rota, a little town opposite Cadiz, which produces but little true Tinto, and that is principally consumed in the country; this is what is called, among us, *tent* wine: it is a rich wine, used as a stomachic, and made from a deep red grape.

The wines of Malaga, known among us by the name of *Mountain*, are of two kinds, sweet and dry. The sweet wines are made from grapes completely ripe, and, when genuine, are highly esteemed; the dry wines are from grapes not so mature, are of an agreeable flavour, and improve by age. Some of the Malaga sherry comes next to that of Xeres, and is cheaper.

From Valentia, the *Benicarlo*, a strong, full-bodied, deep-coloured red wine, is exported chiefly to Bordeaux, as we have stated, to mingle with the wines of that place, in making up the claret for England, and to Oporto, for mixing with port. It is grown at a place which is a few miles from Valentia. At Alicante they have an excellent red wine.

From Catalonia a great deal of red wine is annually shipped to Bordeaux, and sent to England. The Macabeo of Catalonia is a sweet white wine; but the wine of this province is chiefly remarkable for its strength.

La Mancha is a wine district. There the celebrated Val de Pinas is produced: it is a good red wine, like unadulterated port. As it is sold at about 3*l*. 10*s*. per pipe, Mr. Inglis, a late traveller, observes that an enterprising merchant, taking with him into that country wine staves just before vintage, might secure, at an easy price, some very excellent wine. Murcia produces some very good *vins de liqueurs.*

3370. It is stated, in a late Spanish journal, that in consequence of the abundance of the growth of oranges in the south of Spain, several of the growers prepare from them a delicious wine, resembling Madeira in its flavour: the juice is fermented and put into casks, without the addition of brandy.

3371. Besides these Spanish wines, there are many in the various provinces little known to us; and there is no doubt but that, as the kingdom improves, they will one day be in much higher estimation, and will encroach much upon the Portuguese and French wines. When to the happy nature of the climate, and the richness of the soil, are superadded peace, knowledge, and industry, Spain may probably rival every country in its wines, although at present it is chiefly famous for sweet and white wines.

SUBSECT. 5.—*Wines of Madeira and the Azores.*

3372. The Island of Madeira is almost entirely of volcanic origin, and the soil produced by decomposing lava is found to be very favourable to the growth of the vine. This, added to the warmth of its climate, renders this place celebrated for the excellence of its wines. The vine was planted there soon after its first settlement by the Portuguese in 1421; but the introduction of the wines of Madeira into England is of more modern date than those of Portugal, and they were first brought here about the middle of the last century from the West Indies, which had been supplied from the island where they are made.

3373. *Madeira produces several kinds of wine.* The finest is *Sercial,* a red wine obtained from a grape much like the Malvasia, but which will only succeed on certain spots. The quantity of this wine produced does not exceed forty or fifty pipes in the year; it is harsh and austere when new, but is mellowed by being kept long.

3374. *The white wine usually known in England by the name of Madeira* is made in the greatest proportion; and, when genuine, is one of the richest wines in the world, having great strength, dryness, and delicacy of flavour. It is extremely durable in all climates, and is improved by age. It is meliorated in a remarkable manner by a sea voyage, a circumstance which was observed when it was first exported to North America. In consequence of this improvement, it has been the custom to prepare it for the European markets by sending it purposely to the East and West Indies, which, of course, must very considerably enhance the price. But it is by no means the case that the wine which has been on a voyage to India is the best Madeira, for inferior wines have been sometimes supplied for this speculation; and it has been discovered lately that by keeping the wine in a certain warm temperature, particularly with agitation, it is nearly as much improved as by a sea voyage, and in a much shorter time. Accordingly, it is the practice at present to ripen the wine in stoves in the island, where it is kept in a heat of 90°.

Madeira, being a strong wine naturally, has, least of all, occasion for the addition of brandy; yet it is the constant practice to add some of this spirit previous to exportation, which time incorporates. In other respects the first sorts are very little sophisticated; but the inferior kinds, of which there is a large proportion, are made up with almonds and various additions.

3375. The English wine-merchants who reside in Madeira consign their wines to agents in London, from whom it may be had genuine; and there is no other way of getting it good; but the great demand of late is said to have exhausted the island of all the finest old wine. Madeira should not be kept in a cold under-ground cellar, but in a warm part of a dwelling-house. To have it in perfection, it should be kept several years in wood, and nearly as much in bottle.

3376. *A Malmsey* wine of the first quality is also produced in Madeira from the Malvasia grapes, which are kept till over-ripe and partly shrivelled by hanging a month longer than the other grapes. This wine was much in request in England before the use of tea, when a few glasses were drunk after a meat breakfast: it is now little imported.

3377. Part of the red grapes are employed in making a wine called *tinta,* which is extremely astringent, and, when new, resembles Burgundy; but when it has been kept some time, it becomes pale, like tawny port, or even paler, and acquires, in part, a rich Madeira flavour.

3378. All the best wines are grown on the south side of the Island of Madeira; those from the north side are very inferior, and are chiefly used for distilling brandy, which is not very good; these are too often exported instead of the best wines; and they alone, well brandied, are sent to Russia. But even on the south side the wines are not all of the same quality; about one half is inferior to the rest, but are usually passed off as some of the best.

Madeira wines have lately got much out of fashion, and the prejudice against them has been considerably increased by a supposed discovery that they contain a little more acid than sherry, which is now generally preferred; but this opinion is disputed, having been derived from the inferior Madeiras. So difficult is it to distinguish all these varieties of wine, that a large portion of the inferior Madeiras are now sold for sherry; and even the best Cape wine passes for Madeira. It is stated in Holman's Travels that the winet rade of Madeira is rapidly declining; and that, in consequence, the planting of coffee has become very general in the island.

3379. The *Azores* produce a Malmsey, called *vino passado*, and also a dry wine; but both are inferior to Madeira wines.

3380. *The Canary Islands* formerly produced a great deal of sweet wine, which was formerly imported into England.

3381. *Teneriffe* has the best wines of all these islands: what is called Vidonia is a dry wine, much resembling Madeira. The Malmsey of Teneriffe is excellent: common Teneriffe wine is inferior. The wines of these islands were formerly, in England, called *Sack*, as well as sherry and Malaga. Orotavia is a wine so called from the port where it is shipped.

SUBSECT. 6.—*Wines of Italy, Sicily, and Greece.*

3382. Before our intimate connexion with Portugal in the wine trade, some wines were brought from Italy and Greece, but at present very little is imported from thence. Notwithstanding the favourable soil and climate of these countries, the wines produced there, with a very few exceptions, are of an inferior quality.

3383. The wines of Italy are all made for home consumption only; and though many good wines are produced by land proprietors for their own use, the greater part of the ordinary wines are execrably bad, principally owing to the careless mode in which they are manufactured. In Tuscany, however, more attention has been paid both to the cultivation of the vines and to the vintage than in the other Italian states, which is much owing to the care of the grand-dukes. In the villas of Italian noblemen some good wines may be found, but these are not exported. The sweet Muscadine wine of Monte Pulciano is the most celebrated, and the red Muscadine of Aleatico; but the Tuscan wines, upon the whole, do not equal those of Spain and Portugal.

3384. The volcanic soils round Naples are particularly favourable for the vine; and the exquisite Lachryma Christi, produced on Vesuvius, is well known; but the best variety of red wine grown at Galetta, having a rich Muscadine flavour and perfume, is very rare: an inferior kind is sold from Torre del Greco, and other places in the vicinity; a white Muscadine is also made on Vesuvius. A bottle of full-bodied wine of the ordinary kind may be had at Naples for twopence halfpenny, and at Rome for fourpence.

3385. Calabria produces some good wines; but in some parts the heat is even too great, and they are obliged to shade the vines from the sun.

3386. The principal wines of Italy are consumed in Rome, and some very fine are made in the Papal States, as at Albano, Monte Fiascone, and Orvietto, &c.; but they do not bear carriage, and are known only in the country.

3387. Throughout Italy, generally, the vines are suffered to run up in wild luxuriance, being carried from tree to tree round the enclosures, without any pruning, and to waste their strength, not in fruit, but in leaves and branches. In fact, such a quantity of fruit is produced with very little trouble, that the farmers, who use the wine only for their own beverage, and have no motive sufficiently powerful to induce them to take much pains, manage the vintage in the most slovenly manner. The wines are, therefore, often exposed to acidity.

3388. *Sicily* is nearly in the same circumstances as Italy with respect to the abundance of its wine, and the bad management of it in general. The Marzara and Marsala white wines are imported into England; and, could they be had free from the admixture of Sicilian brandy, which is peculiarly harsh, would be found of good body, and to resemble the lighter kinds of Madeira. They are among the least expensive of our foreign wines; and many of the vineyards are in the occupation of English merchants. Some of the hills at the foot of Mount Etna are covered with vineyards, and a great variety of wines are produced there; but it is only the inferior growths that are brought to us. Some red wines are made, but they are not excellent.

3389. *Corsica* produces, among several wines of various qualities, one called *particolore*, of excellent flavour, and a fine red colour: it is stomachic.

3390. *Greece, so celebrated in ancient times for its wines*, still produces some of superior quality, and in many places the processes of manufacture are far from being injudicious.

3391. Before the oppression of the Turks, good wine continued long to be made in Candia, Cyprus, Scio, Tenedos, Cephalonia, Zante, Lesbos, Nanos, and Santorini. When under the Venetian republic, Candia and Cyprus supplied the whole of Europe, and particularly Venice, with the finest Malmsey, and towards the end of the sixteenth century they exported 200,000 casks of this wine. Since the conquest of Greece by the Turks the quality of the wines has deteriorated; but Candia and Cyprus at present afford an excellent red wine resembling claret, and dry as well as sweet muscadine white wines of a very fine quality; in short, these two islands alone could furnish us with every variety of wine in abundance. Wine of Cyprus is particularly praised for its keeping quality, and improving by age: in that island, the hills on which the vine is cultivated are covered with stones or flints with a blackish earth. The vessels in which the grape-juice is fermented are of earthen-ware, covered internally with a mixture of turpentine and pitch, and the art of making them is extremely ancient; the leathern bags in which the wine is carried are pitched, which communicates to the wine a taste which does not go off for many years; it is ten years old before it is exported. Mr. Fuller informs us that the chief production of Cyprus now is wine, of which there are several qualities; the red kinds are sound and well flavoured; but the most celebrated is the white wine, called *vino della commanderia* (from its having been originally made on vineyards belonging to the knights of St. John), which resembles in taste the *vino d'oro* of Mount Lebanon, or the Mountain of our cellars: it is exceedingly strong, and will keep and continue to improve till a very great age. The muscadine wine of Cyprus is excessively sweet, and drinks best at two years of age; it has probably undergone no change since the days of Strabo and Pliny, who considered it as the most valuable in the world; after sixty or seventy years this wine is as thick as sirup.

3392. But in many parts of Greece, where circumstances do not admit of the proper means being employed in making and preserving the wines, and where the poverty of the inhabitants prevents their having casks, they are spoiled by the pitch and tar which the skins to hold them are smeared with; and a custom prevails of adding to them salt, gypsum, and lime, with a portion of resin, as among the ancient Greeks. These mixtures are not drinkable except by the inhabitants.

3393. *In the Ionian Islands*, now in our possession, some excellent wines are made. Those of Cephalonia and Ithaca have been found very fine, the former having a peculiar muscadine flavour. In Zante there are both dry and sweet wines. Corfu produces *Rosolio*, a rich liqueur wine; others resemble claret. These wines are now beginning to be drunk by some of the Turkish magnates, notwithstanding their prohibition by the Koran. In some of the islands they use vats of masonry, and some keep the wine in large earthen jars, which they bury up to the neck in the ground, in the manner of the ancients.

Malmsey is a corruption of Malvasia, from Napoli de Malvasia in the Morea, where that class of sweet wines was originally made, and which has since been imitated in every wine country in the world. The conquest of that country by the Turks destroyed this manufacture in the Morea; but it is still continued in Candia. The term is now applied to any wines of the sweet and luscious kind.

3394. *On the Crimea* some good red wines are produced; and, as the climate is excellent, and the Russians are very desirous of wines and brandy, the cultivation of the vine is on the increase.

SUBSECT. 7.—*Wines of Africa.*

3395. The Mohammedan religion has impeded the cultivation of the vine in Northern Africa, although wine is made in a few places by Jews and others not Mohammedan, as at Tituan, where it is said to equal that of Xeres.

3396. *Cape Wines.*—At the Cape of Good Hope, the goodness of the climate and the equality of the temperature are particularly favourable to the cultivation of the vine; and large quantities of wine are now brought to us from thence. The Dutch were the original settlers at the Cape, and first planted vines there in 1650. But they have been extremely imprudent in their choice of situations for the vineyards, many of them being placed in rich, low soils, instead of being confined to dry, rocky lands; and their mode of culture proves that they were more solicitous about the quantity than the quality of their wine. To this defect has been added careless training and dressing; in consequence of which, with a few exceptions, the wines of the Cape are at present of very inferior quality. These exceptions, however, prove that good wine may be produced in that country. The grapes originally planted were the Muscadine, Frontignan, and other European varieties; and in those parts where the soil has been congenial, and the mode of culture proper, good wine is manufactured. The best wine of the Cape is *Constantia*, so called from being made on two farms of that name, and about eight or nine miles from Cape Town, where the soil is stony. One farm produces red wine, and the other white. Very good wine is also produced in some other places. There is also a white wine called *Cape Hock*, and a red wine called *Rota*.

Cape Madeira is said to be mixed with some boiled must; but it is likewise strengthened by bad brandy. Most of the Cape wines brought to England have a disagreeable taste called *earthy*, are often acid, and want flavour; yet the smaller duty which they pay occasions the importation of an immense quantity; that annually entered for home consumption being about 540,000 imperial gallons, much of which is said to be employed as a convenient menstruum for adulterating sherry, Madeira, and other wines.

In no other wine country is there greater room for improvement in the manufacture of wine, nor is there any place where science and care, properly directed, would produce more beneficial results. As the Cape is the only colony which we possess where the art of manufacturing wine is practised upon the great scale, it would appear to be extremely desirable that the new settlers should be made acquainted with those scientific principles which have given the French so great advantage.

SUBSECT. 8.—*Wines of Asia and America.*

3397. It does not enter into our plan to follow up this sketch of an account of the principal wines of Europe, by noticing all those in the other quarters of the globe, yet it would seem imperfect were these entirely omitted.

3398. *Persia* is supposed by some to have been the native country of the vine, and certainly it grows there with unequalled luxuriance, the grapes attaining an extraordinary size. The Persians have always been less scrupulous observers of the precept of the Koran, which forbids the use of wine, than other Mussulmans; many of them indulge freely in this beverage, and suppose that they evade the law by drinking only what is made by Jews or Armenians. The white wine of Shiraz has a high celebrity, and a great deal of it is sent to the East Indies in bottles. A fine, sweetish, red wine is made near Ispahan. These are the only wines at present made in Persia.

Some wine is made in the *Crimea* belonging to Russia. In 1831, no less than 9,600,000 bottles of red wine, called Kokour, were produced in that province.

3399. *The other wines of Asia* are few and little known. Syria produces red and white wines like Bordeaux, and boiled wines are made on Mount Libanus. India produces little or no wines, except in the northern parts, near the Sutledge and Indus. At Lahore good wine is made, and also in Candahar and Cashmere; the latter resembles Madeira. Grape wine is scarcely known in China.

3400. *Wine is made both in North and South America*, in many places. In the former the vine grows wild on the Ohio, and also in Louisiana and Florida, where the grapes attain an immense size, and wine is made, but not of the best quality. The Hock grape was introduced into Canada and Ohio by German settlers. Near Washington is grown a species of grape named *Catawba*, unknown in Europe; and at Boston there is a good grape called *Isabella*. South America abounds in vineyards. Between Buenos Ayres and Mendosa, they are extremely productive; and wine is made of a secondary class, both dry and sweet, red and white. Some is sent to the United States. Peru produces delicious grapes; and wine is manufactured in some places, which, by proper management, might be excellent. That of Pasco is the best, where the Muscatel grape excels that of old Spain.

3401. To make out a mere list of the numerous wines made in the various countries of the world would be almost impossible. In the following table are placed the most remarkable of those which are imported into this country; and a few, perhaps, only known at present by name.

French Wines.

Red Wines.

1st class.
Romanée Conté.
Romanée St. Vivant.
Clos Vaugeot.
Chambertin.
Richebourg
La Tache.
St. George.
Clos de Tart, St. Jean, Le Perriere, Mont Rachet, Muscigny } Burgundies.
Lafitte, La Latour, Chateaux Margaux, Haut Brion } Bordeaux wines.

2d class.
Verzy.
St. Thierry.
Vosne.
Red Hermitage.
Cote Rotie.
Roussillon.
Pomard.

3d class.
Hautvilliers.
Mareuil.
Fleury, Blagny, Santenay, Clarion } Burgundies.
Crozes.
Gervaut.
Chateauneuf.

White Wines.

1st class.
Mont Rachet.
Hermitage.
Riversaltes.
St. Bris.
Pontal.
Sauterne.
Barsac.
Sillery, Ay, Marceuil, Dizy, Hautvilliers, Pierry } Champagne.
La Perriere, Goutte d'Or, Combotte, Genevrière } Burgundies.

2d class.
Menil, Oger, Cramaut } Champagne

3d class
Vaumorillon
Grenouille.
Chablis.
Valmare.
Vandesir.
Pouilly.
Etoile.
Frontignan
Lunel.

Wines of the Rhine and Moselle—Hocks.

Rhine.
Schloss Johannisberger.
Johannisberger.
Reinberger.
Rudesheim.
Laubenheimer.
Kœsterich.
Niersteiner.
Œstricher.
Zoruheimer.
Hockheimer.
Graefenberger.
Oppenheimer.
Vaskenheimer.
Roth.
Koningsbach.
Ungstein.

Moselle.
Braunenberger.
Scharzberger.
Graach.
Zettingen.
Wehlin.
Piesport.
Reinsport.

Wines of Portugal.

Red or Ports.
Pezo de Regna.
Abasas.
Villarinho des Tricres.
Gorvaens.
Hormida.

White Wines.
Carcavellos, or Lisbon.
Bucellas.
Setuval.

Wines of Madeira.

Malmsey.
Madeira.
Sercial.
Tinto.

Wines of Italy and Sicily.

Lachryma Christi.
Reggio.
Ovieto.
Asti.
Aleatico.
Mazara.
Marsala.

SUBSECT. 9.—*On mixing Foreign Wines in the Manufacture, and particularly with Brandy.*

3402. Wines of the first quality, whose principal merit consists in the bouquet, are never mixed with any other, but each variety is preserved as much as possible in its natural pure state, being marked according to the year of the vintage; and the wines of certain favourable years are much more highly esteemed than others. But the second-rate produce of certain vintages in unfavourable seasons, and of particular vineyards in all seasons, require to be mixed with other wines to correct some bad quality or defect. These mixtures are made by the wine-growers or the foreign merchants, and are often done very judiciously by persons who have great skill in thus improving the wines; these are not, therefore, considered as adulterations, because the wines which are added are equally expensive with the others. Thus, to weak wines are often added those of a more generous nature; and certain wines will not keep sufficiently long without being mixed with others. They are also mixed to suit the taste of different markets; thus, wine prepared for Paris is different from that made up for London, and those for Russia or Germany require a peculiar treatment. It is said, however, that wines consumed in France are less mixed than such as are sent to other countries, probably because people there are more accustomed to the taste of pure wines; and it is impossible by any mixing to produce the qualities of the first growths. Respectable wine-growers or dealers never sell mixed for pure unmixed wines, as the former are always inferior in price. No rules can be given for mixing the produce of different vintages or vineyards with each other, as it must depend upon so many variable circumstances; the taste alone, and experience, can indicate the state of the wine, and the quality and quantity of that which it is proper to add, and this can only be done properly by persons much accustomed to this business.

3403. *One of the great evils in many of the foreign wines imported into England is the large addition made to them of brandy*, which all physicians who have written on this subject consider to be injurious to health. It was at one time supposed that alcohol did not exist ready formed in pure wine, but only the elements of alcohol; and it was imagined that these combined and produced the alcohol during the process of the distillation. This opinion was rendered probable by some curious facts. It is found that the chemist can obtain, by distilling Madeira, Port, or Sherry, nearly one fifth their bulk of alcohol; so that a person who drinks a bottle of either of them will swallow nearly a quarter of a pint of pure spirit as strong as brandy; yet every one knows that the latter would produce a more intoxicating effect than a bottle of wine. It was agreed, therefore, that, according to chemical language, alcohol was the *product*, and not the *educt*, of the distillation of wine; that is, that it had been produced, or actually formed, by the process of distillation which had been employed in analyzing the wine, and had not been merely extracted ready formed from the wine in which it existed. This opinion had originated with Rouelle, a French chemist, and had been supported in this country by Dr. Macculloch and others.

It was, therefore, very important to determine what was the fact; for, if this opinion is well founded, it would account for the difference of effect obviously produced by taking a bottle of wine, or a quarter of a pint of brandy; and it would follow that, if no alcohol ready formed really existed in wine, this beverage did not, and could not, produce the same injurious consequences on the stomach as spirits and water. Careful experiments upon wine were, therefore, instituted, a few years back, to determine this interesting question; but, unfortunately for the theory, the result of these was unfavourable to it. Gay Lussac separated the alcohol from wine at a temperature of 66°, which was considered as too low a heat to effect that combination of principles that had been supposed to give rise to the alcohol; and since that time, the same thing has been done even at 56°, and in a vacuum. It has been, therefore, concluded that wine does contain alcohol already formed in it; and this conclusion has been confirmed, and the question nearly set at rest, by experiments made by Professor Brande, who, without any additional temperature, and by other chemical methods which, it is thought, cannot possibly cause the formation of alcohol, has separated this liquid from a great variety of sorts of wine.

Notwithstanding this decision, however, the fact of the difference in the effect on the constitution which we have mentioned, between a quantity of pure brandy or brandy diluted with water, and an equal quantity in wine, remains unaccounted for. There must, therefore, exist some cause that modifies the intoxicating power of alcohol in wine, so as to occasion it to produce less effect than when taken by itself, or with water only. Physiologists are already well acquainted with the extraordinary effects of chemical combination, and even of mixture, in modifying the activity of substances upon the living system; that the alcohol in wine is combined in some though unknown manner, is rendered probable from the fact, that if brandy be added to wine during its fermentation, it is not so easily separable as if it be added when the fermentation is completed, entering into union with some of the principles of the wine. Thus, brandy added to wines after they are brought to England is much more easily perceived by the palate, and is more injurious to the stomach, than when it has been added during the fabrication. Some imagine that the acids contained in wine modify the effect of the alcohol.

In the practice of Oporto, the complete fermentation of the must takes place in the vat; the wine is then introduced into large tuns capable of holding twenty-five pipes each; and at this stage the brandy is added, according to the discretion of the maker. In Madeira, the second or insensible fermentation is carried on in pipes, and the wine is racked from them at the end of three or four months, at which time a portion of the brandy is added; the remainder is reserved to be mixed at the time of exportation. The process followed in making sherry is rather more complicated, and appears to afford some useful hints relative to the disposal of the brandy which fashion has introduced into the composition of this, as of the former wines. The grapes are first slightly dried, and sprinkled with quicklime; they are then wetted with brandy on being introduced into the press, a farther portion being added to the must before the fermentation commences. By this procedure the brandy is better enabled to combine with the wine, so as to form a fluid more perfect than when it is merely, as in the former cases, mixed with the wine after that is completed. The subsequent process consists in repeated racking, at intervals of a month or two, till March, brandy being added at each of these operations.

3404. Still, in whatever way the brandy is added, the result is injurious to the human constitution; and such brandied wines are relished only by those whose palates are accustomed to them. The diseases which destroy spirit drinkers, chiefly liver complaints, are frequent among those who are in the habit of using constantly the strong-brandied wines; and such ill health is to be attributed to the alcohol with which the wine is adulterated rather than to the wine itself, such complaints being rare in those countries where pure unadulterated wine alone is drunk. These observations apply, as we shall afterward show, equally to the addition of brandy to our domestic wines, which are supposed, erroneously, to require this addition, but by which they are rendered extremely unwholesome.

SUBSECT. 10.—*Table of the Quantity of Alcohol in several kinds of Wine and other Liquors analyzed by Brande, Prout, &c.*

	Alcohol in 100 parts by Measure.
Port	from 25·83 to 19·00
Colares port	" 19·75
Madeira	" 24·42 to 19·24
Red Madeira	" 22·30 to 18·40
Cape Madeira	" 22·94 to 18·11
Sherry	" 23·80 to 18·25
Teneriffe	" 19·79
Lachryma Christi	" 19·70
White Constantia	" 19·75
Red Constantia	" 18·92
Calcabella	" 11·20 to 18·10
Vidonia	" 19·25
Roussillon	" 19·00 to 17·26
Shiraz	" 19·80
Bucellas	" 18·49
Lisbon	" 18·94
Malaga	" 18·94 to 17·26
White Hermitage	" 17·43
Claret	" 17·11 to 12·91
Zante	" 17·05
Marsala	" 17·26
Burgundy	" 16·60 to 11·95
Aleatico	" 16·20
Malmsey, Madeira	" 16·40
Syracuse	" 15·28
Lunel	" 15·52
Nice	" 14·63
Hock	" 14·37 to 8·88
Sauterne	" 14·22
Constantia	" 14·50
Tent	" 13·20
Barsac	" 13·86
Vin de Grave	" 13·94 to 12·80

	Alcohol in 100 parts by Measure.
Champagne (still)	from 13·80
Champagne (sparkling)	" 12·80
Champagne (red)	" 12·56 to 11·30
Red Hermitage	" 12·32
Frontignac	" 12·79
Cote Rotie	" 12·32
Rudesheimer	" 10·72
Johannisberger	" 8·71
Œstrichen	" 8·46
Zornheimer	" 8·75
Rhenish wine	" 7·58
Tokay	" 9·88
Raisin wine	" 26·40 to 23·20
Currant wine	" 20·55
Grape wine	" 18·11
Gooseberry wine	" 11·64
Elder wine	" 9·87
Cider	" 9·87
Perry	" 7·26
Mead	" 7·32
Burton ale	" 8·88
Edinburgh ale	" 6·20
Dorchester ale	" 5·56
Brown stout	" 6·80
London porter	" 4·20
London small beer	" 1·28
Brandy	" 53·39
Rum	" 53·68
Gin	" 57·60
Scotch whiskey	" 54·32
Irish whiskey	" 53·90

3405. The following list of average prices of wines, as sold by wine-merchants in London, may serve to give some idea of their comparative cost:

	Per Doz.
Port.	
Port from wood	from 24*s.* to 30*s.*
Port, crusted, two years in bottle	" 36*s.*
Port, four years in bottle	" 42*s.*
Port, eight to ten years in bottle	" 45*s.* to 60*s.*
Sherry.	
Pale and brown	" 24*s.* to 30*s.*
Pale, old	" 36*s.* to 42*s.*
Pale, superior brown	" 48*s.* to 60*s.*
Lisbon.	
Lisbon	" 24*s.* to 36*s.*
Mountain	" 21*s.* to 42*s.*
Sweet Lisbon, and Carcavella	" 36*s.* to 42*s.*
Bucellas	" 36*s.* to 42*s.*
Madeira.	
Malmsey, Madeira	" 54*s.*
East India, direct	" 40*s.* to 60*s.*
West India	" 40*s.*
Vidonia	" 30*s.* to 36*s.*
Rota Tinta	" 48*s.*
Sicilian.	
Marsala	" 21*s.* to 24*s.*
Mazara	" 26*s.*
Cape Wines.	
Cape	from 15*s.* to 18*s.*

	Per Doz.
Cape Madeira	from 18*s.* to 24*s.*
Constantia	" 48*s.* to 60*s.*
Rhenish.	
Hockheim	" 42*s*
Rudesheim	" 64*s.*
Moselle	" 6*s.* to 54*s*
Johannisberg	" 72*s.*
Tafelwein—table hock	" 36*s.*
Champagne.	
White sparkling	" 60*s.* to 66*s.*
Ai Mousseux	" 72*s.* to 78*s.*
Sillery cremant	" 84*s.* to 90*s.*
Burgundy—Vin de Bourgogne.	
Beaume, St. George and Cote Rotie	" 42*s.* to 60*s.*
Chambertin and Clos Vougeot	" 60*s.* to 84*s.*
Frontignac, Muscat, Lunel, and St. Perey	" 48*s.* to 60*s.*
Hermitage	" 84*s.*
Claret—Vin de Bordeaux.	
St. Emilia	" 30*s.* to 36*s.*
St. Julian	" 42*s.* to 44*s.*
Larose and Latoux	" 54*s.* to 60*s.*
Chateau Margaux, and Lafitte	" 72*s.* to 84*s.*
Sauterne, Grave, and Barsac	" 42*s.* to 60*s.*

SUBSECT. 11.—*Wines of the Ancients.*

3406. We shall not detain our readers long on the subject of the wines of the ancient nations, but a few words will not be misplaced to fill up our sketch of the historical part of this subject; and particularly as this beverage, so much esteemed among the Greeks and Romans, is often alluded to by classic authors. It is proper to state that we are indebted to the elegant work on wines by Dr. Henderson for many of the leading facts on this interesting subject.

3407. *The invention of wine* must date from that period when truth cannot be separated from fable: it was ascribed to Bacchus by the Grecian poets; and, no doubt, when once discovered, the knowledge of so fascinating a liquid soon made its way through the civilized part of the ancient world.

3408. *The effect produced by the fermentation of vegetable matter must have been perceived shortly after the commencement of gardening and agriculture.* When the juice of fruits, the grape, for instance, was kept for some time, this fermentation would appear in a very evident manner; nor was the result less striking; instead of the sweet luscious taste peculiar to the grape, it would be found, after the fermentation was over, to have acquired new flavour and other properties. Its taste had become what we now call *vinous;* and, after drinking it, a delirium of the senses was felt, to which we give the name of *intoxication.* We can very easily conceive that mere accident might have led to this discovery, which appears to have been made at a very ancient period of human history. We learn from Scripture, that Noah "planted a vineyard; and he drank the wine, and was drunken." Whether this was the commencement of fermented liquors it would be useless now to inquire; but there can be no doubt but that the person who was first intoxicated must have been so from entire ignorance of the nature of that state. Happy would it have been for man if he had always remained in that ignorance; or, with this addition to his knowledge, had he been sufficiently impressed with all the dangers that might result from his discovery! But it is with this as with many other things; he too often converts that into evil which, under proper guidance, might prove a benefit.

3409. *The grape, like most of our fruits, appears to have come originally from the milder climates of Asia.* Palestine, at an early time, abounded in vineyards, and the manufacture of wine was known to the Hebrews; the wines of Damascus and of Lebanon were celebrated. But it does not appear that the vine was cultivated, at least to any extent, in ancient Egypt; there corn was produced in abundance, and from it the Egyptians prepared an intoxicating liquor, probably analogous to beer, which is at present made in many parts of Africa. Among the Greeks, wine was a favourite beverage, and its virtues have been highly extolled by their poets. In the time of Homer, the wine of Maronea, in Thrace, was made of great strength; and that of Cyprus, Lesbos, and Chio were long in high estimation, and were exported to Rome. The cultivation of the vine was not introduced into Italy till 600 years after the foundation of Rome; but it became afterward an object of diligent attention among the Romans, and we find ample directions in their writings on agriculture for their management. They frequently trained their vines on lofty trees to the height of thirty or forty feet, from an idea of improving the grapes, although in modern times this practice is condemned. In general, the processes for the manufacture of the wines used by the common people probably did not differ much from some that are employed at present; the fruit was collected, bruised by the feet or subjected to a press, and fermented much in the same manner as it is now.

3410. *But they were likewise in the practice of preparing richer and sometimes more durable kinds of wine,* the nature of which has given rise to much speculation. Some of these wines, and the manner of producing them, are described by Pliny. The juice of the most luscious grapes was expressed, and kept as much as possible from the contact of the external air, by which the fermentation would be very slight, and the full flavour of the fruit preserved; and in some cases the must was put into an amphora well pitched and sunk in a pond or in the sea for a month or more, until it nearly lost all tendency to ferment, and was then in a state between a sirup and wine. They also prepared a rich wine, called *passum,* from the juice of grapes half dried.

3411. *Both Greeks and Romans were in the habit of concentrating their wines by spontaneous evaporation of the must,* or by boiling it till it was reduced to one half, or even one third. By these means the wine was brought to the state of sirup, and required to be diluted with water before it could be drunk. Pliny speaks of wines as thick as honey, which it was necessary to dissolve in warm water and filter. The inspissated wines of the ancients, obtained from rich grapes, may be regarded as corresponding to some modern wines, called *vino cotto,* which are prepared by boiling must; and the practice of boiling the juice of grapes for culinary purposes is common at this time in France and Italy.

3412. *Some of these ancient wines were capable of being preserved for a very long time;* and Horace, in his Odes, boasts of drinking Falernian wine of his own age; indeed, wines of a hundred years old seem not to have been uncommon among the luxurious citizens of ancient Rome. But we are not to suppose that the Falernian and similar wines were of the kind which had been boiled to a sirupy consistence, since this process of evaporation is not necessary, as is well known, to their being preserved, since some of the German wines have been kept for two or three hundred years; but these very old wines have been kept so long more for curiosity than use.

3413. *Independently of these more simple preparations of wine by the juice of the grape alone, the ancients were fond of giving their wines an artificial flavour;* and for this purpose they introduced not only honey, aromatic fruits, leaves, flowers, and seeds, but even pitch, rosin, and turpentine. However extraordinary this taste may appear, we have abundant instances of acquired tastes of a similar kind among ourselves; and traces of this practice may still be observed in modern Greece, where wines are still flavoured with pitch. The origin of this taste may, perhaps, be traced in the necessity they were under of rendering their skins, the earliest receptacles for wine, impervious by means of oils and resinous substances, a practice common at present, and likewise of coating with pitch, instead of glazing, their large earthen vessels in which wine was generally preserved, casks of wood being seldom used. Few of the ancient wines probably contained much alcohol; they were chiefly esteemed for their fine flavour and sweetness;

and, when these qualities were naturally wanting, they supplied the defect by adding aromatic substances. But of all the ingredients employed in preparing these mixed wines, that of sea water is the most singular; and there is no doubt but it was occasionally used, although it would be difficult to reconcile this practice to modern palates.

3414. *Another practice of the ancients for mellowing* those wines which were of a harsher quality was by exposing them to the heat of the sun, or placing them in apartments warmed by flues, called *fumaria.* This does not appear to differ much from the modern method of improving Madeira by keeping it in a hot-house, or in the vicinity of an oven or kitchen fire, to produce early maturity. The Greeks, in particular, surpassed all other nations in their luscious sweet wines, the best of which were the products of the islands in the Ionian and Ægean Seas, where the fineness of the climate brought the grapes to an extraordinary degree of perfection; among others, the Lesbian and Chian wines were much celebrated. But, besides these sweet wines, the ancients were not unacquainted with the manufacture of dry wines, and, in some degree, with the sparkling and frothy kinds.

3415. *All attempts have been, and probably ever will be, fruitless* in endeavouring to discover what was the taste, flavour, or even the colour of the best wines of the ancients, so as to compare them accurately with those of modern date. A principal difficulty in the description of the qualities of various wines arises from the imperfection of language, which is scarcely capable of conveying in a perfect manner, by any selection of words, the flavours peculiar to certain wines. It is true that when qualities are of the ordinary or usual kind, they may be nearly discriminated by certain expressions; thus, port may be described as rough or astringent; Rhine wines as sharp or tart; malmsey, bitter, sweet, &c. But no terms can convey an accurate idea of all the delicate and nice distinctions which the palate readily perceives, and which each person will endeavour to express in such language as appears to him fittest for the purpose, but which will seldom be found to convey any other than ideas extremely vague. It is probable, from the descriptions, that some of the wines of ancient Greece were not unlike those made in that country in the present day. Others are supposed to have resembled the sweet, luscious wines of the south of Europe, as those of Malaga; and Dr. Henderson considers it as highly probable that the Falernian wine had the strongest analogies with our sherry and Madeira.

Sect. III.—Manufacture of British or Domestic Wine.

Subsect. 1.—*Wine from British Grapes.*

3416. *Introduction.—We have already stated the superiority of grapes above every other fruit employed for making wine,* and that, indeed, it is the only fruit from which wine, properly so called, can be produced. The climate of Great Britain is certainly unfavourable to the successful cultivation of the vine, and a general impression prevails that it is too cold for this purpose. Still it would be interesting to ascertain with accuracy how far art can, in this as well as in many other cases, overcome the difficulty which nature has placed before us. Various kinds of what are called *home-made wines* are annually produced in England from grapes, and likewise from other native fruits; and although it is not possible by any management to render the latter equal to grape wine, yet they are extremely capable of improvement by a judicious mode of manufacture.

3417. *Grape wine being the standard of perfection for vinous fluids,* the nearer approach that is made to it in the fabrication of any other wine, the better it must be. It is essential, therefore, that the maker of domestic wines should first understand clearly the principles of preparing that procured from the vine; and with this view we shall lay down the best rules drawn from successful experiments and the theoretical opinions of those scientific men who have devoted much attention to the subject.

History of British Wine.

3418. *The grape not being indigenous to Britain,* wine was probably unknown to its inhabitants previous to the Roman conquest, except it had been brought by the Phœnicians, who are said to have planted the vine in some of the Mediterranean islands. It is supposed that it was only towards the latter term of the Roman power in this island that the vine was properly cultivated here.

3419. We are informed that about A.D. 85 vineyards in Italy had so much increased that agriculture was neglected, in consequence of which Domitian prohibited planting any more; and that it was upon the removal of this edict by Probus, A.D. 280, the cultivation of this plant was extended to Great Britain, as well as the northern parts of Gaul and the banks of the Rhine. However this may be, and whether or not the Roman nobility of Britain were obliged at first to import their wine, it is probable that vines grew in England at the time of its invasion by the Anglo-Saxons; for Bede the historian informs us that there were several vineyards here in his time, A.D. 731.

3420. At the time of the Norman conquest, it is certain that the culture of the vine had made some progress in Britain; for, in Domesday Book, mention is made of vineyards eight-and-thirty times, as well as of orchards and gardens: there was one at Westminster, another at Ware in Hereford, and even Holbourne had its vineyard belonging to the Bishop of Ely. We find a record that there was an enclosure among the lands of Suien in Essex of six arpents, which in good seasons yielded twenty modei (hogsheads) of wine. The Isle of Ely was denominated *L'Isle des Vignes* by the Normans, and the Bishops of Ely, shortly after the conquest, received annually three or four tuns of wine as the tithes of the vines in his diocess. In the archives of the church of Ely there is preserved an account of the produce of a vineyard for two or three years; even the number of bushels of grapes sold is recorded, as also the value of the wine; and an unfavourable year is mentioned in which no wine was made, but only verjuice.

Bede describes the domain of Thorney, in the Isle of Ely, to be an earthly paradise, and observes that "it is so fully cultivated that no portion of the soil is left unoccupied. On the one hand, it may be seen thickly studded with apple-trees; on the other, covered with vines, which either trail along the ground, or are trained on high, and supported on poles."

3421. The essays of Mr. Pegge in the Archæologia, with the subsequent controversies which originated in the opposition of Mr. Daines Barrington, have established beyond doubt the fact that vineyards were attached to the more considerable monasteries of Britain, at least in the southern parts of the kingdom, for the purpose of making wine. These establishments were generally placed in fertile and well-sheltered valleys, where the choicest exposures of the vine might be found; and the monks possessing most of the learning and knowledge of these times, they were, no doubt, familiar with the best modes of culture of this favourite plant, as we find they were of other vegetable productions, many of them being foreigners from Italy and France. Numerous examples are upon record of the vineyards attached to the abbeys about this period: according to Somner, Canterbury Church and St. Augustine's Abbey were possessed of numerous vineyards; and the Bishop of Rochester made wine, a present of which he sent to Edward II. The rolls of the Exchequer contain an account of certain expenses incurred for the royal vineyard at Rockingham; and, if we credit William of Malmsbury, large tracts of country in various parts of England produced excellent wine in the twelfth century, particularly the vale of Gloucester, where a sweet, palatable wine, little inferior to that of France, was made in abundance. Indeed, in this place grapes grow with great luxuriance in the present day, and without doubt could be raised in great plenty by proper care. We are told by Stowe of the yearly account of the wine produced from grapes grown in the little park at Windsor in the time of Richard II., part of which was used in the king's house, and the rest sold.

3422. It is possible that some of these vineyards belonging to wealthy individuals might be kept as much for amusement as profit; but still we have abundance of proof that wine was formerly made in England in considerable quantity. Foreign wine was, however, imported into the country at an early period; and as it could be had of much better quality from abroad, and perhaps often at less expense than when produced in the island, it is not likely that the supply of the latter was ever sufficient for the consumption of the country; and it is probable that the uncertainty of the climate formed a considerable impediment to the culture of the vine, which limited the use of this beverage to the wealthier classes. But notwithstanding this, enough was raised to render the cultivation of the wine an object of study, until the acquisition of French provinces, under Henry III. and Edward III., gave a taste for the wines of that country, and rendered them so cheap as to occasion a neglect of our native wines, which were analogous to those of the Rhine.

3423. *In the year* 1273, 8846 *tuns of foreign wine were brought to England*, paying one penny per tun duty, of which London imported 3799 tuns; Southampton and Portsmouth, 3147; and Sandwich, then a great seaport, 1900. At that period wine was very plentiful in the houses of the nobility and gentry; and so cheap were French wines, that in the reign of Henry VIII. they were sold at eightpence a gallon.

3424. *The chroniclers of the time complain that this abundance of foreign wines caused the first neglect of the English vineyards*, which was completed by the dissolution of the monasteries. It was not only in England, but in other countries, as in France, that the cultivation of the vine was more attended to by the clergy, who were at one time almost the sole depositaries of learning, and had much leisure and opportunity for observation and study. On the lands of the rich monasteries were to be found the choicest growths of the vine, the quality rather than the quantity of the vintage being the object in request. No pains were spared in the improvement of the soil, and in the dressing and management of the vine, and the fermentation of the juice. When ecclesiastical domains in France passed into the hands of laymen, the same assiduity and skill were not shown in the cultivation of the vine, and in the hands of wine-manufacturers quantity was preferred to the quality of the produce. It is a fact that at this day many of the best vineyards in France are on the sites of lands that once belonged to the monasteries.

But, in order to cover the harshness which belonged to the greater part of the wines of that period, it was usual to mix with them various sweets and spices, and a sort of liquid called *piments* were compounded, not very unlike some of the liqueurs of the present day, served at feasts and entertainments, as exquisite luxuries. Of this kind was the *Ypocrase*, prepared, when "*for lords*, with wine, gynger, synamon, graynes, sugour, and turesoll; and when *for comyn pepull*, of wine, gynger, canell, longe pepper, and clarified honey." *Clarry* was a similar mixture of wine, honey, and some spices; and the *Bishop* of our days, made of wine, oranges, and sugar, is probably a remnant of these ancient beverages. The taste for sweet wines was considerable, and we find that the malmseys of Candia and the rich wines of Greece and Spain were much in request.

3425. *In the time of Queen Elizabeth no less than fifty-six kinds of foreign wines were imported*, French, Italian, Spanish, Canary, Cyprus, Malmsey, &c.; and this profusion displayed on the table was not confined to England, but was seen in Scotland also.

Most probably the dissolution of political bonds between England and the French provinces which she lost might have diminished the facility of importation, and the consumption of Bordeaux wine; we find that afterward the strong wines of Spain came more into use, and early in the sixteenth century they had almost superseded the milder growths of France. In the reign of Elizabeth and James I. "your *sack* was the only drink;" and there has been much diversity of opinion as to the class of wines those called sacks belonged. It appears that the name was originally applied to certain white wines of Spain, and was a corruption of *seck*, or *sec*, signifying a dry wine. The original sack was probably not unlike sherry; and this name came afterward to include similar wines, as those of Malaga and the Canaries, with malmseys and other sweet wines, which probably had at that time the same character by which they are at present distinguished. But although these wines were held in the greatest estimation, the light wines of France and the Rhine were still much in use, until all commercial intercourse with France ceased during the long wars with Louis XIV., which gave rise to the introduction of the wines of Portugal, the history of which we have already given when describing the wines of that country. Nevertheless, the cultivation of the vine was continued in England during the reign of Queen Elizabeth; and Barnaby has pointed out the vineyards of Lord Cobham and Willienus of Thames as eminently productive.

3426. *About the end of the fifteenth century agriculture was more attended to*, and malt became more plentiful; the hop was likewise introduced into the country, which gave rise to a great improvement in the ale, and rendered it a beverage accessible to the people generally. From this, and the high duties laid on wine, the use of the latter gradually declined, and malt liquors were more used.

3427. *We have several well-authenticated accounts of wine having been made in England at a period not very far back*. In the "Museum Rusticum" it is stated that at Arundel Castle in Sussex, the Duke of Norfolk had a vineyard which annually yielded considerable quantities of wine; of which there were in his grace's cellar, in 1763, above sixty pipes of wine resembling Burgundy. Bradley informs us that Warner, a gentleman of Rotherhithe, made good wine from his own vineyards. Switzer mentions several instances, and, among others, that of Rocque, of Waltham Green, who made wine for thirty years from a vineyard he had planted in a common field garden. Hanbury and Hales confirm these accounts, and cite others. It is said that Dr. Ralph Bathurst, President of Trinity College, Oxford, made as good claret in 1605 "as could be wished for."

But the best account we have of an English vineyard of modern times is that by Sir E. Barry, the author of a work on wines, in which he describes a very productive one formed by the Hon. Charles Hamilton, at Painshill in Surry, about sixty years ago, from which excellent wine was made. We shall give the whole account as an authentic document when we treat of the practice of making English grape wine. Besides those examples on a great scale, abundant instances occur at present where individuals have made for their families, and from their own grapes, wine equal to the generality of imported table wines, and at less than one third of the expense.

3428. *The cultivation of the vine in Britain, though at present carried to a high degree of perfection in hot-houses for table fruit by the professed gardener*, has been much less attended to for the purpose of making wine than might be expected from what we have stated of the history of British wine. Mr. Hoare, to whom we are indebted for an excellent work on the "Cultivation of the Grape-vine," and to which we refer the reader who wishes to attempt it, observes that "vines are now cultivated in this country only under glass, upon the roofs of buildings, and against walls. The expense of growing the grapes under glass is such as obviously to place that method out of the reach of the mass of the people; and vineyard culture, now that it has fallen into disuse, is, perhaps, considered so much in the light of a commercial speculation, that those who possess the means of practising it are deterred from employing them, from an apprehension that the risk and uncertainty attending it would prove more than sufficient to counterbalance its advantages. But the cultivation of vines on open walls being free from these and all other objections, presents an advantageous method of producing grapes, which may be embraced by every person who has at his command a sufficient number of square feet of the surface of a wall."

3429. *It has been supposed that the established fact of numerous vineyards having formerly existed in England demonstrates that our climate has deteriorated;* but this opinion is wholly without foundation: on the contrary, there is great reason for believing that the climate of Europe has for several centuries past been rather in a state of amelioration, from the clearing of woods, draining of marshes, and agricultural improvements. It must be admitted, however, that, from the uncertainty of our climate, such crops would be liable to occasional failures; and, indeed, by the records of Ely it appears that this was formerly the case. With what advantage the manufacture of domestic wine from grapes could be carried on to a considerable extent in this kingdom is a subject that does not belong to our objects to inquire into; and, indeed, no accurate judgment could be formed without some direct experiments; but that this is perfectly practicable on a small scale for domestic use, and with manifest advantage with a view to economy, there is abundance of proof. Enough is already known to demonstrate the complete practicability of producing wine for the table equal to ordinary Champagne, and some of the Moselle and Rhenish wines of the second and third classes, at less than a half, or perhaps one third of the price now paid for them, with the advantage of being entirely free from adulteration; whereas a great part of the cheap wines called foreign are compositions of the vilest description.

3430. *But the practice of making wine from grapes in England is far from being extinct.* The cottagers in Sussex are in the habit of making wine, almost annually, from the produce of vines trained on the walls of their houses. Many individuals through various parts of the southern counties, and even as far north as Derbyshire, practice the same with success.

3431. *The sorts of grapes best adapted for the culture on open walls* are, according to Mr. Hoare, the black Hamburgh, the black Prince, the black Muscadine, Miller's Burgundy, the Esperione, the Claret grape, the black Frontignan, the grizzly Frontignan, the white Frontignan, the white Muscadine, the Malmsey Muscadine, and the white sweet water. It would not be prudent to try any foreign kinds that have not been acclimated.

3432. *The vine is easily cultivated;* and no fruit-tree grown in this country can be depended upon with more certainty for a full crop, or that will yield a more ample return, than a vine judiciously trained on an open wall; but Mr. Hoare observes that an erroneous idea prevails that a single vine requires for its training a large portion of walling; whereas this opinion has arisen from the general defective method of pruning and managing that plant, whereby the wood is suffered, and, indeed, encouraged, to extend itself beyond the capability of its fruit-bearing powers. The pruning-knife ought to be more used, whereas vines are usually allowed to load themselves with more fruit than they can mature; and when that is the case their strength becomes exhausted, and the fruit is of little value.

One of the principal causes of failure in this country is the neglect of a proper soil: that generally employed has too great depth of mould, in which the roots of the vine are suffered to run, enticing them to raise too much moisture, by which the vegetation is carried on too late in the autumn, so as to delay the ripening process until the sun has lost too much of its power. The soil should be loamy, and not above eighteen inches deep. The subsoil should be of dry materials, containing stones, brickbats, lumps of old mortar, broken pottery, oyster shells, and similar things. Soils that retain wet are injurious. All animal matters may serve for manure, but these are best formed into composts by mixing them with road sweepings, sand, gravel, and broken bones. Though the vines of Champagne grow upon chalky soils, yet these are not so good as those just mentioned for wines that are to keep long.

Walls are best of brick: dark flint walls retain more heat, but are more uneven. The best aspects are those that are southerly; when the aspect partakes of the north, it is unfit. Shelter is essential as well as aspect, wind being very pernicious.

3433. *In planting a vineyard in England,* care should be taken to select the kind of soil most suitable to the vine, as well as such an exposure as consists of southern slopes; and much would depend upon obtaining the proper varieties of vines. The sorts planted at Painshill, where so successful an experiment was made, as well as those most commonly used on the Continent, are the Burgundy, or large black cluster, and the miller's grape, or small black cluster; but the grapes which produce the sweet wines, as the Constantia, malmsey, and Madeira, are varieties of the Chasselas or Muscadine, which is one of the oldest and most common of our grapes. Professor Martyn recommends that in an English vineyard the vines should be trained very near the ground, he having found that by this method of training the grapes were much increased in size, and also ripened earlier. This method is successfully pursued in the north of France. But in this country it is, perhaps, in peculiarly favourable situations only that vineyards will succeed.

Practical Directions for making Wine from British Grapes.

3434. *We owe to the late Dr. Macculloch the first and almost the only attempt to rescue this branch of domestic economy* from the degraded state into which it had fallen. From his chemical and other knowledge, he was eminently qualified to do it justice, and in his luminous essay he has pointed out the scientific principles upon which the whole depends, presenting the philosophy of the subject. He has distinctly expressed his opinion that "wines not to be distinguished from some of those of foreign growth can, in this country, be made from grapes, and at a moderate expense; and that the success of this process is little, if at all, affected by the uncertainty which attends the ripening the grape in our climate." He adds that "it is not too much to say that the use of this fruit is calculated to supersede that of all others for wine, and that its produce is almost the only species of domestic wine which is worthy of serious attention."

3435. It is necessary to observe that, in thus speaking of the possibility of imitating successfully wines of foreign growth, Dr. Macculloch alludes only to the light white wines of France and Germany, for he admits that it would be vain to attempt the manufacture of such as the rich, highly-flavoured Burgundy, or strong heavy wines like Port, Sherry, Madeira, &c.

3436. *We have stated that the mode of proceeding in making wine must depend partly upon the class of wine to be produced;* whether it is to be brisk, dry, or sweet, and no directions can be given of any use that do not take this into consideration, as upon this must depend the proportions of those principles which are to form the wine, saccharine matter, ferment, tartar, and water; and in these must be taken into account, likewise, the condition of the grapes, whether immature, or ripe and sweet.

3437. It may be convenient to the reader, who is supposed to have perused the previous articles on fermentation, and the sketch of the general theory of wine-making, to remind him that to produce a sweet wine it is necessary that there should be more saccharine matter in the must than the ferment can act upon and decompose; consequently, some of it remains in solution in the wine, being the cause of its sweetness. In dry wines the sugar and ferment have been so exactly balanced that both have been entirely decomposed by acting on each other during the fermentation, which has been carried on to its utmost limit. In brisk wines the fermentation has been interrupted a little before it was completed by putting the wine into bottles, in which a slow fermentation goes on, producing carbonic acid gas ready to escape with violence on uncorking the bottles. It is, therefore, in the power of the operator to produce what class he thinks proper by managing the process accordingly.

3438. *It is the usual defect of grapes grown in our climate to be deficient in sugar, and to abound in the fermenting principle.* This is sometimes the case even in the wine countries, and there experience has taught to correct this defect when it occurs, by the addition of sugar, of honey, or of sweet must evaporated by boiling until it has become a thick saccharine fluid. With us sugar is the substance employed for this purpose. It is obvious that the strength of the wine must depend upon the quantity of sugar in the must, or, rather, the quantity decomposed in consequence of fermentation. But there is a limit to the addition of sugar: if too much is added, the ferment will not be sufficient to convert it into alcohol, and the overplus will remain in the wine, merely rendering it sweet; the water will, likewise, then be in too small proportion, and the must will be too thick to ferment readily. But the whole of the sugar is seldom decomposed during the first stages of fermentation; a portion is frequently attached to the wine, even those considered dry, long after they are put into casks, and even after they are bottled. It is only by the slow fermentation in casks and bottles, a process that often requires years for its completion, that the sugar is entirely changed into alcohol and combined with the other ingredients of the wine.

3439. *To make a brisk wine resembling Champagne,* the grapes may be used in any stage of maturity in which they are most conveniently obtained. Those of different degrees of maturation may even be mixed together, nor is it requisite to attend to the selection of any particular variety. It is rarely, indeed, that we are allowed any choice in this matter. It is a great advantage, which affords greater facility in making this kind of wine, that it is not essential that the whole, or, indeed, any of the fruit should be ripe.

Unripe grapes will, in general, be found equal, if not superior, to those which are ripe; for, though the former are deficient in saccharine matter, the latter, with us, has seldom a great deal. Though our ordinary grapes, with the exception of those raised in hot-houses, are deficient in sweetness, this defect can be supplied by the addition of sugar to the must: the fermenting principle and the tartar are therefore of more value, which diminish with the maturity of the fruit. The price of ripe fruit, also, is higher. The skins and stalks of the grapes may be subjected to the fermentation, or not: in making Champagne they are better separated; keeping them in will give an austerity which in some other wines is desirable: the seeds should not be bruised. In general, it will be preferable to wait till the grapes exhibit the first tendency to ripen, or till the advance of the cold season shows that no farther ripening can be expected: but a small proportion of crude grapes is useful: and where the vine is largely cultivated, fruit for this purpose may be obtained from the thinning usually practised.

3440. The method of bruising the grapes to extract the juice is, in many parts of the Continent, extremely imperfect: treading with the feet effects it very unequally. A press of some kind is preferable, and it should be one of considerable power, to extract perfectly the tartrate, which lies mostly in the skin. In the wine countries the very best wine is sometimes made from juice obtained with scarcely any pressure: this, in Italy, is called *vino virgine*. In England the quantity employed and the state of the fruit will render this impracticable.

3441. It is essential to the success of the fermentation that the water should be added in the right proportion, in order that the fluidity of the must may be sufficient When Champagne is intended, there should be equal quantities of water and grape-juice.

3442. The proportion of sugar added to the must will, in some degree, determine the strength of the wine. Two pounds of sugar to a gallon of the mixture will yield a light wine of no great durability, resembling the lighter sorts of Champagne; and three pounds of sugar will give a strength equal to the best sorts. Sugar from the cane is not exactly of the same species as that from the grape, as we have shown in another place; but this difference is not appreciable in the spirit produced from each of them Yeast is not necessary; but it is too common to add it. The phenomena of fermentation having been amply described in previous parts of this work, we need not repeat what has been said.

3443. For brisk wine the must should be put into the cask at once, as the fermentation there will be sufficient. The best temperature is about 62°. The time employed in the fermentation must depend upon a variety of circumstances, as the weather, the composition of the must, and the sort of wine to be made; of course, it must be regulated by a knowledge of general principles and experience.

3444. The practice followed in France is described as follows: "The fermentation will sometimes not begin so soon as might be expected, but the operator must not be impatient; it will not finally be less effectual because it has been more tedious; and increasing the temperature a little will generally produce a commencement, and continue it. If the fermentation should be too languid during its progress, it may be increased by agitating the cask, or by omitting to replenish it to the bung, so that the scum or head may be compelled to remain in the liquor. The first fermentation in the casks is violent, and the discharge of the yeast is encouraged for ten or twelve days by keeping them full to the bung-hole; it then becomes more moderate when the bung is put down, and a gimlet hole fitted with a spile is made by the side of it. When the cask is thus closed, the vent-hole is opened every day or two, according to the state of the fermentation, for a space of eight or ten days, to allow the carbonic acid to escape. When this state is passed, fresh wine reserved for the purpose is poured in at the vent-hole about once a week for the first three or four weeks, according to its waste, so as to fill the cask; this operation is then performed at longer intervals of a month or more, till the end of December, when the wine usually becomes clear. It is afterward decanted from the lees into a fresh cask, where it is fined with isinglass, in the proportion of half an ounce to a pipe; and this process of decanting is carefully executed in dry, clear, frosty weather. A new fermentation is now excited, by which the wine loses a portion of its sweetness, and becomes farther ameliorated. If it should prove too sweet, this first operation of decanting is not performed until the fermentation in the first cask has been rendered more vigorous, which is done by stirring up the lees or rolling the cask; and by this the sweetness is overcome, and the wine strengthened and improved. To ensure the fineness of this wine, which is one of its essential properties, and to render it at the same time durable, it is, at the end of six weeks, decanted a second time into a fresh cask, and once more fined with half the quantity of isinglass; it is then completed, and is put into bottles in March, clear, dry weather being also chosen for this purpose. In the bottles the farther fermentation will go on in a very slow and almost insensible manner, because the carbonic acid which is produced will be confined, and absorbed, and condensed by the wine, as it would be in water by means of pressure, but will escape on decanting, with the appearance and noise which brisk wines exhibit, upon the same principle as when it escapes from soda water. This gas, being itself an acid, communicates an agreeable and peculiar acidulous taste, which constitutes one of the most valuable qualities which these wines possess. It can scarcely be necessary to observe that this abundance of gas, though it adds to the briskness, is no proof of the strength of the wine, as this depends upon another principle, the alcohol. The production, therefore, of brisk wines must be effected by so contriving the process that a great quantity of carbonic acid gas shall be enclosed with the wine in the bottle. For this purpose two fermentations are necessary; the first, by which the juice of the fruit was converted into a vinous liquor, and during which the carbonic acid that was generated escaped; and the second, much slower, which takes place in the bottle itself, and where the gas, in consequence, is retained, and constitutes the briskness of the wine. Notwithstanding all the above-mentioned care, a fresh deposite is sometimes formed in the bottles, from a renewal of the fermenting process which goes on in them. To remove this, and to render the wines perfect, those of the best quality in Champagne are sometimes decanted clear into fresh bottles in about fifteen or eighteen months, when the wine is complete. A certain loss, amounting to about ten, though sometimes to twenty per cent. on an average, is sustained by their bursting previous to this last stage. The brisk ones will be drinkable as soon as they have been six months bottled, or even less; but if of good body, they are better in the following, or even in the third year. After this, or should they from any cause lose their briskness, they generally become dry wines, resembling some of those of France, or of the Rhine and Moselle, while in this case they keep indefinitely, and proceed in improving."

It is easy to perceive, from this description of the mode of manufacturing brisk wines in Champagne, that our grapes, though the produce of a country not sufficiently warm to have this fruit of the first quality, may yet be quite sufficient for the purpose of making brisk wine, or even dry wine of good quality, if great strength be not required.

Those wines only which are capable of continuing in a state of slow fermentation for a long time, can be brisk. The richest juices, therefore, which contain the greatest quantity of saccharine matter, are not calculated to form brisk wines; on the contrary, these are prepared *best* from fruit that has not quite ripened. For the fabrication of such wines, much of the natural fermenting principle is necessary, which is most abundant in unripe fruits, a fact which must be well known to those who attempt to imitate Champagne wines by gooseberries, since the object, however easily attained by using the immature fruit, is nearly unattainable with the ripe.

3445. *A few additional directions respecting the fermentation* of brisk wines may be useful. If the temper ature be less than 62° the fermentation will be too feeble, and if much higher it will be too rapid, and there will be great danger of its running into the acetous stage. If the quantity of must be small, a greater degree of heat is necessary than when it is large, because the heat excited by this process increases with the quantity of the fluid. Strong musts will also bear a higher temperature than weak ones, as the alcohol produced has the power of checking fermentation, and also of preventing the wine from becoming acid. It is not uncommon, in the manufacture of domestic wines, that, from not attending accurately to the temperature, it is suffered to rise too high, and, consequently, some acetic acid is generated, which cannot afterward be got rid of. When the fermentation is slow in beginning, a little warm must is sometimes introduced to the bottom of the vat by means of a long funnel. In order to check the fermentation when in danger of proceeding too far, from the fermenting principle being in too great quantity, several modes may be adopted. Sugar may be added to the must, that the ferment may act upon this in producing more alcohol, and thus increase the strength of the wine, instead of causing the acetous fermentation to come on, or the fermentation may be checked by racking. Fermentation is always more rapid in large than in small vessels, which may explain the difference that may be perceived in making ten or two gallons of wine. But the flavour is best preserved when the quantity is small and the fermentation slow.

3446. *The intoxicating property of brisk wines*, like all others, depends chiefly upon the alcohol; but the reason why they produce this effect so rapidly is supposed to be that the alcohol and carbonic acid are held in some peculiar state of combination when they are applied to the nervous system.

3447. *The colour of wines from grapes*, though an important circumstance in foreign wines, is one that does not here demand our attention, as red wines are seldom attempted with us. It has been already stated, that the juice of all grapes alone produces only colourless or white wine, the colour residing in the skin of the grape. When a red colour is required, the skins of red grapes are fermented together with the juice, when the newly-formed alcohol dissolves the colouring matter. With respect to artificial colouring, it is probably much better omitted. The claret grape may, however, be employed for this purpose.

3448. *We have now shown that a compound or artificial must* can be fabricated from due admixtures of sugar with the natural ferment of the grape and the saline part of the fruit, which is capable of undergoing a regular fermentation, and of forming good and perfect wine. Experiments have been made long ago in France with green grapes and sugar, and with complete success: these experiments have been repeated by Dr. Macculloch, and thus have been produced wines resembling Champagne, Grave, Rhenish, Moselle, St. Peray, and white Hermitage, and of qualities so perfect that the best judges and wine-tasters have not been able to distinguish them from foreign wines. When sugar is employed, it is probable that the sugar now made from starch or potatoes will be the best, being the same as that of the grape, which, as we formerly stated, is different from the common or cane sugar.

It is evident that wines made on this principle, that is, from green grapes, will be more expensive than when made from ripe grapes, as a sufficient quantity of sugar must be used to compensate for the deficiency of the natural saccharine matter of the grape. But even then they need be little more costly than currant or gooseberry wines, while, at the same time, their superiority is beyond all competition. The hardiest grapes will produce a wine of the strength of white Hermitage with a proportion of three pounds or less of sugar to the gallon; nor are these wines void of flavour, as might, perhaps, be supposed. Dr. Macculloch states that all the wines made under his direction were characterized by flavours as genuine and decided as those of the foreign wines to which they approximated.

3449. *Dr. Macculloch's receipt for making wine of mature grapes:*

"It is so seldom that a sufficient quantity of these can be procured, that it is almost superfluous to mention this variety of domestic wine; and the reader already knows that the grapes ripened in this country make very indifferent wine, and, indeed, it happens, even in more favoured climates, that the grapes of gardens are noted for producing bad wine. If wine is to be made from ripe grapes, no water is to be used; but as the juice of our fruit is, in general, deficient in sweetness, it is necessary to add a quantity of sugar, varying from one to perhaps one and a half pound for each gallon of *must*. The addition of some tartar to the must is also useful in this case, our ripe grapes being deficient in this principle."

"The general, though not the sole cause, of failure in those wines which are made in this country from ripe grapes is the deficiency of saccharine matter; and even those, as well as the wines from unripe grapes, would be much improved by an addition of sugar to the must. It is owing to this deficiency chiefly that these wines are perishable, and easily pass into vinegar, the natural must containing too much water to produce a durable wine. No positive rules, however, as we have said, can be given for the quantities of sugar to be added, as this must depend upon the degree of sweetness in the grapes."

3450. "If the wine is intended to be dry, like hock, more grapes must be used, with about the same quantity of sugar, or less water, or perhaps this will be best omitted. The fermentation must be allowed to continue long enough to convert all the sugar into alcohol, which will be known by the disappearance of the sweetness. Should it happen that the ferment is rather in too small a quantity to decompose all the sugar readily, it is proper to make the most use of what there is. Instead, therefore, of removing the yeast which rises to the surface, it should be beat down, and mixed again through the fermenting must; and when the liquor is transferred to the casks to undergo the slow fermentation, it should not be made to fill the casks quite, but space should be left for the yeast to collect, and this should be frequently mixed up with the liquor by shaking or rolling. As soon as all the sweetness is gone, the fermentation must be checked, and the wine must be racked into other casks, otherwise it would pass into the acetous stage. The fermentation, if unchecked, would continue, under favourable circumstances, as long as any sugar or ferment remains undecomposed; if these have been in such proportion as exactly to neutralize each other, the fermentation will be perfect, and will terminate naturally; the wine being dry, the ferment, now rendered insoluble and inactive, appearing under the form of yeast and lees. But this nice accuracy is seldom attainable; if the ferment be considerably in excess, the fermentation will proceed from the vinous to the acetous stage, and the whole will become vinegar. It is necessary that there shall be so much saccharine matter that a small portion of it shall still continue unchanged; and this will be the case, though it may not be perceived, because the palate is unable to detect the last portion of sugar, marked as it is by the predominant taste of the wine. This small excess of sugar is necessary to exhaust the ferment, and to prevent the acetous stage. The addition of sugar to wine will, in the same manner, prevent acidity, when it is suspected that this may happen, by exhausting the ferment; but, should acidity have commenced, sugar will only aggravate the evil, by adding material for the acid fermentation to work upon."

"All the dry and sweet wines require to be kept in bottle for four or five years, if it be desired to have them in perfection. The impatience of the makers of domestic wines to enjoy the produce of their art is, indeed, one of the causes of failure. They are generally drunk within a year or two, and long before they are completed, since even the best wines of foreign countries often require many years to bring them to perfection. It is very common for the made wines to possess a bad flavour when first made, not unlike that which has hitherto infested most of the wines of the Cape. Time dissipates this, even in the bottles."

3451. With regard to the durability of these wines, Dr. Macculloch farther observes that he has kept some of them for twenty years, and during all that time with evident improvement. They seem to be as little liable to destruction as wines of the best manufacture; and this, it is to be observed, without the addition of brandy.

3452. If the wine is intended to be sweet like malmsey, the grapes should be ripe, and contain much saccharine matter, or a large proportion of sugar must be used; also the fermentation should not be carried on so far as to change all the sugar; but it must be checked in the first instance, as soon as it is thought to be sufficient for this kind of wine, leaving still a good deal of sugar unaltered; this is done by removing all the yeast and scum as soon as it is formed; sometimes, if it is thought that there is still too much ferment in the liquor for the quantity of sugar, it may be taken out by adding some solution of isinglass, which will precipitate the ferment; or more sugar may be added for the ferment to act upon, and thus increase the strength of the wine. In the wine countries, where much sweet wine is made, this effect is produced in various other ways; sometimes by racking and sulphuring, processes which will be afterward described, by a partial drying of the grapes, or by the addition of boiled must, sugar, or honey.

3453. *The account by Mr. Hamilton of the manner in which the wine was made formerly from the vineyard at Painshill* is so interesting a document, that we shall give it in his own words:

"The vineyard at Painshill is situated on the south side of a gentle hill, the soil a gravelly sand. It is planted entirely with the two sorts of Burgundy grapes: the Auvergnat, which is the most delicate, but the tenderest, and the miller grape, commonly called the black cluster, which is more hardy. The first year I attempted to make the red wine in the usual way, by treading the grapes, then letting them ferment in a vat till all the husks and impurities formed a thick crust at the top; the boiling ceased, and the clear wine was drawn off from the bottom. This essay did not answer; the wine was so very harsh and austere that I despaired of ever making red wine fit to drink; but through that harshness I perceived a flavour something like that of some small French white wines, which made me hope I should succeed better with white wine. That experiment succeeded far beyond my most sanguine expectations; for the very first year I made white wine it nearly resembled the flavour of Champagne; and in two or three years more, as the vines grew stronger, to my great amazement, my wine had a finer flavour than the best Champagne I ever tasted; the first running was as clear as spirits, the second running was *œil de perdrix*, and both of them sparkled and creamed in the glass like Champagne. It would be endless to mention how many good wine-merchants were deceived by my wine, and thought it superior to any Champagne they ever drunk; even the Duke de Mirepoix preferred it to any other wine; but, such is the prejudice of most people against anything of English growth, I generally found it most prudent not to declare where it grew till after they had passed their verdict upon it. The surest proof I can give of its excellence is, that I have sold it to wine-merchants for fifty guineas per hogshead; and one wine-merchant, to whom I sold five hundred pounds' worth at one time, assured me he sold some of the best of it for 7*s*. 6*d*. to 10*s*. 6*d*. a bottle.

"After many years' experience, the best method I found of making and managing it was this: I let the grapes hang till they had all the maturity the season would give them; then they were carefully cut off with scissors, and brought home to the wine-barn in small quantities, to prevent their heating or pressing one another; then they were all picked off the stalks, and all the mouldy or green ones were discarded before they were put upon the press, where they were all pressed in a few hours after they were gathered; much would run from them before the press squeezed them, from their own weight upon one another. This running was as clear as water and sweet as sirup, and all this of the first pressing and part of the second continued white; the other pressings grew reddish, and were not mixed with the best. As fast as the wine ran from the press into a large receiver it was put into the hogsheads and closely bunged up. In a few hours one could hear the fermentation begin, which would soon burst the casks if not guarded against by hooping them strongly with iron, and securing them in strong wooden frames, and the heads with wedges; in the height of the fermentation I have frequently seen the wine oozing through the pores of the staves. These hogsheads were left all the depth of winter in the cool barn to reap the benefit of the frosts. When the fermentation was over, which was easily discovered by the cessation of noise and oozing, but, to be more certain, by pegging the cask, when it would be quite clear; then it was racked off into clean hogsheads, and carried to the vaults before any warmth of weather could raise a second fermentation. In March the hogsheads were examined; if any were not very fine, they were fined down with common fish glue in the usual manner; those that were fine of themselves were not fined down, and all were bottled about the end of March, and in about six weeks more would be in perfect order for drinking, and would be in their prime above one year; but the second year the flavour and sweetness would abate, and would gradually decline, till at last it lost all flavour and sweetness; and some that I kept sixteen years became so like old hock that it might pass for such to one who was not a perfect connoisseur. The only art I ever used to it was putting three pounds of white sugar candy to some of the hogsheads when the wine was first tunned from the press, in order to conform to a rage that prevailed to drink none but very sweet Champagne. I am convinced much good wine might be made in many parts of the south of England. Many parts are south of Painshill, many soils may be yet fitter for it, and many situations must be so; for mine was much exposed to the southwest wind (the worst of all for vines), and the declivity was rather too steep; yet, with those disadvantages, it succeeded many years. Indeed, the uncertainty of our climate is against it, and many fine crops have been spoiled by May frosts and wet summers; but one year balances many disappointments."

3454. This example is of great importance; for the grapes were grown in a situation of which, as to soil and exposure, many parallel instances are to be found almost everywhere throughout the country, and with land of no value whatever for the ordinary purposes of agriculture. It is said that some of the vines may yet be seen on the spot, which is now covered with a plantation of Scotch firs.

3455. Not only can wine be made from the vine in countries where, from the climate, its fruits will not ripen, but chemical examination has proved that the *young shoots*, the *tendrils*, and even the *leaves*, contain certain principles exactly similar to the immature fruit, and they have been employed in the same manner for making the same kind of wine. These had been tried with success in France many years ago; but, as the discovery was little important in that country, where grapes were fruitful, it was neglected. We are indebted to Dr. Macculloch for drawing attention again to the subject; and he states that he has made with these materials wines resembling Champagne and St. Peray, and some quite as good as the ordinary Cape wines, resembling them even in flavour, so as to be undistinguishable. Chaptal informs us that it is sometimes the practice in France to suffer the stalks of the grapes to remain in the fermenting vat. The roughness and austere taste which the stems possess appear, he observes, to be an advantage to some wines, especially to those made in the more northern districts, where the slight astringency imparted by the stems corrects their insipidity, and appears to have the property of making them keep better.

As Dr. Macculloch speaks with the utmost confidence respecting the success of his experiments, we shall quote his receipt.

3456. *Dr. Macculloch's receipt for making wine from the leaves and stalks of the vine.*

"The young leaves may be taken at any period from vines which have been cultivated for this purpose, and from which no fruit is expected. In other cases they may be obtained from the summer pruning. The tendrils and green shoots are equally useful. The claret vine may be cultivated for this purpose, in which case the wine will have a red colour. The leaves are best when young, and should not have attained more than half their growth; they should be plucked with their stems. In the neighbourhood of London they require to be carefully washed to remove the taste of soot, which so often adheres to them; sometimes that is insufficient. From sixty to eighty pounds of such leaves being introduced into a tub of sufficient capacity, seven or eight gallons of boiling water are to be poured on them, in which they run to infuse for twenty-four hours. The liquor being poured off, the leaves must be pressed in a press of considerable power; and being subsequently washed with an additional gallon of water, they are again submitted to the action of the press. The sugar, varying from twenty-five to thirty pounds, is then to be added to the mixed liquors, and the quantity being made up to ten gallons and a half, the process which will be shown in making gooseberry wine is to be followed. Although the water is here directed to be boiling hot, it must be remembered that it is immediately cooled down to that temperature which is most efficacious in extracting the several soluble ingredients of the fruit."

3457. The following additional observations on this curious subject are extracted from the same author: "The difference between young and old leaves is very great; the former contain ten or twenty times the quantity of bitter that the latter do. The old leaves are unfit for the ferment. June is the proper time to pluck them; at this season it is usual to remove leaves from the fruit-bearing vines, so that they may be easily procured; but if vines should be grown for this sole purpose, as they may be in any waste place or hedge-row, being allowed to run wild and unpruned, it will be always easy to procure a sufficient quantity, and in the best condition. In their very best state at least six pounds are required for two of sugar, and it is perhaps preferable to adopt eight and a half; though no rule can be absolute, such is the variation in the extractive produce of the leaves. In the progress of the fermentation, should the wine promise to be too sweet, from defect of ferment, it is quite easy to add a fresh infusion, so as to correct this defect by a renewal of the fermentation. Of the leaves it must be observed, as they scarcely yield anything to the press, they require to be infused in the water for some time before they are subjected to fermentation, and they seem to yield their soluble parts most readily to hot water, without any material alteration in the result—a matter of no surprise, because, though the water be applied at the boiling heat, its temperature is immediately lowered. Tartar appears sometimes to be a useful addition to the leaves of the claret vine; and it may be added in the proportion of half a pound or one pound to ten gallons of the must. One advantage results from the use of vine leaves, the facility with which they are reproduced during the growth of the vine. By this the produce of a small vineyard in leaves alone will be abundant; and even that of a single vine suffered to run wild, branches and leaves will be as great as is required for the use of most families. It must always be remembered that in these cases the price of the sugar is the price of the wine. The expense of utensils and labour is comparatively trifling; and, when the manufacture is upon a small scale, scarcely worthy of regard."

3458. *The expense of making grape wine* must vary with so many circumstances, that it would be impossible to fix any price as a standard, but, from the following statement in the "Gardener's Magazine," it would appear to be very little, at least when of moderate quality.

Materials: Water, 4½ gallons, beer measure; grapes, 5 gallons, beer measure, crushed and soaked in the water seven days; sugar, 17½ lbs., at 10¾*d*. The sugar came to 15*s*. 8½*d*., and the grapes, perhaps, to 5*s*. The cask in which it was made held exactly 6¾ gallons, beer measure, and produced thirty-four bottles of wine clear. A bottle of the above wine, kept ten years, proved good.

Excellent Champagne has been made from British grapes for a shilling per bottle, and it is said that foreign grapes are now imported for this purpose.

SUBSECT. 2.—*Raisin Wine.*

3459. *Since raisins are dried grapes, there appears no reason why excellent wine should not be made from them*, as we know that it is found necessary to dry, wholly or in part, the grapes employed in the manufacture of the finest sweet wines of the south of Europe, as those of Cyprus, Malaga, and Tokay; and as the dryness of wines only depends upon the fermentation being continued longer, it seems obvious that, from raisins, good wines, both sweet and dry, may be easily produced in Britain. This, accordingly, is well known to be done upon an immense scale in manufactories, among which that of Beaufoy has been long celebrated; but the wines thus produced are often, by certain management, contrived to pass for foreign white wines of various denominations, instead of being sold in their genuine state. The success of individuals shows that the process of making good raisin wine is extremely easy; and any family desirous of doing so may thus supply itself with genuine wine at a very moderate price.

3460 *To make Raisin Wine.*—Procure fresh Smyrna or Malaga raisins; pick out the stalks and all defective fruit; chop twenty-eight pounds of these into small bits, and pour upon them three gallons of tolerably hot water, and let them stand to soak for twelve hours. Put the whole into a hair cloth or clean canvass bag, and with a sufficiently powerful press press out the juice. Put two gallons more of hot water on the marc of raisins; let this remain also twelve hours, and press out as before. Mix the two liquids together, but the skins are not to be used. Add to the juice thus obtained three pounds of white sugar, and put the whole into a proper vessel to ferment. Some add an ounce or two of crude tartar, but no yeast, as the raisins contain of themselves sufficient fermenting principle. This liquor will ferment, and the vessel should be covered with a blanket. When the first fermentation is over, the wine is to be transferred or racked into a clean cask, and suffered to undergo the slow fermentation; it is then to be kept bunged up for three months, and then racked into another cask. In about twelve months it will be fit to bottle. Some add brandy after the first fermentation; but this is not necessary. A still richer wine may be made by increasing the quantity of fruit, and leaving out the sugar.

3461. *Mr. Aikin, formerly secretary to the Society for the Encouragement of Arts, &c.*, made a light, dry raisin wine of excellent quality; and the following is an account of the process, abridged from his paper in the Transactions of the Society:

The raisins which he employed were the muscatel, which are imported in boxes containing about twenty pounds, and when new are in common use as a table fruit. In this state the price prohibits its employment for this purpose; but in those which remain unsold for about a year, the rich pulp of the recent raisin becomes mixed with sugary concretions, which renders them less acceptable at the dessert; and the price of such fruit, being about ten pence a pound, brings it within the reach of the domestic wine-maker. The matter contained in grapes, which we have described by the name of ferment, exists in raisins in sufficient abundance to change into wine a greater quantity of sugar than the fruit contains, and it was found advantageous to add to the raisins from one tenth to one third of their weight of sugar. In order, however, to avoid tainting the wine with the peculiar flavour of brown or moist sugar, which happens generally in the usual mode of making raisin wine, he used good loaf sugar. Having separated the raisins from the stalks, the former were chopped very fine.

The proportion of the ingredients found to be the best was three pounds of raisins, one pound of sugar, and one ale-gallon of water. The must was prepared sometimes by mashing, and sometimes by maceration.

The mashing was performed as follows: The chopped raisins being put into an open tub or earthen-ware pan, hot water was poured on them, in the proportion of about a quart to four pounds of fruit. It is desirable, in this first mash, to extract the greater part of the saccharine mucilage as little altered as possible; the water was therefore heated only to about 120°. The water and fruit, after being mixed, was suffered to stand about a quarter of an hour, and then the whole was stirred carefully by the hand, taking care to break down all the lumps. The whole was next poured upon a sieve placed over a tub, where it drained for a short time; the husks were pressed by hand, and were returned to the mash-tub. The second mash is made exactly as the first; and the husks, after pressing, are returned to the mash-tub.

The raisins were now found to have lost all their clamminess, though they were still sweet; the greater part of the saccharine mucilage had been therefore extracted, and the principal object in the subsequent mashes is to dissolve the tartar which they contain. For this purpose the water of the third mash was heated to 150° or 160°, and was managed as the former. The liquor thus obtained was in a considerable degree acidulous, from the tartar having the flavour of the raisins, and but little sweetness. Three fourths of the mash being now made, the next operation was regulated by the degree of astringency which it was wished the wine should have. If it were desired the wine should be somewhat astringent, some boiling water was poured upon the stalks of the raisins, which were kept for that purpose in a separate tub, and, after they had macerated for a quarter of an hour, the liquor so produced was poured into the third mash, and well mixed with it; if astringency was not wished for, the stalks were rejected. In a quarter of an hour the liquor was put in the sieve, and the husks were well squeezed by hand. While the last mash is preparing, the liquor of the first three mashes was transferred to the fermenting tun, and the sugar was dissolved in it; then as much of the last mash was added as was requisite to bring the must to the due proportions, viz., one ale-gallon of must to three pounds of fruit, and one pound of sugar. The time occupied by the above processes was four or five hours.

The temperature of the must, when put into the fermenting tun, was usually about 70°; and the fermentation began in from twelve to thirty-six hours, according to the weather and the manner in which it was treated. The scum which rose was sometimes taken off every day, and sometimes it was allowed to remain till the liquor was about to be removed from the fermenting tun. If the fermentation was languid, the cover of the tun was kept on, and the scum was stirred daily into the liquor; if too rapid, the cover was taken off, and the scum was removed as it rose. In general, the best time for fermenting was when the temperature of the air is from 55° to 60°; of course, cold, frosty weather is unfit. When the fermentation had become languid, and was judged to have been sufficient, the liquor was vinous, but sweet; it was then carefully skimmed, and transferred to glass carboys containing about six or seven gallons, or to stone-ware barrels of the same size. As the latter are always more or less porous, they should be warmed thoroughly before a fire, and rubbed over with a mixture of bees'-wax and turpentine (about one part of turpentine to three of bees'-wax), and when this thin coat is grown cold, it should be well rubbed in with a hard brush. Instead of the usual vent-peg, which, however, answers the purpose, though requiring more attention, a more elegant method was employed, by the use of a well-known chemical apparatus called tubes of safety, which are little bent glass tubes containing a drop or two of quicksilver; these are inserted in the bungs, which are cemented down and covered with a mixture of wax and resin. The fermentation that goes on in the cask will be distinctly shown by the motion of the quicksilver in the tubes, as the carbonic acid gas that escapes will pass through the quicksilver; and this will continue for some weeks, after which it ceases. Upon the whole, the loss by fermentation in the tun is usually about six per cent. The wine should remain in the carboy or cask an entire summer, in order that the whole of the sugar may be decomposed by the fermentation. If the wine is made in April, it is bottled in the following March: if made in October, it is bottled about the end of September, or a week or two later, according to circumstances.

The wine is never fined, Mr. Aikin being of opinion that the light dry wine, which it was his aim to produce, would be materially injured by being deprived of its tannin through the action of isinglass or any similar substance. At the time of bottling, the wine did not appear to have any very sensible flavour, meaning by flavour that compound sensation of smell and taste which characterizes the finer kind of wines; but after remaining for a year in bottle, a flavour resembling elder flowers was strongly developed, mingled generally, in a slight degree, with that of prussic acid. When the principal part of the wine in the carboy had been run off to be bottled, the remaining part was passed through a flannel filter; but notwithstanding care had been taken that the wine when bottled should be clear, though not bright, there was always more or less of flocculent matter deposited, which required the bottles to be set upright in the binn, and to be decanted with care. The wine, when first decanted, was often of a very pale yellow colour, especially if highly-flavoured; but in an hour or two it deepened more or less, and at last acquired a tint like that of Bucellas, the prussic acid flavour at the same time disappearing.

Subsect. 3.—*General Principles for the Fabrication of Domestic Wines from other Fruits independent of the Grape.*

3462. *Though the principles described for making wine from the grape are, in general, applicable to that from any other fruit*, yet, from some differences in the composition of the latter from that of grapes, certain circumstances require particular attention.

3463. *We stated that grapes alone of all our fruits contain tartaric acid united to potash*, and that this tartrate of potash, though held in solution in the fruit, being insoluble in alcohol, is precipitated in a solid form, called tartar, when fermentation has converted a portion of the must into spirit; and that, consequently, grape wine properly made is free from acid, the tartaric being the only one contained in grapes in any considerable quantity. With all our other fruits the case is different; they do not contain the tartaric acid, but, instead, they have chiefly the malic, and sometimes the acetic and the citric, all of which exist either in a free state or form salts that are soluble; hence they remain in the wine after it is made, and are, to a certain degree, injurious to the human constitution. Another circumstance which distinguishes grapes from other fruits was stated: the tartar which they contain naturally acts as a ferment in the must, and hence grape-juice ferments spontaneously; but the ferment of other fruits is in such small quantity that yeast must be added to their juices to begin the fermentation.

3464. *The art of making what is termed home-made wine in England is of no great antiquity.* Pennant says that in the year 1635 they began to make some from the raisins or dried grapes of Spain and Portugal, and that one Francis Chamberlayne had succeeded so well that he obtained a patent for the manufacture of such wines for fourteen years. The author of the "Tatler" complained that in his day "they could squeeze Bordeaux out of the sloe, and draw Champagne from an apple."

3465. *It must be evident that a knowledge of the chemical composition of all substances used in fermentation* is essential in our reasonings or experiments made to ascertain the best modes of operation. But, unfortunately, vegetable chemistry has not yet made sufficient progress, or chemists have not considered it as an object of sufficient importance, to determine with accuracy the analysis of our various native fruits. We are, therefore, enabled only to possess general ideas on this subject, which, however, imperfect as they are, will assist us in our practice. The gooseberry has been chemically examined by Dr. John; but the proportions of its ingredients were not ascertained. It consists of water, uncrystallizable sugar, bi-citrate of lime, bi-citrate of potash, bi-malate of lime, bi-malate of potash, resin, a modification of gum, fibrin, ammonia in an unknown state of combination, phosphate of lime, and phosphate of magnesia.

Whether great practical advantages would result from the complete analysis of all our fruits employed for the purpose of making wine, it is difficult to say at present; but the analogy of similar cases would lead us to desire more definite information on this subject than we yet possess.

3466. *Dr. Macculloch, in consequence of successful experiments which he has made on this subject, recommends the addition of tartar* in preparing the must of domestic wines from other fruits than grapes. He has found this not only to meliorate the quantity of the produce, but also to increase the spirit which a given quantity of sugar is capable of yielding. The same author farther observes that experiments have not determined accurately the proper proportion of tartar that should be used; but as all wine deposites tartar with its lees, it may be considered that it has dissolved as much as it can of this salt during the process of vinification; or, in other words, only a certain quantity can remain in solution in the wine, the rest being precipitated or thrown down as so much extraneous matter. It is not likely, therefore, he observes, that we should err in adding too much, as the wine will only keep its proper proportion. The proportion of tartar may vary from two to six per cent., in proportion to the sweetness of the fruit and the quantity of added sugar, the sweetest must requiring most tartar. For this purpose the purified cream of tartar may do, but this is the *pure* bi-tartrate of potash separated from the fermenting principle, which is united with it as it falls down in the lees. The crude or unpurified tartar is better, and it should be employed in the same state in which it comes from the wine casks. This will be a powerful and proper ferment, instead of the yeast commonly made use of.

3467. *The malic acid, which derives its name from its abundance in apples, is the predominant acid in our fruits*, and, indeed, constitutes the chief difference between cider and wine. It might be a question for chemists whether some means might not be contrived for getting rid of a portion of the malic acid which is so detrimental to our domestic wines. Dr. Macculloch observes that perhaps a hint might be taken from the manufacture of sherry in Spain, in which lime is added to the grapes, which probably acts in neutralizing what portion of malic acid they may contain, or a part of the tartaric acid.

3468. *With respect to the processes for producing wine from our fruits*, our readers will have perceived, from what was said on making wine from grapes, that different methods must be pursued, according to the class of wine intended to be made, and whether they are to be brisk, dry, or sweet; and that no positive rules can be given applicable to all cases.

The manner of modifying the must and the fermentation for each of these is the same as in the case of grape wine; and we need not repeat the general principles, but refer the reader to what has already been said on the subject, adding, however, a few remarks.

3469. *Wine of the brisk kind is generally made here from gooseberries*, but it may also be produced from currants, or any other fruit, care being taken not to use it too ripe, and by following the directions already given. This modification of wine is one of the most esteemed, and deservedly so, and therefore the principles for forming it ought to be carefully studied, since failure can only occur from negligence or ignorance in the conduct of the process.

Sweet wines may be made from any ripe fruit, sufficient sugar being added, and the fermentation stopped in time, not to decompose too much, which is effected by racking off the wine from the lees into a clean cask, and even to remove what still remains of the ferment by clarifying with isinglass or white of eggs.

3470. *Dry and light wines*, like Hock and Grave, have seldom been successfully produced by our domestic wine-makers, except from grapes. The reasons are chiefly that they require the saccharine matter to be completely decomposed by fermentation, as we have already explained; but this has seldom been sufficiently attended to, nor the subsequent operations of racking, sulphuring, and fining: too much sugar has also, in general, been employed, from which they have turned sour, or have remained sweet. These wines are the most difficult to fabricate, and success is unattainable except all the circumstances which we have pointed out are accurately attended to. Wines that are dry and strong, such as Madeira and sherry, are seldom attempted with our fruits; but these might also be made by increasing the proportion of sugar and ferment, if due attention be paid to every part of the processes. With respect to strength, we have already explained that the sugar must be chiefly depended upon for giving it.

3471. *In proportioning the sugar according to the desired strength of the wine*, Dr. Macculloch gives the following rules: Two pounds of sugar, added to a gallon of a compound containing all the other ingredients requisite to a perfect fermentation, produce a liquor equal in strength to the lightest class of Bordeaux white wines. Three pounds' produce are equal in strength to the wine known by the name of white Hermitage; and from four, if fermented till dry, a wine resembling in strength the stronger Sicilian wines, that of Marsala, for example, or the Cape Madeira, is produced.

3472. *One of the faults frequently occurring in our domestic wines is excessive sweetness*, arising from too large a proportion of sugar having been employed compared with that of the fruit juice, or from the imperfect fermentation which the fluid has undergone. If it arise from the first cause, it is obvious that the evil might have been avoided at first by reducing the quantity of sugar and increasing that of the ferment and tartar: if it proceed from the latter cause, the fermentation might have been prolonged.

3473. But this sweetness is often intentional, for the purpose of concealing much acidity. We have stated that the wines made from our fruits cannot be entirely freed from the acids contained in them, and that, to cover this, a superabundant sweetness is found necessary.

We are prevented from deriving all the advantage which we might from the natural sugar existing in our fruits, because, were we to depend upon fruit juice alone, we should introduce too much malic acid into our wines, no means being known for separating this easily. Hence we are obliged to add artificial sugar in the must, and to dilute it with water, that we may have sufficient spirit with as little malic acid as possible. In making currant or gooseberry wine, if the fermentation was suffered to go on till the whole of the saccharine matter was converted into alcohol, the wine would be very acid, there being then no sugar to conceal the taste. It is, therefore, necessary to arrest the process, during the progress of the fermentation, long before the whole of the saccharine matter is consumed. There is, therefore, little natural strength in such wine, and it will not keep long, for the remaining free sugar is converted into acid by the slow fermentation, and the taste of the acid is perceived. Brandy is then frequently added to increase the strength of the wine, and to retard the slow fermentative process, and, consequently, the conversion of the remaining free sugar into alcohol, and it thus hinders the wine from tasting sour so soon; but the bad effects of brandy have been already pointed out.

3474. *But it is generally prudent to have the full quantity of sugar;* for we have said that there is seldom such a balance of the two fermenting substances, the saccharine matter and the yeast, that both are perfectly neutralized, and it is not possible always to determine if this has been the case; for the palate is unable to detect a very small portion of sugar, as its taste is masked by that of the wine; and the fermenting principle is still less ascertainable by the taste. If the wine be sweet after the fermentation, it is evident that some sugar remains undecomposed, and that all the ferment has been expended. In this case the wine will not turn sour immediately, particularly if it be strong, because there is no ferment to carry it on to the acetous stage. But if the wine be light, that is, not strong, and the fermentation should have been carried on so far that the wine is *dry*, that is, not sweet, it is a proof that all the sugar has been expended; there is then great danger of its passing into the acetous state, and becoming vinegar. In this case, the addition of sugar *immediately* will prevent this change, as it will serve for the ferment to act upon; but should the acetous change have already begun, sugar will only accelerate, instead of retarding it.

3475. *Another fault in domestic wines is excessive sharpness;* and this is an accident liable to happen from the prevalence of the malic acid in our native fruits.

3476. *The proportion of water to be used in the prepared must* is of great consequence, and Dr. Macculloch reprobates the current practice of using too great a quantity, and too little juice of the fruit: a custom apparently originating in a misplaced economy. In the practice of making wine from grapes in the wine countries, no water is used, but the whole fluid is composed of the juice of the fruit itself; but in the common practice, as recommended in the English domestic receipts, the juice of the fruit rarely forms more than one third of the whole liquor, and often much less; this proportion being also fixed without regard to the ripeness of the fruit. This artificial *must*, thus compounded of water, sugar, and juice, contains, in general, too small a quantity of the fermenting principle so essential to a perfect fermentation; the fermentation is too slow, and only a small quantity of alcohol can be the result; hence the liquor is so weak that it soon changes into vinegar. When green fruit is used, in which little exists but acid and ferment, of which the former, in this case, exceeds, bulk for bulk, the quantity in ripe fruits, the acid would generally be too abundant, and would require a dilution with water. But in ripe fruits, where the acid is reduced in its proportion, there is not the same necessity for employing water, and a smaller proportion of it will be sufficient, and with advantage to the wine. If too little water is used, the juice and sugar are too much concentrated, the fermentation is brought on with difficulty, and its progress is so slow that the operator will sometimes conceive, from the time employed, that it has continued long enough when it has scarcely commenced; and the result is therefore a sweet wine, the fermentation being stopped before all the vinous fluid has been formed.

3477. *Good flavour is a very important quality in wine, and our native fruits are mostly deficient in this quality;* nor is what they do possess always of the best kind. It is frequently useful, therefore, to introduce substances for the purpose of giving agreeable flavours. Here one caution may be of use: it is not to do too much. Wine may bear a small quantity of a particular flavour with advantage, whereas an increase of the same may be even nauseous. The taste alone can here be the only guide, which must regulate experiments and practice. Various substances are employed by wine-makers with this view: flavours of elder, cowslips, clove-pinks, vines, have all been occasionally used; likewise, other flavours may be obtained from sweet-briar, wormwood, walnut leaves, oak chips, rose water, sweet and bitter almonds, ginger, cloves, and orris root. The strawberry and raspberry have a high flavour, but it is difficult to preserve them during the process of vinification, otherwise we might have highly-scented wines. The most convenient mode of managing all these is to suspend them in a linen bag from the bung-hole of the cask during fermentation; and care must be taken to taste the liquor frequently, that the flavouring ingredient may be withdrawn in time. Astringency, when required, may be communicated in the same way, by catechu and other materials containing tannin, or the astringent principle. An agreeable bitterness may be given by burned sugar, which is likewise capable of producing every variety of yellow colour that can be desired in these, as in the wines of the grape.

3478. *Colour* is a matter of little comparative moment in our domestic wines. The only fruits of our own growth capable of yielding colour are the black cherry, strawberry, black currant, raspberry, mulberry, elderberry, and blackberry; the latter also affords a very agreeable flavour. Colour, when required, may also be communicated by several dye-woods, as Brazil wood, logwood, also oak chips, burned sugar, &c. *The astringent principle* is found in the sloe and the damson; and may, if required, give a roughness like that of port; but this is seldom desirable.

3479. *We have already stated that it is necessary to add yeast* or tartar in fermenting wine made from our ordinary fruits, although grape juice ferments spontaneously; but the yeast of beer should not be employed if it can be avoided, since it contains some of the bitter of the hop. It is best, when that can be done, to employ yeast obtained from a former fermentation of wine. The lees of grape wine may be preserved for this purpose in a dried state; and the yeast of gooseberry wine keeps perfectly well dried.

3480. "*It is a prejudice not uncommon,*" Dr. Macculloch observes, "*to suppose that the wines made from the fruits of this country are unwholesome.*"

"There is no doubt that they may occasionally disagree with individuals, either from defects in their fabrication, or from their undergoing the process of decomposition from pernicious accidental admixtures, or from the idiosyncrasies of particular constitutions. But they are not necessarily unwholesome;" and he adds, that their general insalubrity, whatever it may be, will certainly be diminished by every step which they shall make in their approach to the wine of the grape, that standard of perfection to which they must all ultimately be referred. But we should observe, that Dr. Macculloch in this alludes to domestic wines made by private individuals in the best manner, and not to what is sold in shops, of the manufacture of which we are ignorant.

3481. *With respect to the wholesomeness of our domestic wines made from ordinary fruit,* as they are commonly manufactured and sold, we cannot recommend them, considering the quantity of free acid which they usually contain, and that their actual composition is not known to us; and though, by proper management, conducted upon principle, they may be made by private individuals of superior quality, yet we are far from holding out the hope that they shall, from our native fruits alone, independently of the grape, ever be the rivals of the wines of foreign countries. But, without pretending to do with our gooseberries, currants, and other fruits of that kind, what is impossible, we might fairly expect to make from them a class of useful beverages, as various, at least, as the fruits from which they are produced, and holding an intermediate rank between the more ordinary ones, cider and perry, and that first of all liquors, the wine of the grape.

3482. *The usual addition of brandy to our domestic wines* is a circumstance that deserves particular consideration. We have stated that the great radical defect in this manufacture is using too small a quantity of fruit compared with the sugar employed. It is this circumstance chiefly which renders the fermentative process incomplete, and thus imparts the sweet, mawkish taste which renders our wines intolerable to most people, and even to all, perhaps, without the addition of brandy. We have, when treating of "Foreign Wines," stated the great prevalence of this practice in preparing many wines for the English market, and the bad effects of it. The general taste of this country, so long accustomed to strong brandied wines, can scarcely relish less potent beverages; but the alleged reason for introducing spirits into our domestic wines is that without it they will not keep; but it has been shown by Dr. Macculloch that the necessity of introducing spirits into our wines on this account is a mistaken notion; and that, were they made with the proper quantities of the materials, and with due attention to the fermentation and other processes, there is no reason why our wines should not be sufficiently durable without this addition. Independently of the brandy never combining completely with the wine, and, consequently, existing in a state that renders it injurious as a beverage, *fine* wines are invariably spoiled by the addition of ardent spirits, which seems to have the effect of slowly decomposing them, and thus of destroying that delicate, brisk, and lively flavour so eminently possessed by natural wines. If the addition of brandy be thought essential, either for keeping or strength, it should be done during the second fermentation in the cask, or the fretting-in process, since then a portion, at least, of the spirit will enter into permanent combination with the wine, which will not be the case when the fermentation is completed.

3483. *The names of foreign wines given to our home manufactures by dealers* is a gross fraud upon the public, and is particularly calculated to mislead numerous persons little acquainted with the history of wines, and who scarcely know that Calcavella, Frontignac, and other names displayed in a conspicuous manner in our shops, belong to wines of the Continent which cannot possibly be made in Britain. There is nothing wrong in endeavouring to imitate the flavour of these wines; the crime is in not taking care lest the purchaser should lie under the erroneous impression that the imitation is the original wine. Another circumstance is obvious; that, as we do not know all the substances employed in making these imitations, not having any acquaintance with the chemical skill nor the honesty of those who manufacture them, we run the greatest risk, if not of being actually poisoned, yet of taking substances in our wine extremely deleterious to our health. Nothing is more dangerous than permitting the composition of our food or drink to be a secret; and it must be evident that it has been a leading idea, all through this work, to enlighten the public upon this subject, and to induce every one to perceive the necessity of understanding accurately the nature of what is so important to our health, and, consequently, our happiness. Those who are desirous of ascertaining how nearly our domestic wines may be made to imitate those of foreign growth will be safe if they make the trials themselves, guided by their own skill in chemistry, or that of some chemical friend; and experiments of this kind, conducted with care, will highly deserve being laid before the public. We would strongly recommend all those who turn their attention to the subject to possess themselves of the theoretical principles which we have endeavoured to render familiar and easy to be comprehended, as this cannot fail to light them in their path in making experiments and trials in making wine. Some knowledge of the elements of chemistry will be of the greatest use in enabling them to vary their practice as circumstances may require.

3484. *We have now given a sketch of the leading facts which are necessary to be known in the art of making domestic wines; but as we are convinced that there are many persons who will not take the trouble of studying these with sufficient attention,* who yet would be desirous of attempting to fabricate some home-made wines in the usual manner by following a receipt, we feel it necessary to add *some receipts of this kind,* collected from the best sources.

SUBSECT. 4.—*Gooseberry Wine.*

3485. The gooseberry is one of our fruits most commonly used among us for domestic wine, and, if managed judiciously, may produce an excellent brisk wine, which is likewise the readiest made, and the cheapest. For this purpose the fruit may be used in the unripe state; and wine so prepared, by judicious management, comes often so near to real Champagne as not to be distinguished except by those much accustomed to the French wine. It is difficult, however, to get quite rid of a peculiar flavour derived from the gooseberry, which is most developed in the ripe fruit, and is less perceptible in the immature state. This flavour resides in the skins alone, and therefore some employ the expressed juice only; but it must be observed that the produce is thus rendered nearly tasteless, which, however, is not so bad as an offensive flavour; but a certain proportion of the skins is observed not to injure, but to communicate a flavour that is rather agreeable.

3486. Various proportions of fruit and sugar are given in different receipts; but Dr. Macculloch observes that the quantity of fruit is usually too small, and the fermentation is generally so imperfect that the wine is left disagreeably sweet.

3487. From the ripe gooseberries having more saccharine matter, sweet and dry wines may be produced; but these are ill flavoured, particularly if the husk is not carefully excluded, which contains more flavouring substance in proportion to its ripeness.

Gooseberry wine, properly made, is perfectly durable, as much so as Champagne of corresponding strength, provided equal care be taken in the bottling, cellarage, and other management, all of these being circumstances in which our domestic fabricators are too apt to fail.

3488. *Dr. Macculloch's Receipt for making Gooseberry Wine.*—"The fruit must be selected before it has shown the least tendency to ripen, but about the time when it has nearly attained its full growth. The particular variety of gooseberry is perhaps indifferent; but it will be advisable to avoid the use of those which in their ripe state have the highest flavour. The *green Bath* is perhaps among the best. The smallest should be separated by a sieve properly adapted to this purpose, and any unsound or bruised fruit rejected, while the remains of the blossom and the fruit-stalk should be removed by friction or other means. Forty pounds of such fruit are then to be introduced into a tub carefully cleaned, and of the capacity of fifteen or twenty gallons, in which it is to be bruised, in successive proportions, by a pressure sufficient to burst the berries, without breaking the seeds or materially compressing the skins. Four gallons of water are then to be poured into the vessel, and the contents are to be carefully stirred and squeezed in the hand until the whole of the juice and pulp are separated from the solid matters. The materials are then to remain at rest from six to twenty-four hours, when they are to be strained through a coarse bag by as much force as can conveniently be applied to them. One gallon of fresh water may afterward be passed through the *marc*, for the purpose of removing any soluble matter which may have remained behind. Thirty or twenty-five pounds of white sugar are now to be dissolved in the juice thus procured, and the total bulk of the fluid made up with water, to the amount of ten gallons and a half. If I name two quantities, it is because the fruit itself varies in quality, and it depends on the operator to distinguish. The old receipts allow forty pounds, of which the consequence is, invariably, a sweet wine, while it fails of being brisk in nine out of ten cases. And the smaller proportion here given will most frequently ensure a brisk wine, if the operator will but attend to the progress of the fermentation, and the treatment as formerly described. The liquor thus obtained is the artificial *must*, which is equivalent to the juice of the grape, that is, made to resemble it as nearly as possible. It is now to be introduced into a tub of sufficient capacity, over which a blanket or similar substance, covered by a board, is to be thrown, the vessel being placed in a temperature varying from 55° to 60° of Fahrenheit's thermometer. Here it may remain for twelve or twenty-four hours, according to the symptoms of fermentation which it may show, and from this tub it is to be drawn off into the cask in which it is to ferment. When in the cask it must be filled nearly to the bung-hole, that the scum which arises may thrown out. As the fermentation proceeds, and the bulk of the liquor in the cask diminishes, the superfluous portion of *must*, which was made for this express purpose, must be poured in, so as to keep the liquor still near the bung-hole. When the fermentation becomes a little more languid, as may be known by a diminution of the hissing noise, the bung is to be driven in, and a hole bored by its side, into which a wooden peg, called the *spile*, is to be fitted. After a few days this peg is to be loosened, that, if any material quantity of air has been generated, it may have vent. The same trial must be made after successive intervals, and when there appears no longer any danger of extensive expansion, the spile may be permanently tightened.

"The wine thus made must remain over the winter in a cool cellar, as it is no longer necessary to provoke the fermenting process. If the operator is not inclined to bestow any farther labour or expense on it, it may be examined in some clear and cold day towards the end of February or beginning of March, when, if fine, as it will sometimes be, it may be bottled without farther precautions. To ensure its fineness, however, it is a better practice to decant it, towards the end of December, into a fresh cask, so as to clear it from the first lees. At this time, also, the operator will be able to determine whether it is not too sweet for his views. In this case, instead of decanting it, he will stir up the lees so as to renew the fermenting process, taking care also to increase the temperature at the same time. At whatever time the wine has been decanted, it is to be fined in the usual way with isinglass. Sometimes it is found expedient to decant it a second time into a fresh cask, and again to repeat the operation of fining. All these removals should be made in clear, dry, and, if possible, cold weather. In any case it must be bottled during the month of March. The wine thus produced will generally be brisk, and similar in its qualities (flavour excepted) to the wines of Champagne, with the strength of the best Sillery, if the larger proportions of sugar have been used, but resembling the inferior kinds with the smaller allowance. Inattention, or circumstances which cannot always be controlled, will sometimes cause it to be sweet and still, at other times, to be dry. In the former case it may be manufactured the following season, by adding to it that proportion of juice from fresh fruit which the operator's judgment may dictate, and renewing the fermentation and subsequent treatment as before. In the latter case, as its briskness can never be restored, it must be treated as dry wine by decanting into a sulphured cask, when it must be fined and bottled in the usual manner. Such dry wines are occasionally disagreeable to the taste in the first or second year, but are much improved by keeping; nor ought they to be drunk under five or six years."

3489. On comparing this receipt with others, it may be proper to remark that white sugar is recommended, whereas some use raw sugar, which is much inferior. Here the fermentation is performed in the cask; others ferment in an open tub for several days, thus losing much carbonic acid, skimming off the yeast as it forms; they then put the liquor into a cask, where the fermentation is renewed, the yeast which runs out at the bung-hole being cleared away as it rises. When this fermentation has ceased, they add brandy, and sometimes honey, a practice which is condemned by Dr. Macculloch.

3490. *Mr. Donovan's Process for making Wine from ripe Gooseberries.*—"Although the fruit should have been red, the wine will not be so; its tint will be a flesh colour, for the red colouring matter is precipitated during the process. The wine will not be quite so good as that from unripe fruit, at least it will require a far longer time to ameliorate to the same degree of goodness. Ten gallons of gooseberries are to be bruised in a tub, and left so for twenty-four hours. The pulp thus prepared is to be introduced, either at once or in successive portions, into a hair cloth or canvass bag, and submitted to pressure. The matter remaining in the bag is to be returned into the tub, and five gallons of tolerably hot water are to be poured on: the whole is to be well mixed up. After thus remaining in the tub well covered for about twelve hours, the matter is to be pressed through the bag, and the liquor obtained is to be mixed with the original juice. The solid matter of the fruit is then worth very little, and may be thrown away.

"In every five gallons of the liquor, consisting of the mixture of the original juice with the infusion, twelve pounds of white sugar are to be dissolved perfectly. If the liquor be now left to itself, it will, after some hours, show symptoms of a commencing fermentation. In proportion as the fruit is ripe, the temperature of the weather ought to be high. Should it be very cool weather, the liquor should be placed near the fire. If the gooseberries were unripe, or just ripening, the fermentation will take place at a lower temperature, and with more activity.

"The progress of the fermentation should be frequently ascertained by tasting the liquid, it becoming continually less sweet until at length the sweetness totally disappears; at this period the fermentation is complete. When the fruit has been over ripe, or when the weather is remarkably cool, the last portions of sugar remain a long time unaltered, and the fermentation is suspended. Placing the containing vessel near the fire will always renew the fermentation; so long as this degree of heat is kept up the fermentation will proceed. When the quantity of wine under fermentation is very considerable, it will generally keep up its own temperature. Should the season be so warm, and the fermentation so rapid, as to excite fears of souring, which, however, can never happen while the quantity is so small as ten or twenty gallons in each fermenting tub, we can readily avert the danger by racking off from the lees, having first skimmed off the head of yeast.

"When the fermentation has totally ceased, the wine is to be racked off as clear as it can be procured. To every five gallons of it two quarts of brandy or good old malt spirit are to be added, well mixed and left to settle; for the spirit causes a separation of flocks which previously had been in solution. After subsidence for perhaps a month, the clear liquor is to be cautiously drawn off, introduced into a cask which it just fills, and set by in a cool cellar for a great length of time. It is seldom that the impatience and curiosity of inexperienced makers of domestic wines for family use can brook the delay of keeping the wine long enough to mellow sufficiently. The wine just described will require five years at least to be in its best condition, and must have been kept in wood all that time; it may then be bottled. A much shorter time will, however, render it tolerable."

Subsect. 5.—*Currant Wine.*

3491. *Three varieties of currants are employed in making wine*, white, red, and black, but the first two are most common. The wines from the white and red sorts differ a little from each other in colour, and also in flavour. With proper management, they are capable of producing a wine analogous to the lighter wines of the grape, according to Dr. Macculloch, "not easily to be distinguished from the Colares of Portugal, which, although not in the first class, is certainly superior to most of our domestic wines." A principal defect in currant wine, as commonly made, arises from too small a quantity of the fruit being used, and, of course, too much sugar and water. On this account, and from the imperfect fermentation, these wines are usually too sweet, and from a natural bad flavour in the husks, which are often kept in the *must*, a mawkish taste is induced. By increasing the quantity of fruit, which is generally used only in the same proportion as in gooseberry wine, and avoiding the use of the husks, the flavour and quality of the wine are materially improved.

At present only sweet wines are generally made from currants; but dry wines may also be fabricated from this fruit by the methods already pointed out; for these the fruit should be ripe.

Brisk wine may also be made, and then a proportion of unripe fruit should be introduced. The use of tartar, likewise, Dr. Macculloch is of opinion, would be advantageous, and would correct a defect not uncommon, that of having an ammoniacal taste.

Another improvement has been put in practice with success, not only in making currant wine, but in all those wines produced from fruits of which the flavour is either bad, or which have little or no flavour; this is *by boiling the fruit juice* previously to fermentation. From this treatment many tasteless fruits acquire a flavour, and many bad flavours are converted into agreeable ones. This is particularly remarkable in the case of the black currant, which, though harsh in its natural state, acquires by boiling a powerful and, to most persons, an agreeable flavour. Wine made from this fruit in the raw state has no particular property, whereas that of the boiled may be, by careful management, brought to resemble some of the best of the sweet Cape wines. The boiling must not be too long continued, as this degree of heat tends to coagulate and precipitate the ferment, and thus render it ineffective. Some artificial ferment is generally necessary with boiled juice. Great care must be taken in separating the stalks; and if the skins and solid matter are fermented in the vat, they must not, at all events, be introduced into the casks. Many persons put the pure juice into the casks at once, strained, without any previous fermentation in the vat.

Receipt for White Currant Wine.—Bruise forty pounds of fruit in a tub of the capacity of fifteen or twenty gallons, and add to it four gallons of water. Stir the whole well, and squeeze till the pulp is thoroughly separated from the skins. Leave these materials at rest for about twelve hours, and then strain them through a canvass bag or fine hair sieve, and pass one gallon of fresh water through the *marc*. Dissolve thirty or twenty-five pounds of white sugar in the juice thus obtained, and make up the whole quantity by an addition of ten gallons and a half of water. The proportion of sugar here given is for a brisk wine; if a sweet wine is required, there must be forty pounds of sugar. White sugar is recommended as much the best; if moist sugar be used, somewhat more will be necessary. The must being now prepared, the fermentation and subsequent treatment must be exactly the same as for gooseberry wine, and the reader may therefore refer to that receipt.

If brandy is to be added, it should be added towards the end of the fermentation in the cask. For the above quantity, some will put in a quart of brandy alone; others first mix it with honey.

Whether the wine should be racked off from the lees at the end of six months, put into a fresh cask for six months longer before it is bottled, or be suffered to remain the whole time in the lees, must depend upon the state of the wine, according to the principles explained above. The bottling should be carefully attended to.

Another Receipt.—White currants, nine gallons; white gooseberries, one gallon; white sugar, twenty-five pounds; white tartar, an ounce; bitter almonds, two ounces; water, nine gallons; brandy, one gallon.

3492. *Mr. Cornell's Receipt for making Red Currant Wine.*—Bruise eight gallons of red currants with one quart of raspberries. Press out the juice, and to the residuum, after pressure, add eleven gallons of cold water. Add two pounds of beet root, sliced as thin as possible, to give colour, and let them infuse, with frequent mixture, for twelve hours; then press out the liquor as before, and add it to the juice. Next dissolve twenty pounds of raw sugar in the mixed liquor, and three ounces of red tartar in fine powder. In some hours the fermentation will commence, which is to be managed according to the details given for gooseberry wine, and the principles we have stated previously. When the fermentation is completely over add one gallon of brandy; let the wine stand for a week, then rack off, and let it stand for two months. It may now be finally racked off, bunged up in the cask, and set by in a cool cellar for as many years as may be required to ameliorate it.

3493. *Black currant wine* may be made in the same manner, using six gallons of black currants, three gallons of strawberries, twenty-five pounds of raw sugar, four ounces of red tartar, ten gallons of cold water, and three quarts of brandy.

SUBSECT. 6.—*Elderberry Wine.*

3494. *The elderberry is well adapted for the production of wine.* Its juice contains a considerable portion of the principle necessary for a vigorous fermentation, and its beautiful colour communicates a rich tint to the wine made from it. It is, however, deficient in sweetness, and therefore demands an addition of sugar.

There are several methods of making this wine. The following are some of the most approved receipts:

3495. Take one gallon of ripe elderberries and one quart of damsons or sloes for every two gallons of wine to be made. Boil the fruit in about half the quantity of water till they burst, breaking them frequently with a stick. Strain the liquor, and return it to the copper. To produce eighteen gallons of wine, twenty gallons of this liquor are necessary; and for whatever quantity the liquor falls short of this, water must be added to make up. Boil this together with fifty-six lbs. of coarse, moist sugar for half an hour, and it is to be fermented in the usual manner when sufficiently cooled, and then it is to be tunned, or put into the cask. Put now into a muslin bag a pound and a half of ginger bruised, a pound of allspice, two ounces of cinnamon, and four or six ounces of hops; suspend the bag with the spice in the cask by a string not long enough to let it touch the bottom; let the liquor work in the cask for a fortnight, and fill up in the usual manner. The wine will be fit to tap in two months, and is not improved by keeping, like many other wines. Elderberries alone may be used.

3496. *Another Method.*—Elderberries, ten gallons; water, ten gallons; white sugar, forty-five pounds; red tartar, eight ounces; fermented with yeast in the usual manner. When in the cask, ginger root sliced or allspice, four ounces; bitter almonds, three ounces, suspended in a bag, may be allowed to infuse in the liquor when it is fermenting; they are then to be removed. Brandy may be added or not. When the wine is clear, which will be in about three months, it may be drawn off from the lees and bottled. The spices may be varied according to taste.

SUBSECT. 7.—*Cherry Wine.*

3497. *An excellent Wine may be made from Cherries.*—Pick Morello cherries, not over ripe, from their stalks; mash them in a mortar and pan to detach the pulp without bruising the stones, and suffer the mass to stand twenty-four hours. Press the pulp through a coarse hair sieve, and to every three gallons add from eight to nine pounds of loaf sugar. Put the mixture into a cask, add yeast, and suffer it to ferment; then rack the wine from its lees as soon as it becomes clear. Some persons crack the stones, and hang them with the bruised kernels in a bag suspended from the bung-hole in the cask during the fermentation of the wine, which thus acquires a nutty flavour. Mr. Tooke informs us that they make a good deal of this wine in Russia, and that they add some honey to the cherries.

3498. *Damson, or Black Cherry Wine.*—Infuse together for twenty-four hours eight gallons of the fruit, eleven gallons of warm water, thirty pounds of sugar, six ounces of red tartar, breaking the fruit as in the case of the elderberries. Break one eighth part of the cherry-stones, and add them to the marc. Strain and ferment as usual. The rest of the process as in currant wine.

3499. *French Method of making Cherry Wine.*—Bruise together fifteen pounds of cherries not quite ripe, and two of currants; add two thirds of the cherry kernels. Put the whole in a small cask, with a quarter of a pound of sugar to each quart of juice. Let the cask stand in sand, and cover the bung lightly while it is working, which will occupy nearly three weeks. The cask should be of the size just to hold the juice, or the latter must be made up in the above proportions to the size of the cask, as it is necessary it should be full. Carry on the fermentation in the usual manner, as in grape or gooseberry wine. When the fermentation is over, bung up the cask, and in about two months the wine will be fit to be drawn off and bottled.

SUBSECT. 8.—*Mulberry Wine.*

3500. Gather the mulberries before they are quite ripe, bruise them in a tub, and to every quart of the bruised berries put the same quantity of water. Let the mixture stand for twenty-four hours, and then strain it through a coarse sieve; having added to every gallon of the diluted juice three or four pounds of sugar, allow it to ferment in the usual manner; when fine in the cask, bottle it.

SUBSECT. 9.—*Apricot Wine.*

3501. Take apricots when nearly ripe, remove the stones, and bruise the pulp in a mortar. To eight pounds of the pulp add a quart of water; allow the mixture to stand for twenty-four hours, and then squeeze out the juice; add to every gallon of it two pounds of loaf sugar; put it into a cask and ferment it, and when perfectly clear bottle it. *Peach wine* may be made in a similar manner.

SUBSECT. 10.—*Strawberry or Raspberry Wine.*

3502. Bruise and press out the juice of either fruits. Pour on the marc seven gallons of water; infuse for twelve hours, and press out the liquor; add this liquor to the juice, and mix them with six gallons of cider. Dissolve in the mixture sixteen pounds of raw sugar, and three ounces of powdered red tartar, and then set it to ferment in the usual manner. Pare the rinds of two lemons and of two oranges, and, together with the juice, throw them into the fermenting tub, and take out the rinds when the fermentation is over. Three gallons of brandy may be added. In making raspberry wine a gallon of red and white currant juice should be added, and an equal quantity of water left out.

SUBSECT. 11.—*Cider White Wine.*

3503. Mix sixteen gallons of apple juice, sixteen pounds of honey, four ounces of white tartar; enclose in a bag one ounce each of cinnamon, cloves, and mace, and suspend it in the mixture while fermenting. When the fermentation is complete, add one gallon of rum.

SUBSECT. 12.—*Cowslip Wine.*

3504. Boil together seven pounds of moist sugar, two gallons and a half of water, and two ounces of hops. Pare the rinds of eight lemons or Seville oranges, or a part of each; pour the boiling liquor over them; when this is cool, squeeze the juice over it, and add this to the liquor. Ferment the whole with yeast in the usual way, and put it into the cask. Gather cowslip flowers on a fine day, picking out carefully all stalks and leaves. Put into the cask of wine as much of the flowers as would be a quart, when fresh gathered, for each gallon; stir them well till they sink. Dissolve three ounces of isinglass in a little of the wine, and return it to the rest to fine; in a few days bung it up close. In six months the wine will be fit to bottle, but will improve by being kept longer in the cask. By managing as above, the wine will be fined in the casks, and will be as good from the cask as if bottled, which is a great saving of trouble. The cowslip flowers may be dried and kept in bags till they are wanted, and will do as well as fresh.

SUBSECT. 13.—*Orange Wine.*

3505. Seville oranges are used for this purpose; they are best in March. For eighteen gallons of wine half a chest of oranges are required. Pare the rinds from about a dozen or two dozen, as more or less of the bitter will be agreeable; pour over this a quart or two of boiling water, and after letting this stand for twelve hours, strain off the water which extracted much of the essential oil of the oranges. Take the peel off entirely from the remainder of the oranges, squeeze the juice through a bag or a sieve, and put it into a cask with about forty five pounds of white sugar, or fifty-five of the best moist sugar. Soak the pulp in water for twenty-four hours, and after straining this, add it to the cask. Repeat this several times till the cask is full; stir the whole well with a stick till the sugar is dissolved; then set it to ferment. The fermentation is slower than with currant wine, but may be heard hissing for several weeks; when this subsides, close the bung-hole, and proceed as in the case of gooseberry wine. Some add brandy. The wine requires to be kept in the cask a year before it is bottled.

SUBSECT. 14.—*Birch Wine.*

3506. A wine was formerly made from the sap of the birch tree, though now it is scarcely known. The sap contains so much saccharine matter as to be fermented; it is to be obtained in the month of March, when it begins to ascend, by boring a hole in each tree about a foot from the ground, large enough to admit a faucet, which is to be inserted. The sap will flow for several days into a vessel placed to receive it without injuring the tree. Having obtained as much as is proper, the hole should be stopped with a peg. To a gallon of this sap add a quart of honey, or two pounds and a half of sugar, and boil them together, stirring the whole; add also two ounces of hops for every nine gallons, a few cloves, and a rind or two of lemons. Ferment this with yeast, transfer it to the cask, refine it with isinglass, and proceed as in the other cases. In about two months the wine may be bottled, and in two months more it will be fit for use. It will improve by keeping.

Birch wine has been made from an open grove of about 100 *birch trees, near Overton Hall,* for sixty or seventy years past. Thirty trees or more are tapped in a season, about six or eight inches above the ground, in March. A piece of bark about three quarters of an inch in diameter is cut out with a gouge, and the wood penetrated an inch or more; an iron spout is then driven into the bark below the hole, which conducts the sap to a bottle. In warm weather the holes soon grow up, and will cease to run in four or five days; but in windy weather they will run for a month. Some trees will run twenty-four gallons in twenty-four hours; others not half a pint. The juice is sold at sixpence a gallon to those who make small wine as a substitute for small beer. If the juice is scalded, but not boiled, it may be kept a month before it is made into wine: if not, it will not keep above a day or two. For making wine, two pounds of coarse sugar, and a quarter of a pound of Malaga raisins, are added to every gallon of birch juice when cold; it is then boiled for an hour, until it is observed to grow clearer, when it is set to cool; and when about the same heat that beer is set to work, a toast of bread, spread with yeast, is put into it, and for four days suffered to work freely, when it is barrelled; and the same quantity of raisins as before, and about an ounce of isinglass to every twenty gallons, are added. It seldom works out of the barrel, and in two or three weeks is ready for close bunging down, to remain for three months, when it should be bottled off, and in two or three weeks after it is fit for drinking, but is better for being kept longer.—*Loudon's Encyclopædia of Agriculture.*

3507. The sap of the birch is convertible into wine, vinegar, and spirit, and from it sugar may be obtained. From a large tree tapped in the spring several gallons of saccharine sap may be drawn daily without obvious injury to the plant, which forms, when fresh, an agreeable beverage, and, when fermented, an intoxicating liquor.—*Burnett's Botany.*

SUBSECT. 15.—*Ginger Wine.*

3508. Dissolve eighteen or twenty pounds of sugar in nine and a half gallons of boiling water, and add to it ten or twelve ounces of bruised ginger root. Boil the mixture for about a quarter of an hour, and, when nearly cold, add to it half a pint of yeast, and pour it into a cask to ferment, taking care to fill the cask from time to time with the surplus of the liquor made for that purpose. When the fermentation ceases, rack off the wine, and bottle it when transparent. It is a common practice to boil the outer rind of a few lemons together with the ginger destined for the wine, to impart to the wine the flavour of lemon peel.

SUBSECT. 16.—*Rhubarb Wine.*

3509. The leaf-stalks of the giant rhubarb, cut into pieces as if for tarts, and bruised with a wooden mallet to express the juice, will make a delicious wine, quite equal to green gooseberry, and very closely resembling Champagne.—*Gardener's Magazine.*

SUBSECT. 17.—*Wine made from mixed Fruits.*

3510. Take cherries, black currants, white currants, and raspberries, of each an equal quantity, though, if the black currants predominate, the better. To four pounds of the mixed fruit, well bruised, put one gallon of water; let it steep three days and nights in an open vessel, frequently stirring up the mass; then stir it through a hair sieve; put both liquids together, and in each gallon of the liquid put three pounds of sugar. Let the whole stand again three days and three nights, frequently stirring it up as before, after skimming off the top; then turn it into a cask, and let it remain at the bung-hole, while fermenting, about two weeks. Lastly, to every nine gallons put one quart of good brandy, and then fasten down the bung; if it does not soon become fine, a solution of isinglass may be stirred into the wine.—*Papers of the Bath Society,* vol. xi.

SECT. IV.—MANAGEMENT OF THE WINE-CELLAR.

To manage wines in the cellar with advantage, it is necessary to be acquainted with their manufacture, which we have already explained; also to know the several diseases to which they are liable, and the remedies.

SUBSECT. 1—*Construction of the Wine-cellar.*

It is necessary that the temperature of wine-cellars should be as uniform as possible. If liable to be affected by the variations of weather, wine in bottles will become turbid, or "sicken;" they should be placed so as not to be affected by any of the ordinary causes of concussion. Wine is easily acted upon by any unusual kind of motion; and it has sometimes happened that when taken from a good cellar in London to a bad cellar in the country it has been all spoiled.

The openings of a wine-celler ought to be few and narrow; yet the means of occasional ventilation should be provided for; but a current of air should not pass constantly through it, since this must often introduce a change of temperature.

Cellars where wine is kept in the wood should neither be too humid nor too dry. The excess of humidity may be observed by the moisture of paper, corks, &c., kept in them for some time. If the cellar is too damp, the casks are apt to rot and decay; and fungous matter and mouldiness will grow and infect the air; at the same time a moderate degree of humidity is proper; for if a cellar be too dry, the staves of the cask will shrink and warp, and occasion a loss of wine.

3511. *Different wines require different qualities in a cellar to be preserved in the best manner.* In England it is useful to have two wine-cellars, or two divisions in one, in large establishments, to suit various sorts of wine. One of these should be some degrees warmer than the other, for there are many wines which do best in a cellar of higher temperature than usual; thus Madeira, Sherry, Canary, Malaga, Syracuse, Alicant, Cyprus, and some others, keep better in warm than cold cellars, although such are not well adapted to the delicate wines of France. Where there are two cellars of different temperatures, they should not communicate, lest the temperature of each should be affected by opening the door of communication.

In cellars which hold the wines of the south it may be necessary sometimes to introduce artificial heat; and to regulate this, a thermometer should be kept in it. The increase of temperature may be obtained occasionally by a chafing-dish and charcoal, but much better by a fire, for which reason such cellar ought to be provided with a fireplace. But it should be recollected that charcoal burned in a place having no means of ventilation will render it dangerous to enter after a certain time, from the carbonic acid generated; a fireplace will be free from this danger.

3512. *The cellar ought to be swept often, and kept extremely clean,* as filth gives rise to noxious vapours, which will, sooner or later, affect the wine.

3513. *To make a cellar complete,* it should have a small ante-room, the door of which may be shut before that of the cellar is opened, to prevent, as much as possible, any change of temperature. This ante-room may be usefully employed in holding a number of things that might litter the cellar, which should be kept as free as possible from lumber.

Subsect. 2.—*Casks for Wine.*

3514. *New casks require some preparation* before wine is put into them. It is recommended that they should first be well washed with cold water. Then a hot solution of salt in water (about half a pound of salt to every thirty gallons) should be thrown in, and the cask bunged up: after this it should be well shaken, and suffered to get cold. Some wine heated should next be poured in, and the cask shaken again.

When a cask is emptied it should be well drained, and a brimstone match about an inch square burned in it; then it should be bunged up quickly and put into a dry place, particularly if not wanted for immediate use; this will prevent its contracting any bad taste.

When casks that are crusted interiorly with lees are to be rinsed, the crust may be loosened by suspending a piece of iron chain from the bung-hole and shaking the cask so that the chain may knock against the sides. Mouldiness is best destroyed by rinsing the cask with water in which quicklime has been dissolved.

The casks in a cellar should be inspected very frequently, once a month at least, that accidents may be immediately repaired. When the wine is perceived escaping from the giving way of a hoop, no time should be lost in surrounding it with an iron hoop; and in default of such a hoop, a strong rope may be used, and drawn tight round it with a packing stick, till a hoop can be got ready. Slight leakages may be stopped for a time with a little tallow or cement; but if the leakage is considerable, the wine had better be racked off into a sound cask.

3515. *The casks should be placed upon strong, elevated tressels, touching no part of the walls;* and they should, if possible, be at such a distance from the wall, that one may be able to go round them to examine the condition of the cask. When they stand near the walls they are apt to be attacked by the dry rot, and then the casks burst, and the wine is lost. They should be kept steady with wedges. Wines in wood generally ferment more or less about the time of the equinoxes, when the weather is very unsettled; and then they exert such a force upon the staves that they are apt to burst, particularly if any stave happens to be decayed: to prevent this, a gimlet hole should be bored in the bung, and stopped with a peg, to be drawn out occasionally to give vent to the gas. The casks should be filled up monthly, to make up for the loss by evaporation, or mouldiness will come over the surface of the wine and spoil it.

3516. *The binns to hold the bottles* are in some cellars made of brick-work; in others of wood, which is apt to decay; and in others they are of cast iron, and moveable, which is very convenient. The bottles should be placed in rows upon each other; some put laths between each row, to prevent one from touching the other, which might occasion breakage. The lowest row should be very well bedded upon sand or sawdust, though some omit this; and it is necessary to take care that the bottles are placed quite horizontally; for if the neck be higher than the bottom, the cork will be left to dry, and cease to close well; if lower, the lees, which continue to form, will mix with the liquid when used.

Subsect. 3.—*Racking.*

3517. *Racking is transferring wine into another cask;* this process requires sometimes to be performed in the manufacture of the wine, as has been already shown; and it is often necessary in the cellar to put an end to any fermentation that may have begun; and it is also necessary previous to a cask of wine being removed. Should the fermentation, from any cause, be renewed in the cellar, there is great danger of its passing into the first stage of acetification, or, according to the coopers' phrase, of being *pricked.*

For racking, it is proper to choose dry, cold weather, as it is then only that the wines are clear. They are frequently turbid in damp, close weather, and in southerly winds; and it is evident that if they are then racked, a portion of the thick matter will come off with the liquor.

The mode in which this operation is performed is very necessary to be known. By the common method of tapping it is scarcely possible to draw off the wine without mixing a portion of the lees with it; and the wine is much injured by being so much exposed to the air. A siphon introduced at the bung does it very effectually if well managed. An excellent method, much used in France, is one similar to that which is practised by the retailers of porter here in drawing that liquor, namely, the condensation of air on its surface. This may be readily performed without the aid of complicated machinery. To effect it, a straight brass tap, with a key to turn like a cock, is fixed in the full cask, *a, fig.* 563, three or four inches above the bottom, according to the

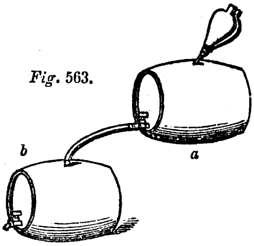


Fig. 563.

quantity of the lees. A leathern hose, three or four feet long, is provided, terminated by two tubes in a conical form to fit the brass tap. Fit one of these tubes into the orifice of the tap, and the other into the bung-hole of the empty cask, *b*. Some small holes must be bored in the highest stave of the empty cask; and fit the nozzle of a pair of common bellows in the bung-hole of the full cask. Turn the key of the brass tap so as to permit the wine to flow, and by the action of the bellows it will pass through the hose into the empty cask; by this means the wine will be transferred from one cask to the other without in the least disturbing the sediment. When all the wine has run that will pass by the hose, withdraw it, and stoop the cask to get out what more of the wine is clear. There are other methods of racking too well known to require description.

Subsect. 4.—*Sulphuring.*

3518. *Sulphuring we have mentioned as a process always employed in the preparation of sweet wines on the Continent*; and occasionally it is used here by the maker of domestic wines. Its use is to check completely any fermentation that has begun improperly, and this it will do after many other methods have failed. The explanation of its effect is the following: By the burning of sulphur, the pungent vapour produced is an acid of a gaseous nature, called sulphurous acid, which has a strong attraction for the fermenting principle in wine; and when they unite, the ferment loses its power, and becomes inactive and dead. If wine, therefore, be made to absorb in any way the vapour of burning sulphur, the ferment which it contains is effectually destroyed, and hence no future fermentation can take place in the fluid.

The manner of effecting the sulphuring is sufficiently simple. Matches dipped in sulphur are introduced into the empty cask which is to receive the wine which is to be operated upon, where they are suffered to burn as long as they will; and they will only be extinguished when they have exhausted or consumed all the atmospheric air in the cask. The vessel will then be full of sulphurous acid gas. The matches may be fixed upon a wire turned up like a hook, and fastened to the under side of the bung; after lighting them they are put into the cask, and the bung adjusted to the hole. During the burning the air expands, and escapes through a small hole bored in the bung. Great care must be taken that the match does not drop off into the cask. The wine is then poured into it, and, after being suffered to remain some time, is racked off in the usual way.

Once sulphuring is generally sufficient, but sometimes the process requires to be repeated should the ferment be very abundant; or it may happen that a slight sulphuring may be thought enough; in that case a part of the liquor only may be drawn from the cask, and a brimstone match made of rags may be held or suspended for a short time in the cask through the bung-hole, and then withdrawn. One thing should be observed, that it is said sulphuring is apt to communicate an unpleasant taste to the wine. Other substances answer the same purpose, as sulphate of potash; a drachm of this salt is sufficient for a pipe of wine, and is very useful in checking fermentation, and communicates no taste to the wine.

Subsect. 5.—*Clarifying Wines.*

3519. *Racking alone being generally insufficient to deprive wine of all its turbid matter*, a certain quantity will still remain in the liquor. *The complete clarification, which is also called Fining*, can only be effected by precipitating the turbid matter by those substances which experience has proved to possess this power. These are fish-glue or isinglass, gum, starch, rice, and albumen either in the form of white of eggs or the serum of blood. The substances most in use are isinglass and the white of eggs; whichever of these is used, it is first diluted in a portion of the wine, and then strongly agitated with the whole. After some days, when the wine has become clear, it must be again drawn off. The materials above enumerated cannot be employed indifferently for all wines: red wines are usually clarified with whites of eggs, and white wines with isinglass.

3520. *To clarify red Wines with White of Eggs.*—For a cask of one hundred and sixty bottles draw out four or five bottles; mix the whites of four new-laid eggs with half a bottle of this wine, and beat it well with some birch twigs. Put this into the cask through the bung-hole, and stir the wine well with a stick; pour in the remainder of the wine, and stir the whole again for a few minutes; replace the bung, and, after four or five days' repose, the wine will be clear and fit for bottling.

3521. *To clarify white Wines with Isinglass.*—Dissolve some isinglass in wine made lukewarm; when it is dissolved, strain it through a linen cloth, mix with it some more wine, and beat it with birch twigs. When cold, it should form a jelly. Beat some of this jelly with wine, and pour it into the cask; stir the wine about well and leave it at rest.

If, after clarifying a cask of wine, the liquid remain thick at the end of eight or ten days, take another cask, burn a sulphured match in it, transfer the wine into this, and bung up for three or four days, and then bottle it.

Subsect. 6.—*Bottling Wines.*

3522. *Bottling wine, though a simple operation, yet requires great care*, and if negligently performed, the destruction of the wine is inevitable. The first thing to be attended to is the choice of good corks: any saving in cheap and indifferent corks is false economy: it is of the first importance that they should be sound, perfectly new, well cut, and flexible; any having blackness upon them, the remains of the bark, must be rejected. As it is useful to be acquainted with the natural history of this material, we shall describe it, as well as the mode of manufacture.

3523. *Cork is the exterior bark of a tree* belonging to the genus oak (*Quercus ruber*), which grows wild in many parts of the south of Europe, particularly Spain, Portugal, and Tuscany. When the tree is about fifteen years old, its bark is fit to be stripped off, and this can be done successfully three times, allowing an interval of three years between each barking. The bark always grows up again, and its quality improves as the age of the tree increases. It is taken off in sheets or tables by making circular and longitudinal slits in the tree. As the sheets are curved when first taken off, they are flattened by heat and pressure. But there is another use in applying heat to the plates of cork. Previous to this operation the pores of the bark are open, and its sponginess of texture would make it not only give too much way to the knife, but, particularly in the case of "taps" and "bungs," would suffer the liquids to come through. The application of moderate heat causes it to shrink, and closes its pores. For this purpose the convex side is held to the fire till it is somewhat charred, which is the cause of the black colour to be seen on the surfaces of sheets of cork. In ordinary bottle corks this is not seen, because the black surface is cut away in the process of rounding them; and the pores of the cork go across from side to side of the manufactured cork, to which circumstance they owe their imperviousness to liquids. In taps and bungs this charred surface is not cut off.

The most extensive use of cork is for stoppers to bottles. To this purpose it is excellently adapted, because it is very light, may be easily compressed, and expands again by its elasticity as soon as the pressure is removed; and therefore it fills and stops up the space into which it has been driven by force. It may be easily cut into all forms, and though it abounds with pores, which is the cause of its lightness, yet these are so minute that they suffer neither water, wine, beer, nor any common liquid to escape through it, and it is but slowly, and after a considerable interval, that it can be penetrated by spirits; it is less penetrable to fluids than many hard woods, which, though apparently more compact, yet have larger pores. If corks are suspected to be bad, so as to give a corky taste, this may be prevented by dipping them completely in a varnish made of melted suet and purified wax; but in that case they should be well cemented over, likewise, to hold them down. It is the business of the cork-cutter to convert the plates into corks for use. This is effected by a sharp knife dexterously handled, and the corks are sorted, according to their qualities, into four kinds, superfine, fine, common, and coarse, which are sold at different prices. The use of cork was not unknown to the Romans; but it appears to have been more generally used after the invention of glass bottles, of which no mention occurs before the fifteenth century.

3524. *Instead of corks for bottles*, the lately invented *patent caoutchouc stoppers* are a valuable substitute. They are said to be, in the first instance, cheaper than corks, and can often be used a second time; they hermetically seal the wine, communicate no taste nor colour, and are not subject to the attacks of insects. They are formed by an extremely thin sheet of India rubber wrapped round a cylinder of elastic material.

3525. *Glass bottles*, though known to the ancients, having been discovered in Pompeii, were not in common use before the fifteenth century. Before this invention, wine was kept in vessels of earthen-ware and leather, and stoppers of wax were used. It is unnecessary to remark upon the perfection of bottles of glass on account of their transparency, which admits of seeing when they are clean, their perfect imperviousness to air, or the fluid contained in them, and their cleanness. Bottles should be selected of good manufacture, and of equal diameter throughout, or they will be liable to break in the binn when piled very high. In France, a machine is used for proving their strength before they are used. Twenty-four hours, at least, before they are filled, they should be cleaned and rinsed. Lead shot is commonly employed for cleaning them; but it is desirable that great care should be employed that none are left in the bottles, as sometimes happens; one or two grains of shot not unfrequently remain in the bottle jammed in the angle, and if these should be dissolved by the acid of the wine they will communicate to it a poisonous quality. It would be very easy to procure small, round pebble stones of the size of shot, which would answer the purpose quite as well. Sand or angular pebbles will scratch the bottles.

Bottles are best if quite new; but if thoroughly cleaned they will continue to answer sufficiently. It is much best to wash them as soon as they are empty, and to drain them by hanging with the neck downward. If they should have contracted a musty smell, they may be fumigated by a lighted brimstone match put inside, first washing them; after which, they should be washed again. In bottling, the cork should be so long in the nose as fairly to enter into the neck of the bottle to prevent spilling, or contact with the air. Nothing should be bottled that is not quite fine, and the fermentation over; otherwise the bottles may burst, particularly if they are not kept in a very cool place.

3526. *For the process of corking*, when the wine runs clear, place a shallow tub under the tap of the cask, and take care that there be two or three small holes near the bung, or in it, to allow the air to enter to supply the place of the wine drawn. All being ready, hold the bottle close under the tap in a leaning position. Fill the bottle to within two inches of the top of the neck, so that, when the cork comes in, there may remain three quarters of an inch of space between the wine and the lower end of the cork. The corks should be dipped, not soaked, in wine, and should enter with difficulty; they are driven in with a wooden mallet. If the corks are soaked all over before they are driven they are apt to shrink too much in drying, and not be tight. If the cork is to be waxed, it must be cut off close, or to less than a quarter of an inch. Champagne bottles sometimes have their corks driven but half way, and are fixed down by a wire; this makes them easy to draw. It is best to cut off the cork close to the glass, and to cover the whole top with cement, to prevent the air from passing between that and the corks. Insects also abound in some cellars, which eat through the corks.

3527. *For the cement*, resin, with half the quantity of Burgundy pitch, and a fourth of bees' wax, with a small portion of any colouring substance, is used by the French manufacturers; or, melt carefully together a pound of resin, one of bees' wax, and half a pound of tallow, and keep stirring all the while. Add to this red or yellow ochre, soot, or whiting, according to the colour required. If likely to boil over, stir with a candle end, which will check the ebullition. The end of the bottle-necks are dipped into this mixture melted.

While a cask of wine is bottling off, it is impossible to exclude the admission of air to the surface of the liquor except some particular method is employed; and if the operation last some time, the wine, especially if it be of a very delicate or superior kind, is certain to be injured. To prevent this, a method is frequently employed on the Continent which enables them to draw off the last drop in full perfection, without hurrying the bottling; and, indeed, by this method it may be drawn off slowly for drinking. A bottle of fine olive oil is poured into the cask, which, floating upon the surface of the wine, totally excludes the air, and prevents any acidity or mouldiness for a whole year. In a similar manner, the Italians preserve wine in flasks by putting a small quantity of olive oil in the necks of the flasks.

3528. *The crust, or precipitation of wine in bottles*, is only the continuation of that which began in the vat, and which is called lees, and it varies according to the species of wine, and its age, from the coarse crust of port to the *dépôt de vierre* of Champagne, or the almost invisible sediment in some other wines. This deposite consists of tartar, either red or white, and colouring matter. Those wines which deposite freely are observed to be the most durable. When they deposite much they should be decanted into fresh bottles, in case of removal, or the deposite may mix with and injure the wine.

3529. *The various operations in the cellar*, as fining, bottling, corking, sealing the wine, and placing it in the binns and entering it into a book, is the duty of the butler and his assistants. The business should be carefully arranged and divided, and the names of each sort of wine should be painted on the binn containing it to prevent mistakes.

3530. *Wine, to be fit for bottling*, must not only be separated from the gross lees, and have attained perfect clearness by fining; it must remain for a certain time in the cask to ripen, as it is called, by which its principles are more intimately combined.

3531. *The time which wine requires to be kept in wood* for its amelioration, and, consequently, the time when it is fit for bottling, differs with the character of the wine, but no precise rules can be laid down; the taste alone can determine the maturity of wines. They should not be bottled till they have lost their sharpness, and are no longer liable to fermentation. Age, therefore, is not a criterion for the excellence of all wines.

When wine is bottled too soon, it often ferments, and remains always sharp; and wine, in general, receives most benefit by remaining long in the cask before it is bottled. But though it improves likewise in the bottle, there is a limit to this term, and each variety has a period when it arrives at maturity, and when it should be drunk; after this it does not improve, but may be kept some time in the same condition, and after this it deteriorates. Some lose their strength and colour, others their fine bouquet and agreeable aroma, for which the highest class of wines are distinguished.

3532. Most of the French wines, as Champagne, Burgundy, and Medoc, are short lived; but others, having more body, will keep for a long time. White wines may be bottled, for the most part, earlier than the red, and so may the light muscadines; the latter may be bottled in a year after harvest; some of them lose their flavour by remaining longer in the cask. Light and fine wines, like those of Volney (Côte d'Or), commonly remain only a year in the cask before they are bottled.

3533. The first class of the more delicate Burgundies should be bottled at the end of the year, are in perfection when bottled two years after the vintage, and do not keep above twelve or fifteen years; but the more generous and higher coloured, such as Pomard, Vosnes, or Chambertin, should remain in the wood for four or five years, and will keep for twenty.

3534. Champagne, which requires to be bottled early, is generally in perfection the third year after bottling, and the best wines will be found to improve for ten or fifteen years, and will be sometimes good even at thirty or forty. The Rhine wines should remain in the wood for many years; the best Hock is said not to be in perfection until it is forty years old, and it will keep well four times that time. Claret should be kept seven or eight years in the wood to obtain its full quality, after which it will keep a long time in bottle. The first clarets of Maçon, however, will not last above sixteen or seventeen years. Claret is apt, in the cellar, to change to a brick colour, the consequence, it is supposed, of its mixed composition.

3535. *With respect to those wines imported in bottles*, they should not be moved from where they are first placed, except for the table. Some leave them in the cases in which they are imported; the upper side of the cases should be kept in the same position. Sillery is sometimes apt to effervesce after carriage; in that case, the bottles may be placed on their bottoms for some time, and, before drinking, the wine should be kept in ice for an hour. Brisk Champagne is also improved by being kept in ice before it is drunk, as this tends to repress the effervescence, if that is too frothy. When the glass is entirely filled with froth, on pouring out the contents of the bottle, the better qualities of the wine and the spirit evaporate. The still wines of Pierre and Sillery keep better than the sparkling kinds.

3536. *Port, as it is manufactured for Britain, requires to be kept several years in the wood, and as much more in the bottle*, in order to destroy the fiery strength of the brandy with which it is mixed; but before that time completely arrives, the vinous characteristics are sometimes gone. It then loses part of its colour and strength, becoming what is called *tawny;* but though it has become more mellow, it does not then possess the original qualities of the pure juice of the Oporto grape. Its fitness for bottling and drinking is best judged of by occasional trials. It is so hardy a wine, that even the cellars under the streets of the metropolis will little injure its quality, which is not the case with other kinds.

3537. The dry wines of the south of Europe, as Sherry, Madeira, Canary, &c., endure for a long time, and should be kept in a warm temperature. Madeira is even improved by heat and agitation, which is the reason for sending it to the East and West Indies.

3538. *The sweetest wines not only keep the longest*, but are, in fact, scarcely fit to drink till they have acquired considerable age, as they are in a perpetual state of melioration. The thinnest and briskest are those alone which may, or, rather, which ought, to be drunk when comparatively new. Sweet wines, the fermentation of which has been perfect, cannot readily become sour, because their ferment, having been expended by these processes, no more remains to excite any fermentation that may run to acid. Neither can wine that has been made dry have much tendency to acidity, for the same reason.

3539. *The establishment of the London docks* has proved a very great convenience to wine-merchants in the metropolis, who are not now, as formerly, obliged to keep wine in casks for years in their cellars. The wine now generally remains in the cask in the warehouses at the docks until it is fit for bottling. Many of the above observations, therefore, respecting the periods for which wine should be kept, are of less importance, at present, to the general than to the dock merchants, and few private individuals keep much foreign wine in casks. But we considered the above remarks as a necessary part of the history of wines, and which could not properly be omitted.

3540. *The removing of some wines to a distance* is often an affair of great difficulty, particularly the more delicate wines of France, some of which can scarcely be moved without injury. The best season for removing these, and, indeed, wines of every kind, is the spring and autumn, when the weather is mild. Cold or hot weather is prejudicial to the carriage of most wines. If transported in wood, particularly in hot seasons, they should be racked before they are removed, to prevent the lees mixing with the wine, occasioning fermentation if in bottles, they should be decanted. The most delicate bottled wines are best packed in strong cases, each bottle being wrapped in cartridge paper, and bedded in straw. In this way wine has been successfully carried to India.

Subsect. 7.—*Diseases of Wine and their Remedies.*

3541. *Among the morbid changes to which wine is liable, one of the most common is acidity;* the delicate, thin, and weak wines are most subject to this alteration; in these, on the least increase of temperature, or even on their removal, the fermentation is apt to recommence, which leads to the acetous process. This may be checked at the beginning; but after it is established, the wine is incurable. The acetous acid, when once formed, can only be got rid of by neutralizing or destroying it. For this purpose, alkalies and alkaline earths may be employed; but the alkalies, soda or potash, form soluble salts with the acetic acid or vinegar, and impart a disagreeable taste to the wine. Calcareous earth, consisting of chalk or lime, is the best substance to use, as the neutral salt which this forms with the acetic acid of the wine is insoluble in it, and forms a precipitate, which may be removed by fining. Eggs and oyster shells are the same as chalk. It was formerly the practice to employ lead, in some form or other, for counteracting acidity in wines; but we trust that this very dangerous practice has long been laid aside, the poisonous nature of this metal being now generally known.

3542. *What is technically called pricked wines* are those in which there is a slight commencement of acidity. All wines have naturally more or less of some acid, but in pricked wines it is the acetous acid which prevails. It has been shown that the principal object in the racking, fining, and sulphuring of wines is to clear the liquor from the lees, which contain a portion of the fermenting principle, and would re-excite the fermentation if suffered to mix again with it. Turbid wine may be considered as always in a precarious state, since it is constantly in danger of having the fermentation renewed, and, consequently, in running into the acetous state. It should therefore be borne in mind, that fineness is not merely a quality to please the eye, but that it is essential to the durability of the liquor.

3543. *A method of recovering pricked wines* has been recommended, and may be tried by the following experiments: Take a bottle of red port that is pricked, and add to it half an ounce of tartarized spirit of wine; shake the liquor well together, and set it by for a few days, and it will be found very remarkably altered for the better. The introduction of an alkaline salt, such as tartar imbibed by spirit of wine, has a direct power to neutralize the acidity, the spirit of wine also contributing to preserve the wine. If this operation be dexterously performed, pricked wines may be recovered by it, and remain good for some time. If a small quantity of alkali does not succeed, and the acid fermentation continues, it will be necessary to stop it by racking the wine into a cask strongly fumigated with brimstone, and then to clear it with whites of eggs, and perhaps five or six days afterward to rack and fumigate again. This will generally have the desired effect; but wine after this is not to be depended upon, and should be drunk quickly.

3544. *If wine has become too sour to be recoverable*, the best way is to dispose of it to the distillers to make spirit from, or to let the fermentation go on, and convert it into vinegar.

3545. *Ropiness*, by some called *greasiness*, is another disease to which some wines are liable. This is a change which sometimes takes place after the wine has been closely confined in casks or bottles. But it is only white wines that are subject to this disease, which consists in the appearance of a stringy matter which floats through the wine, and sometimes puts on a reticulated form. When the disease has been contracted, it may sometimes be removed by clarification with fish glue; but this remedy does not always succeed, and when it does, it diminishes a little the strength of the wine. The most efficacious remedy is racking or decanting off; and it is said that a little tannin added to the wine has the effect of precipitating the ropy matter.

3546. *Mustiness* is a peculiard isagreeable flavour, often derived from an unsound cask, or from the cork. This appears to be absolutely incurable, though it may be sometimes diminished by agitating the wine in contact with air, or by the introduction of common air or carbonic acid by pumping.

3547. *The diseases to which made wines are liable* are in every respect similar to those which are the genuine produce of the grape.

Subsect. 8.—*Choice of Wines.*

3548. *The choice of wines in laying in a stock* is a matter of considerable difficulty, particularly to the inexperienced. A habit of tasting the superior wines will alone give the palate the power of discriminating minute differences in the aroma and bouquet of the choicer kinds. But a very correct taste in wine is a rare quality; and there is sometimes a good deal of pretension in passing a judgment upon them. The particular impression on the sense of taste is also liable to be affected by the state of bodily health at the time, or by the last substance taken into the mouth. Thus, wine, after sweetmeats and fruits, frequently tastes harsh; whereas, after made dishes and cheese, wines sometimes appear better than they really are. The first object to be considered, next to the taste, from which the purchaser must judge for himself, is whether the wine is pure, and the genuine production of the country whose name it bears; and whether or not it is adulterated with any foreign substance. To distinguish this accurately, in many cases, requires great experience and a very nice practised palate. It is even said that few persons except the manufacturers themselves are judges sufficiently experienced to distinguish and appreciate the different growths of their own territory; and that even these cannot estimate properly the wines of another district. Another kind of information necessary is to be able to distinguish the condition of the wine, whether it is new, and whether it will keep or will be liable to change. Some wines may appear good that will not keep a year, and others that at first appeared but indifferent will improve so much by keeping as to be in the end excellent. Good wine is most frequently to be found among capitalists, who can afford to buy large quantities in favourable years, and who can select in their stock that which is the fittest for bottling at any particular time, not sending out any but what is fit for use, and who have a reputation to keep up.

It is scarcely necessary to add, after what we have said already in various places, that there are few articles of domestic consumption where there are more frauds practised than in wine, or where more money may be thrown away for want of good management; to say nothing of the pleasure it affords every one to place good wine before his guests, or the danger of injuring their health by offering them what is prejudicial. These considerations must serve as our apology for laying a little stress on the propriety of using some care and discrimination in procuring this article, which will be a good deal, at least, assisted by an acquaintance with the history of wine.

Sect. V.—Adulteration of Wines.

3549. Although it be acknowledged that wine is a luxury, and not a necessary of life, yet it is one of those luxuries which, used in moderation, has its use in the list of our social enjoyments. It is, therefore, exceedingly to be lamented that an article in such general request by the middle and higher ranks in this country is so frequently adulterated that to procure it genuine requires very considerable experience; and in the ordinary mode, on a small scale, this is scarcely possible without employing precautions with which few are acquainted. With respect to the danger to health arising from the use of adulterated wines, those persons who are in the habit of fraudulent practices are seldom stopped by the consideration of the mischief they do to society, and there can be little doubt that though all adulterations are not equally hurtful, many of them are of a highly deleterious nature. It is proper, therefore, that our readers should be put upon their guard against the hazard that exists of their drinking slow poison instead of a healthful beverage, to say nothing of the imposition that is submitted to when they pay for a very inferior article the price of that of the first quality.

3550. *The extent to which the sophistication of wine is carried on in Britain*, and particularly in the metropolis, would be incredible, were it not attested by good authorities; and it is an evil that appears scarcely remediable until the public is more enlightened on the subject. Wine of the best kind not being the growth of this country, few persons, comparatively, are acquainted with the true flavour and properties of genuine wine; hence frauds are more easily practised. The formation of spurious wines has become a regular and extensive trade in London; and so great is the skill with which it is carried on, that foreign wines of almost every description are imitated so as to deceive all but good judges.

3551. Lest it may be supposed that this is an erroneous or exaggerated statement, it may be proper to mention, that, so notorious and general is the practice of adulterations, that books are published containing receipts and directions for this purpose, entitled "Publicans' Guides" and "Licensed Victuallers' Directors," &c., from which much of our information is borrowed, and the sale of which sufficiently proves the use that is made of them; likewise, several prosecutions and trials have supplied evidence of these mal-practices. It is to be observed, however, that we do not vouch for the accuracy of these receipts for adulterating, or assert that they are actually the modes employed. Their publication sufficiently demonstrates that they have been more or less followed; but all the variations of them made by different adulterators will probably never be discovered.

In making these remarks, we are far from intending to say that good wine is not to be had in this country, nor that there are not many wine-merchants of high respectability who would scorn such practices as those which it is our object to expose; and it is one, and not the least of the evils of adulteration, that the fraudulent impostor does much to deprive the fair dealer of the trade and profit which are justly his due.

3552. Some of the principal adulterations of wine have been in consequence of attempts to correct the commencement of acidity. Acidity in wines is induced by a multitude of circumstances which have been already explained; and such wine is, consequently, rendered unsaleable. Merchants are accustomed to neutralize the acetic acid formed in their wines by the addition of various alkaline substances, such as the carbonates of lime, potash, and soda; but those which have undergone this species of amendment are almost always harsh and disagreeable to the taste, notwithstanding that they are freshened by a quantity of brandy.

3553. *Quicklime, from its alkaline quality*, was formerly employed in this country to correct the acidity in wine: it formed with the acid an insoluble salt, which was precipitated to the bottom of the cask. This fact explains Falstaff's accusation of his landlord, that there was "lime in his sack," intimating that his wine had begun to sour. The detection of lime, potash, or soda, used to destroy acidity, requires more chemical knowledge than is possessed by persons in general; and too imperfect acquaintance with analysis would be apt to lead into error. It will be more prudent to apply to a good practical chemist than to venture to pronounce in such case. We purposely, therefore, omit this part of the subject, as those who are already chemically informed will be at no loss

3554. *The most dangerous adulterations of wine are those where any preparation of lead has been employed.* Acetate of lead, vulgarly called sugar of lead, has been used for arresting the process of acetification. It can, however, only be used with white wines, as it precipitates the colouring matter of port and red wines. The ancients knew that it imparted a sweet taste to substances, and that it rendered harsh wine milder, but it was not universally known that it was poisonous. It appears that no other material answers the purpose so well of recovering wines beginning to be ropy; and there is no doubt but that it was formerly employed by wine-merchants for such purposes. Bishop Watson relates that its use was at one time common among the wine-merchants of Paris. In English receipt-books we likewise find directions for using it: thus, in the "Vintner's Guide, 1770," "a lump of sugar of lead of the size of a walnut, and a table-spoonful of sal enixum," are directed to be added to a "tierce (forty-two gallons) of muddy wine, *to cure it of its muddiness.*" In "Graham's Treatise on Wine-making," "to hinder wine from turning sour," it is recommended to "put a pound of melted lead into the cask, and stop it close." And, "to soften gray wine, put a little vinegar wherein litharge has been well steeped, and boil some honey to draw out the wax. Strain it through a cloth, and put a quart of it into a tierce of wine, and this will mend it."

It is probable that the deleterious nature of lead was not so generally understood formerly as at present, and that, in consequence of these directions, wine-merchants and vintners may have contaminated their wines with lead, without suspecting its poisonous nature; but now that, from the diffusion of chemical knowledge, the public is aware of the danger of this practice, and that the means of detection, having been frequently published, are easily resorted to, it is to be hoped that there are very few wine-merchants or dealers who are so iniquitous as to scatter the seeds of disease and death among those who contribute to their emolument, and to add the crime of murder to that of fraud. We believe, indeed, that lead is now rarely employed in this way, although there have been persons imprudent enough to speak lightly of the matter, and to hint that it is not so dangerous as has been supposed. It has been urged that the tartaric and malic acids form salts with lead that are nearly insoluble in the wine, and which, therefore, may be separated by fining; and that the acetate of lead, which is the only soluble salt, may be taken in small quantities without injury. Carbonate of lead, which is poisonous, is also insoluble, and falls down in wine.

Acetate of lead, which is employed in wine, it is true, is not a violent poison; on the contrary, very small quantities are employed as medicine; and it is also true that carbonate of lead is the only direct virulent salt of lead; but it has been shown that the acetate is often converted into the carbonate by the action of the stomach. On this subject Dr. A. T. Thomson observes, "These liquors, when rendered poisonous by admixture with litharge or with sugar of lead, contain the poison in the form of the citrate, which is converted into the protoxyde by being reduced by the animal juices of the stomach; and the attraction of this oxyde for carbonic acid is so great that it is rapidly converted into the carbonate; in this state it acts upon the nerves of the intestinal canal and its muscular coat, and produces disease." In some habits, particularly when the state of vitality is low, a greater quantity of carbonic acid gas is evolved in the intestines than is usual, a circumstance which favours the change just mentioned. Lead, in the small quantity and in the form in which it is used, may not be a violent and rapid poison; but every one the least acquainted with this substance must perceive the danger of admitting it into the system in any form whatever; and surely it is not expecting too much that those who perform the rites of hospitality should be careful that they do not administer to their guests slow poison. It would, therefore, be a precaution not useless, that every quantity of wine purchased should be examined for lead by a proper test for this purpose.

3555. *A ready test for detecting the existence of lead in wine* consists of water saturated with sulphuretted hydrogen gas, and acidulated with muriatic acid, and may be had of any intelligent and scientific chemist. By adding one part of it to two of wine, if lead be present, a dark-coloured or black precipitate will fall down, which does not disappear by the addition of muriatic acid. This precipitate consists of sulphuret of lead; but, to be quite certain of the metal, it is proper to examine this precipitate more particularly; for this purpose, it should be dried and fused before a blowpipe on a piece of charcoal, when it will yield a small globule of metallic lead, known by its malleability and softness.

Another method, equally efficacious, is to acidulate a little of the wine with muriatic acid, and then to pass a current of sulphuretted hydrogen gas through the liquor, when the same precipitate will appear.

Hahnemann's wine test is as follows: Mix equal parts of finely-powdered sulphur and of slacked quicklime, and expose them to a red heat for twenty minutes. To thirty-six grains of this sulphuret of lime add twenty-six grains of super-tartrate of potash (cream of tartar); put the mixture into an ounce bottle, and fill up the bottle with water that has been previously boiled and suffered to cool. The liquor, after having been repeatedly shaken, and allowed to become clear by the subsidence of the undissolved matter, may then be poured into another vial, into which about twenty drops of muriatic acid have been previously put. It is then ready for use. This test, when mingled with wine containing lead or copper, turns the wine of a dark brown or black colour.

Litharge has formerly been used in France, as well as in England, to correct the acidity in wines; but probably not at present, as it is so easily detected by the tests for lead, and better methods are known of performing the desired effect. Lead which has been detected in wine on chemical analysis has sometimes been traced to shot, used for cleaning the bottles, having been lodged in the angle at the bottom, and dissolved by the acid of the wine. We have alluded to this subject in giving directions for bottling.

3556. Besides these adulterations, various other materials will be mentioned as we proceed; but the variety of substances used by wine doctors are probably endless, and complete information upon the subject is impossible to be obtained. Nor is it possible to point out any tests by which all adulterations in wine can be detected, since many of the substances made use of are of a nature very analogous to that of the ingredients of wine itself, and cannot therefore be separated from it by any chemical agent.

3557. Having mentioned the leading facts respecting these nefarious practices, it may be well to describe in a more particular manner the adulterations of foreign wines supposed to be made by fraudulent dealers.

3558. *In the first class of wines* deception is seldom practised, from the impossibility of counterfeiting the fine flavour and bouquet so as to deceive experienced judges; thus no attempt to fabricate Lafitte or Romanée Conté would succeed. It is in the strong and the inferior wines that adulteration is most usually employed.

3559. It is said that wine is seldom adulterated by the growers on the Continent, as they are so much interested in the reputation of their produce, except, perhaps, in the worst and lowest-priced wines; but that they are so operated upon in the cellars of the exporter, and much more frequently after they arrive in this country.

3560. *That port is adulterated in a variety of ways* is a fact well known; but perhaps few persons have an idea to what extent this is practised in England. We have already mentioned, in our description of foreign wines, that the genuine wines of the Douro in Portugal are scarcely, if at all, known among us; and we have alluded to the practices of the Oporto Company, and the large addition of brandy made by them for the purpose of preparing their wines for the English market, and to render them palatable to the vitiated taste of the public. To this spirituous strength and coarseness, from the loss of true flavour, it is probable that adulterations of this wine are so easily practised. It is said that four fifths of the wine called port in the British market is of inferior quality, and therefore peculiarly subject to imitation; hence those who are not accustomed to good wine are incapable of distinguishing between what may have been imported and what is the produce of home manufacture.

3561. The frauds committed in the sale of wines called port are of different kinds. Very inferior wines are imported from various parts of Portugal, being either smuggled or paying the same duty as the wines of the Oporto Company; and are either sold here as port, at very low prices, or are used in adulterations such as will be described. Were these cheap wines offered to the public fairly as what they are, there would be no reason for complaint, as they would acquire their just character, and would be preferred by many persons on account of their price; but, by assuming the title of port, either alone or mixed, they are evidently calculated to deceive. Of this nature is the *Benecarlos* wine, a strong, coarse, red Spanish wine, and other wines of Catalonia, which are much employed in Bordeaux for making up the inferior clarets for the English market, and which may be purchased in Spain at a much lower price than port. *Figuera* is another cheap red wine, which comes from the province of Estremadura, bearing a near resemblance to inferior port. *Red Cape* is also used. It is pointed out by Mr. Redding that a return from the London Dock Company will show the immense number of pipes that are annually imported, and are cleared for the premises of the cheap port wine sellers.

3562. Various practices are used to cause new port to assume the appearance of old, and to make it pass for that of superior quality, an art known technically by the term *doctoring*. When port wine has been kept to a great age, the brandy combines so far with the wine as to lose its peculiar flavour, and permit the genuine taste of the wine to be perceived; at the same time, much of the tartar, astringent, and colouring matter is precipitated in the form of crust; the wine then has become paler, and is known by the name of *tawny* port. As this paleness of colour has been often considered as a test of age, dealers in wine have found means to imitate the wine by filtering it through charcoal, which deprives it of part of its colour; but, it should be observed, when genuine port becomes tawny through time alone, it has generally lost much of its vinosity and most valuable properties. White port is sometimes added for the same purpose.

3563. Were the adulterations of port limited to the mere admixture of genuine wines, though inferior, the case would not be so serious; but the published receipts, which let us into some of the secrets of the adulterator's trade, point out to us frauds of far greater extent.

3564. We cannot do better, perhaps, than to give a selection of those which have been already quoted in a useful book upon this subject; and though we are very far from vouching that those receipts for frauds are now acted upon, yet the very fact of their being printed and sold proves that they have been employed.

Imitation Port Wine.—"Good cider, forty-five gallons; brandy, six gallons; good port wine, eight gallons: ripe sloes, two gallons stewed well in two gallons of water; press off the liquor and add to the rest: if the colour is not strong enough, add tincture of red saunders or cudbear. In a few days this wine may be bottled: add to each bottle a tea-spoonful of the powder of catechu, mixing it well: it will very soon produce a fine crusted appearance, the bottles being packed on their sides as usual: soak the ends of the corks in a strong decoction of Brazil wood, with a little alum, which, along with the crust, gives an appearance of age."—*Vintners' and Licensed Victuallers' Guide*, p. 79.

An excellent Receipt to make neat Port.—"Let the hogshead be matched, then fill as follows: strong port, twelve gallons; rectified spirits, six gallons; cognac brandy, three gallons; fine rough cider, forty-two gallons. Cost about eighteen shillings per dozen."—*Palmer's Publicans' Director*, p. 145.

Another receipt mentioned as very general is as follows: "Benecarlo wine, two pipes; Figuera wine, two pipes; red Cape, a pipe and a half; good port, a pipe and a half; common port, one pipe; a little mountain; some brandy cowe; colouring, consisting of tartar and gum dragon." For colouring.—"Take raspings of red saunders, six ounces; spirits of wine, one quart; infuse fourteen days, and filter through paper for use. I produces a beautiful red colour for port wine."

Another.—"The juice of elderberries, one gallon; lump sugar, twelve pounds; boil together for half an hour, taking off the scum as it rises; strain through a flannel bag, and keep for use. It produces a beautiful colour for imitation wines."—*Vintners' and Licensed Victuallers' Guide*, p. 258.

We learn from one of the above-mentioned publications, the *Vintners' and Licensed Victuallers' Guide*, p. 259, what are the usual substances for performing the operation upon wines called *doctoring*. Thus bitter almonds are added to give a nutty flavour; sweet briar, orris root, clary, cherry-laurel water, and elder flowers, to form the bouquet of high-flavoured wines; alum, to render young and meager red wines bright; Brazil wood, cake of pressed elderberries and bilberries, to render pale, faint port of a rich, deep, purple colour; oak sawdust, and the husks of filberts, to give an additional astringency to unripe red wines; and a tincture of the seeds of raisins, to flavour fictitious port.

3565. It is stated, in a work intended expressly to expose these frauds, that the manufacturers of adulterated wine keep very large vats, holding from eight hundred to a thousand gallons, in which these mixtures are made; that they are more effectually blended by lying some time in such large quantities, by fretting in, on the principles already explained; and that it is from the cheapness of the articles so employed that the advertising dealers are enabled to offer port at so low a price as twenty-four shillings per dozen bottles, the bottles themselves being likewise smaller than they ought to be.

When it is apprehended that wine is about to become acid, or *pricked*, as the first degree of acetification is termed, it is a common practice to add starch sugar; if the acetification has actually begun, but advanced only a little way, then an alkali is added. Wines so treated, or doctored, with the addition of some astringent substance, are sometimes sold under some specious names, in order to account for the bad taste communicated, such as *fine old restorative port, Burgundy port, &c.*

3566. *Claret is less adulterated than port;* yet, from the prevalence of the taste here for strong wines, little even of this comes to us in the purest state. The wines of Bordeaux are generally mingled with stronger wines before they are shipped; the best with Hermitage, or Cahors, which, however, are not injurious; the second class with Benecarlos wine, which is destructive of the bouquet and aroma of the original wine; but to restore in some degree the lost qualities, the French merchants employ orris root and similar things. In England, raspberry brandy is sometimes employed in minute quantities with the same view; but the perfume then given is easily distinguished by practised connoisseurs from the natural one. This kind of adulteration, although it renders the wine less pure, is not injurious to health.

Claret, when old, becomes of a deeper colour, although port becomes lighter; hence the deep red wine of Cahors is sometimes employed to give the appearance of age. Very inferior French red wines, sold in France at a few sous a bottle, are frequently mingled with rough cider, and coloured to resemble claret with cochineal, turnsole, and similar drugs, and is then named and passed off as claret on certain occasions, without the fraud being discovered.

It is said, and with great appearance of probability, that some Frenchmen are equally ingenious with our own dealers; they prepare wines from the refuse of their vintages, or what they call wine of the "third quality," much of which, being scarcely drinkable, would find no other market than the English, being bought up at the lowest price, to be converted into *genuine* "*Vin de Bordeaux*," by means of oyster shells or lime, to destroy acidity, with brandy, colouring and flavouring materials to complete the process. Abundance of cheap *vin ordinaire* of France is now sold here as the best, or is metamorphosed into claret, and offered for sale by fraudulent wine dealers. Cheap Moselle wines are sometimes sold under the specious name of white Burgundy, &c. It is no wonder, therefore, that such wines are found to disagree with the English constitution, and that they are complained of as too cold and acid. The only remedy, as we before stated, is to purchase such wines only of the most respectable wine-merchants.

3567. *Adulteration of Sherry.*—The delicious dry wines of Spain, though naturally strong, receive an addition of brandy in the manufacture for the English market, as we have already stated; but it is said that "pale sherries" are frequently manufactured out of Cape wine, to which have been added what is called "brandy cowe," or the washings of brandy casks; some extract of almonds to give the nutty flavour; with cherry laurel water to improve the latter. Fictitious brown sherries, besides these additions, receive burned sugar and gum, benzoin, or honey.

3568. *Champagne is fabricated* in England with more boldness than any other foreign wine, few persons being acquainted with the true taste of the first quality of this wine. One species of fraud is to substitute, instead of wine of the best kind, a very inferior and weak wine made in France, but which, until lately, was wholly consumed in the district where it was fabricated, and which would not keep more than a year. This has very little alcohol, and is without the flavour or bouquet of good Champagne, but exhibits abundance of frothing and effervescence from its carbonic acid. Large quantities of this, which in France does not cost tenpence a bottle, are passed off for the best at balls, masquerades, crowded public dinners, &c., or is offered for sale at a somewhat lower price. But a still larger quantity, perhaps, sold for Champagne, is entirely fictitious, being made from gooseberries, without any of the juice of the grape, and is worth scarcely one fourth of what is paid for it. In this manner is the public plundered annually of considerable sums of money that might be usefully expended.

3569. *Madeira* may be obtained genuine, called *direct Madeira*, by applying to the merchants to whom it is consigned by the manufacturers in the island of Madeira; but the inferior wine of the north side of the island is sometimes sold for that of the south, which alone produces good wine. A wine from the Cape is also sometimes substituted for real Madeira, with some addition of flavouring ingredients. But very little actual

Madeira enters into the composition of what is sold by the cheap advertisers and placarders: their manufacture is said to consist of a cheap Vidonia, with one tenth of mountain, a fifth Cape, and a little port; this is coloured and fined.

3570. *The Cape wines*, which, when in a genuine state, are but indifferent and cheap, we might suppose would escape adulteration; but this is not the case. Those which, from their flavour, have any resemblance to other wines, are selected and sold under the deceitful names of Cape Madeira, Cape sherry, Cape port, Pontac, and even Cape Hermitage, or Burgundy, or passed off as the wines whose names have been borrowed. After that, the remainder goes by the simple name of "Cape, extremely cheap;" and a great deal is mixed with cider, and some of the adulterating materials we have already mentioned, together with the "brandy cowe," strength being the chief quality esteemed by the class of purchasers for whom it is intended, the generally bad character of this wine serving as an apology for any defect that may appear in this manufacture.

3571. It can scarcely be necessary to enlarge upon the evils produced by the extensive frauds committed in the wine trade, which we have endeavoured to expose.

3572. It must be obvious how great the loss must be to the revenue, to say nothing of the injury done to health, as well as to public morals, from the constant habit of practising imposition in all its various ramifications. Cape wine, which pays a low duty, is much employed in these sophistications, to the amount, it is said, of many hundred tons annually; but the quantity of fictitious liquor sold as wine, with scarcely a drop of grape juice, it is impossible to calculate, although no doubt it is very considerable.

3573. Formerly there were severe laws in England against the adulteration of wine. A company of vintners even took cognizance of such matters; and in 1426 the lord mayor condemned a hundred and fifty butts of adulterated wine to be thrown into the kennel. An act was passed in the reign of Charles II. even prohibiting wines from being intermingled. Of late, this subject seems not to be sufficiently attended to. To prevent altogether this base mode of swindling is probably impossible; but, by some stringent measures, it might, no doubt, be restrained. It is most important, however, that the public should understand the imposition practised upon them, for the remedy is in their own hands.

Sect. VI.—Coopering.

3574. Barrels, casks, tubs, &c., of various kinds, are articles of furniture made by the cooper; and although we have mentioned these in various places incidentally, a few words may not be useless on the subject of cooperage generally, that our readers may know how to apply to the proper person.

3575. In some places a cooper is expected to make all these articles; but in this country, in general, the workmen are brought up to confine themselves to a particular branch of the business; and we have, accordingly, *butt coopers, rundlet coopers, dry coopers, white coopers*, and *wine coopers*. Butt coopers are employed in making and repairing puncheons, hogsheads, and large casks for breweries and distilleries. Rundlet coopers confine themselves to the manufacture of small casks to hold the products of distilleries, and for other purposes, from one-gallon casks to those which contain twenty gallons. Dry coopers manufacture sugar hogsheads and casks of every kind for holding dry goods, such as clothing for the army, and all kinds of military and naval stores; as these do not require to be water-tight, they are not so well executed as the work of butt and rundlet coopers, and their price is proportionately less. White coopers make all articles of this kind in domestic use, such as small brewing vessels, washing tubs, churns, pails, &c., and they frequently add coarse turnery to their business; they use both iron and wooden hoops, the latter of ash, peeled, and white. In general, they keep shops, and expose their articles for sale.

3576. Wine coopers are employed in making and repairing every kind of wooden vessel used for holding wine, as butts, casks, &c.; but they are also the proper persons to remove and deposite wine and spirits, as they can effect this with greater safety than other persons, from being better acquainted with the strength of the vessels, and the proper way of moving them about. They are also employed in bottling and packing wines and spirits, and have often considerable knowledge of the general management of wines. Large backs and vats for breweries require often to be of vast strength to support them, and likewise the aid of the carpenter, and even the engineer. The makers of these and of coolers keep materials better fitted for the purpose than other coopers.

3577. The cooper works with few tools, and it is surprising to see the dexterity with which he handles these few. With an axe, an adze, a saw, two or three spoke staves, a large plane, and a bench made of stout plank placed upon four feet, he goes through almost all his work. The staves of the vessels manufactured by the cooper are made chiefly of oak, and are imported, cut of the proper lengths, from the Baltic or from Canada; the former, however, are the best. The edges are curved by the cooper to produce the bellying forms of casks. The heads and bottoms are of several pieces, put together by pegs called *dowells*, and are fixed in by inserting them in a groove in the staves, the projecting piece of the latter being named the *chime*. The staves themselves are held together by hoops, which vary according to the nature of the vessels; the strongest are of iron; but foreign casks are seldom bound by iron, and this metal is particularly avoided in the wine countries. In stout hoops, as those of butts, iron is the best; but when the staves are thin, the rust of iron destroys the wood. Previously to putting on the iron hoops, the staves are dried by a fire or in kilns, to cause them to shrink, that when they expand by moisture the hoops may be tight.

3578. Very great improvements have been made in this branch of business through cutting out the staves by circular saws, which perform the work with great expedition and accuracy. This was first practised by Mr. George Smart, in making the small casks called canteens, in which soldiers carry their beverage. The accuracy with which the various pieces were sawed out was such that there was no occasion to plane the edges to render them water-tight. It is worth mentioning that the casks in which butter comes from Holland are very well made; and as they may be purchased at the butter shops, when empty, at from sixpence to tenpence each, they are cheap and convenient for many domestic purposes.

CHAPTER V.

ON THE MAKING OF CIDER, PERRY, AND MEAD.

SECT. I.—CIDER.

3579. *Cider is a fermented liquor prepared from the juice of apples;* and although it is not usually reckoned among the wines, yet it belongs to that class of beverages as much as those which are made from currants, gooseberries, or other fruits.

3580. *We learn from Pliny* that both cider and perry were made by the Romans in Italy. The term cider, *cidre* in French, is derived from the Latin *sicera*, a general name for such fermented liquors as were not the produce of the grape. It was made by the Moors of Spain, from whom it was introduced into Normandy, and afterward into England. The apples and cider of Normandy are still reckoned of superior quality, and cider is prepared there abundantly, being the common beverage, as it is in Herefordshire, Devonshire, and the neighbouring counties of England, where it has acquired the highest excellence.

In Book VII., Chap. IX., "On Fruits," we gave a description of the apple: we shall here add some particulars connected with its use in making cider.

3581. *Apple-trees are propagated by seeds, or by ingrafting the scions* or shoots of such trees as are valuable for their fruit on *stocks* or trees raised from seed. *The soil* which in Herefordshire is considered the best adapted to most kinds of apples is a deep, rich loam, when under the culture of the plough; on this the trees grow wild with great luxuriance, and produce the richest fruit. Some trees, however, the golden pippin in particular, form exceptions to this general rule, and flourish most in hot, shallow soils, on a limestone or sandstone.

In the cider counties, as Herefordshire, Gloucestershire, Somersetshire, Devonshire, &c., apple-trees for cider are planted in orchards; but in some places they occasionally grow in hedge-rows, and in pastures moderately sheltered; and these might easily be multiplied in many parts of the kingdom. The fittest for such purpose are those which grow tall, so as not to overshadow the crops.

3582. *Sea air*, and situations exposed to high winds, are unfavourable to the apple. In the cider countries, where the climate is more certain than in some others, it is the custom to plant but a few good sorts, and not to mix above one or two sorts together in the making of cider.

3583. *The principal part of the cider made in England is manufactured by the growers of the fruit,* though much of what is sold in London is made by professional men, who, like brewers, devote themselves to this branch of industry, and who conduct their operations more or less on scientific principles. The varieties of apples which are cultivated for this purpose in the various fruit districts of this kingdom are extremely numerous. It is not often, however, that the maker of cider has it in his power to choose the fruit which he employs, as in most cases he is restricted to the produce of his own orchard; but as he may occasionally have an opportunity of purchasing fruit, the following particulars will be of use in directing his choice. No juice can be depended on for making good cider that does not possess, at the same time, body and flavour; the former depends on the juice contained in the pulp or flesh of the fruit, and the latter on the juice (probably an essential oil) contained in the external skin or peel, and in the seeds or pips. The apples the most agreeable to the palate are those which abound in a juice at once sweet and acidulous, whereas those which answer the best for cider have the juice both sweet and acerb, with little mixture of acid. Hence the best cider fruits, with few exceptions, are too astringent to be fit for the table.

3584. *Mr. Knight supposed* that a particular variety of apple, as well as of most other plants, has only a limited duration; and that those plants which have been propagated by grafting from one stock partake, in some degree, of the same natural duration of life in their youth, maturity, and decay, and hence he accounts for the apparent decline of some of the most valuable varieties, as the golden pippin and red streak, which were favourite old cider fruits. He conceived, therefore, that, since no variety can be preserved for an indefinite period, it is absolutely necessary to seek for new varieties by sowing the seeds, and selecting such plants so produced as possess valuable properties. Though the utility of the latter practice is acknowledged, some persons doubt, with respect to the validity of his theory, of the decline of a variety from the cause which he assigns, and rather attribute any decay which may appear to climate or other circumstances. However this may be, it is certain that some varieties of apples formerly abundant are now propagated with difficulty, and are affected with diseases formerly less frequent.

3585. *Two qualities are particularly required in the fruit proper for cider.* One is the presence of the substance called *tannin*, or *tannic acid*, without which neither cider nor perry are capable of keeping beyond the first summer. This, although indicated by the acerb flavour of the fruit, is still more correctly demonstrated by pressing the juice out of an apple or pear, and then dropping in a solution of glue or isinglass: the tannic acid combines with the gelatin, forming a precipitate, the quantity of which indicates that of the acid. The other quality is the specific gravity of the juice; if that of water be considered as 1000, that of apple juice will be found to vary from 1·050 to 1·080, and the greater the specific gravity of the juice, the greater will be the strength of the liquor which it affords.

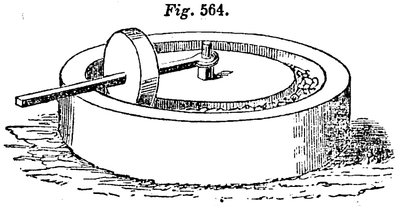
3586. *The juice of apples consists* of a considerable quantity of mucilage, saccharine matter of the same kind as that of grapes, malic acid, acetic acid, tannin, a fermenting matter, and much water. The parenchyma, or cellular membrance of the pulp, in which the above is contained, constitutes about two per cent. of the whole mass. The seeds contain a bitter principle and an essential oil.

3587. *When the fruit is gathered*, each variety should be laid apart, and formed into heaps a foot or more in thickness, in order to maturate or become mellow. It is not necessary for this purpose that they should be laid up under cover, or even protected in any degree from the weather, except during severe frosts; for apples in a loft, unless laid very thin, and carefully attended to, are apt to contract a musty taint which communicates itself to the cider. The process of mellowing has this farther advantage, besides maturing the juice, that the texture is greatly softened; and thus the operations of grinding and pressing are more easily and effectually performed. The mellowing may, in general, be known to be completed when the texture has so far given way that the thumb may without difficulty be thrust through one of the apples of an average quantity selected for the trial; it should not, however, be carried too far, as is sometimes the case. Previous to grinding, the fruits should be carefully looked over: those which are rotten are to be rejected; and those which are partially so should have the decayed part cut out.

3588. *The next operation is grinding or mashing the apples* into what is technically called *pommage:* by this the fruit is reduced as nearly as possible to a uniform consistence, in such a manner that the rinds and kernels may be scarcely discernible from the general mass, the operation proceeding slowly, with free access of air, which is supposed to promote the tendency to that decomposition which the mass is afterward to undergo.

3589. *Several methods of grinding the fruit are practised;* but that most commonly in use in Herefordshire, Devonshire, and the adjoining counties, is the bruising-stone, or apple-mill, *fig.* 564. This is a very ancient method, and is still employed in Devonshire, Herefordshire, and other western counties. The fruit is put into a circular chase, or wide groove, in a solid mass of stone, and they are crushed by a circular stone three or four feet in diameter, which is a little narrower than the groove, and which is carried round by a long axle that passes through it, and is connected at one end with an upright piece which stands in the centre of the fruit cistern. These circular bruising-stones generally weigh from one to two tons. It is essential that they should not be of limestone, nor have calcareous pebbles in their composition, as the lime would be dissolved by the acid of the apples. The best stones consist of a coarse grit, usually called "millstone grit," that is raised in the forest of Dean; but these often have the defect of being of too coarse workmanship, uneven places being left, which prevents them from bruising effectually the pips of the apples. The bruising surface ought to be worked smooth, and very hard stone, as granite, should be preferred. These circular bruising-stones are made to revolve by the hand, or by a horse, according to their weight and the quantity of work to be performed. A strong, round stick, called a *stirrer*, is employed to remove the fruit from the sides, and to keep it to the bottom of the stone.

Fig. 564.



Metal instruments should be avoided, as they are liable to be acted upon by the acid juice; and lead or copper are in particular improper.

3590. *Wooden rollers have been tried* for crushing the fruit, in the same manner as is practised with the sugar-canes in the West Indies; but it is found that the apples, being globular, and of a cellular substance, are not easily laid hold of, or, if caught, have no lengthened fibres to induce them to pass, like the cane, between plain rollers. In Ireland they use wooden cylinders, but they cover the surfaces with studs of iron, like a barrel-organ, and some use fluted rollers of wood and iron; but the acid of the fruit corrodes the iron, which, in a small degree, tinges the liquor. Upon the whole, therefore, perhaps the stone runner above described, if properly executed, is the most eligible instrument. For operations on a very small scale, where a mill is not at hand, a large block of wood hollowed out like a mortar, and a wooden pestle, might prove a succedaneum. Much depends upon the accuracy with which the grinding is performed, which ought to be continued until the pips, as well as the other parts, are completely broken down. On this account, the mill must not be choked with fruit: a moderate and rather small charge is more perfectly comminuted, and in proportionably a shorter time than a large one; the fruit should be strewed one apple in depth.

3591. *Pressing is the next operation;* and some, instead of pressing the pulp immediately after the grinding, prefer suffering it to remain in the grinding trough, or in vats for the purpose, for some time, perhaps for twelve or twenty-four hours, according to the season, that an extract from the rind and kernels may be produced. By allowing the juice to stand some time on the *marc*, the flavour of the apples is extracted, and the fermentation is sooner excited. But in warm weather there is a danger in letting it remain too long, for the acetous, and even putrefactive fermentation, are apt to set in. This danger is greater in apples collected in summer, when they are scarcely ripe, than with those which are gathered in the autumn; for in unripe apples there is abundance of natural ferment, and their juice will sometimes ferment spontaneously in a few hours, whereas the juice of apples perfectly ripe will not ferment for several days, even in a warm room.

3592. *The cider press is constructed* on the same principles as those machines which are intended to afford a strong and powerful pressure, as the packing and oil presses. The presses used in Herefordshire are a modification of the common screw press, the screw being vertical, and about six or seven inches in diameter, and the pressing boards horizontal. In Ireland, the force applied to the boards is by means simply of a lever. The hydro-mechanical press is the most powerful. The pressing is effected by putting the pulp into bags made of horse-hair cloth; some, instead of hair cloth, lay long straw under the pommage, the ends of which they turn up over it; then they cover the pommage with very fresh clean straw or reeds, upon which they spread another layer of pommage, and so on alternately, till the press is full; either method will do, but the bags are the neatest.

The first pressing should be very light, so as to extract only that portion of the juice which flows almost spontaneously; the pulp, now called the *cheese*, being then removed from the press and broken to pieces, should be exposed to the air by laying it on a coarse but clean canvass for twelve hours, turning it over from time to time with wooden forks or rakes. By this exposure the pulp will become brown, and being then pressed by a gradually increasing pressure till all the juice is extracted, will give out not only a deeper coloured, but considerably sweeter juice than that which flowed at the first pressure. In the usual careless mode of manufacturing cider, the juice, as it flows from the press, being intermixed with the finer parts of the pulp which are forced through the interstices of the hair cloth by the action of the press, is immediately transferred to the fermenting tun. This, however, is a bad practice; for the liquor will be found to ferment more moderately, and to become fine with more certainty, if deprived of this pulpy fibrous matter by running it through a common hair sieve, or through a cask with a false bottom covered with hair cloth; it may thus be obtained as clear as the wort that is produced from malt.

3593. *If the cider-maker is desirous of making different qualities of cider*, he will have ground and pressed each variety of apples separately; and, in general, it will be most profitable to make at least two kinds, a best and second, otherwise all the apples are mingled together. Some also keep apart that portion of the juice which drains without pressure, for making a superior cider.

3594. *The marc which remains after pressure*, if infused in boiling water, and allowed to remain for two days, will afford a juice that, when fermented, will make a very inferior kind of cider, formerly called *ciderkin*, and used as a common drink for labourers: at present it is called *water cider*.

3595. *The apple juice is now to be fermented.* The best vessels in which to carry on the first fermentation are casks set on end, the heads being taken out and replaced by a light moveable cover. These, being filled with juice to within four or five inches of the top, are to have their covers put on till the fermentation has commenced, which, in general, will be in from one to four days, according to the temperature and the richness of the liquor. Sometimes, in cold, unfavourable weather, the juice will remain for a fortnight or longer without fermenting; in such cases, sometimes artificial means are employed to produce it. Some persons put into the liquor a toast dipped in yeast, which is efficacious; a better method, however, is to take from two to three gallons of liquor from each cask, and to put the whole into a tub placed in a warm room; in a few hours fermentation will come on, and then the liquor is to be returned to the casks.

As soon as the fermentation has established itself, a scum begins to collect on the surface of the liquor, which should be carefully removed every morning and evening, the cover of the casks being kept on in the mean time, as it is of great importance that this stage of the fermentation should be carried through as quickly as possible. When the liquor has ceased throwing up scum, or nearly so, but while it is still giving off small bubbles of carbonic acid gas, the primary fermentation is concluded. The time which this occupies varies from twelve to thirty-six hours. The completion of the fermentation may be known by the clearness of the liquor, in consequence of the subsidence of the flocks, or muddiness, and by its having acquired a sharp vinous taste.

3596. *It is safer to rack off the cider too soon than to suffer it to remain too long.* By the latter it would certainly pass into the acetous fermentation, and a quantity of vinegar would be formed; by the former the chief defect would be want of strength, from deficiency of the alcohol. Cider, however, is not valued principally for the strength or spirit it contains, but for the agreeable mixture of this with sweetness, sourness with subacerbity; and, so that these qualities are obtained, the degree of strength is of little importance. The most desirable thing is to have sufficient carbonic acid gas to saturate the water of the apple juice, and to have the liquor sprightly, in a state intermediate between bottled cider and draught cider, as it is usually met with. Such cider, when left exposed on the table, does not become vapid, but continues to ferment slightly, and the chief objection to it in this state is want of clearness, a defect that offends the eye more than the taste. In some parts of the world it is customary to drink it in preference before the fermentation has been quite finished, and while it is still turbid.

3597. *The racking or filtering of the fermented liquor into casks is best effected* in the following manner:

For every cask of liquor take two pecks of perfectly sweet bran; scald it in two successive waters, in order to wash out all the soluble matter of the bran, and press it thoroughly; then dissolve one ounce of alum in a pail of boiling water, and pour it on the bran; let the mixture remain for six or eight hours, and then strain off the water, and press the bran as before. The bran thus prepared is to be stirred into the fermenting liquor, and the mixture is to be strained through a cask with a false bottom; the first runnings, being rather more turbid, are to be returned, but as soon as the liquor comes through moderately clear it is to be reserved. In this state it will be found agreeable to the taste, and considerably sweet; and the manufacturer may now, according to his pleasure, make of it either *sweet* or *dry cider, bottled* or *in cask.*

3598. *To produce the best sweet cider for bottling*, it is essential that the fermentation should not be complete, but that some of the saccharine matter should remain unconverted, in order that it may, by the slow fermentation (see "Fermentation" and "Brewing"), be converted into alcohol and carbonic acid gas.

3599. *After fermentation*, nothing more is required than to bottle it forthwith, and to keep it in as cool and uniform a temperature as possible for a twelvemonth or more, that it may ripen; after which it may be brought into a state fit for drinking by being placed for a week or fortnight in a warm situation. For sweet barrelled cider, the cask must be *stummed*, and then filled with the liquor; the bung must be accurately secured, and the temperature kept as cool as possible.

3600. *The term stumming signifies burning sulphur in the cask*, for the purpose of checking fermentation, it is thus performed: Take a strip of canvass cloth about twelve inches long and two broad; let it be dipped into melted brimstone; when this match is dry, let it be lighted, and suspended from the bung of a cask in which there are a few gallons of cider until it is burned out. The cask must remain stopped for an hour or more, and be then rolled to and fro, to incorporate the fumes of the match with the cider; after which it may be filled, when all fermentation will be suspended. Sometimes this process is resorted to for the purpose of giving an additional flavour to the cider. To effect this, some powdered ginger, cloves, &c., may be strewed on the match when it is made. The burning of these ingredients with the sulphur will convey somewhat of their fragrance to the whole cask of cider; but to do this advantageously, it must be performed as soon as the vinous fermentation is fully perfected. Should the fermentation return, this process must be repeated. The complete cessation of the fermentation may be known by observing whether a candle held in the bung-hole will burn. So long as there is carbonic gas escaping the candle will not burn.

For strong dry cider no stumming must be employed, but the cask, being filled to within an inch of the top, must be secured with a bung, having a hole bored through it with a round file. Into this hole, after the bung has been driven into the cask, a piece of tobacco pipe is to be inserted and secured with a little melted wax, taking care that its lower end does not dip into the liquor. A very gentle fermentation will take place, by which the sugar will be wholly converted into spirit in the course of the succeeding summer, and the cider will then be in the state of a dry wine, and will undergo no farther change as long as it is kept in perfectly close vessels.

When the cider-maker has succeeded, by successful management, in preventing the acetous fermentation, his cider will require little farther attention than filling up the vessels every two or three weeks, to supply the waste by the slow fermentation, until the beginning of the succeeding March, at which time it may be reasonably expected he will find his liquor bright, pure, and in a state for final racking, which should be done in fine weather.

3601. *The casks into which the liquor is put* whenever racked off should always have been thoroughly scalded and dried again, and each should want several gallons of being full, to expose a larger surface to the air. New casks, though they are ever so well seasoned, are apt to give a disagreeable taste to the cider: boiling them with pommage is useful. Casks that have contained spirits are best for preserving cider.

3602. *Should the above precautions be neglected*, the consequence will probably be that the acetous fermentation will take place. When, however, this has been suffered to come on, several methods have been tried to check it, sometimes with a degree of success, at other times unavailingly. One of them has been to pour in a bottle of French brandy, half a gallon of spirit extracted from the lees of cider, or a pailful of old, good cider; but this will not succeed if the cider should continue to be kept in a close, warm cellar. If removed to a cooler place, the cider may be preserved. Another remedy is the stumming described above. These remedies are innocent; but it is not safe to employ any preparation of lead, as has been done formerly.

3603. *If the cider, after being racked off into casks, remains bright*, nothing more is to be done to it; but if a scum collects on the surface, it is a proof of fermentation commencing again, and it must be immediately *racked off* into other casks to check this, which must be repeated as often as a new fermentation appears. The strength of cider is somewhat reduced by being frequently racked off.

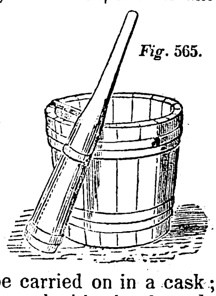
3604. *Fining will be unnecessary if the above directions are attended to;* the liquor will become spontaneously perfectly clear and bright, which will not only be a saving of farther trouble, but such liquor will keep longer unimpaired than that which has been fined. Should, however, the cider-maker, notwithstanding his care, be disappointed, he may use some of the ordinary substances for this purpose, as isinglass, whites of eggs, &c.; but all these deprive the liquor of the greatest part of its *tannin*, upon which its durability essentially depends. If fining is necessary, it may be thus performed: a pound of isinglass is soaked for ten or twelve hours in cold water, and afterward dissolved in about five gallons of cider, and well incorporated with a whisk. About a quart of this is sufficient for a hogshead of cider, and it must be stirred and mixed in the cask; but the whites of a dozen eggs, beat up along with the shells in a quart of the liquor, is thought by some to perform the operation with more certainty.

3605. *Bottling the Cider.*—Cider, in general, will be fit for bottling in about a month; but the best period is when it has arrived at the greatest perfection in the cask, which is when it is two years old; it will then soon become brisk and sparkling. As it is usually made, it will retain a considerable portion of sweetness in the cask to the end of three or four years; but then the saccharine part gradually disappears, probably by the decomposition induced by the slow fermentation. If it possess much richness, it will remain with scarcely any sensible change during twenty or thirty years, or as long as the cork duly performs its office, or resists decay. When the bottles are filled, set them by, uncorked, till the morning; let the corks be driven in very tightly: some tie them down with strong wire or twine, and secure them with melted rosin, or other material of that nature. The bottles should be laid on their sides. Both casks and bottles should be frequently looked at, and if any hissing be perceived, the bungs or corks should be removed, and replaced in a day or two, otherwise the vessels may burst. In winter they should be kept rather warm, or free from frost, and in summer in a cool place.

3606. *In making cider for the common use of the farmhouse*, few of the foregoing rules are accurately attended to. The flavour of the liquor is a secondary consideration with the farmer, whose first object is to obtain a large quantity at a small expense. The common practice is sufficiently well calculated to answer this purpose; the apples are usually gathered and ground as soon as they become moderately ripe, the pommage is pressed, and one fourth of warm water is often added to the juice, which is most frequently conveyed from the press immediately to the cellar. A violent fermentation in the casks soon commences, and continues until nearly the whole of the saccharine matter is decomposed. The casks are filled up and stopped early in the succeeding spring, and no farther attention is paid or required. The liquor thus prepared should be kept at least a year before it is drunk; it may be kept from two to five or six years in the cask, according to its strength. It is generally harsh and rough, but rarely acetous.

3607. *Cider may be made in small quantities* as well as in large, and the superabundant apples of a moderately large garden may be economically applied to this use without much trouble. The fruit should be picked free from stalks, and laid in heaps for three weeks to mellow. A tub (*fig.* 565), thicker and stronger than usual, eighteen inches in diameter, and iron-hooped, may serve for a *crushing trough*, and the apples may be made into pommage with a heavy bruiser of hard wood, not unlike that used by a street pavior.

Fig. 565.



The common clothes press, made very strong, may be employed for *pressing*, and the lower pressing-board must be placed in a tin tray to collect the juice, from which it must run down by a pipe into a vessel to receive it. The apples must be put into hair cloth, or canvass bags, to be pressed. A few must be pounded at a time, and the pressing must be done gradually, and not by using much force at once. The *fermentation* may be carried on in a cask; and a hole may be bored in the head of the cask, which can be stopped with a bottle cork, through which the juice to be fermented may be poured in; and also a cock must be placed near the bottom to draw it off by. The fermentation may be promoted by using some new yeast mixed with a little honey and flour warmed; put this into a muslin bag, insert it through the hole of the cask, and keep it suspended by a string, but do not suffer it to reach the bottom of the vessel. In warm weather the fermentation should be carried in the shade about 60°; in cold weather the cask should be placed near the fire. September is the best season for the operation. The fermentation should not be carried far, but only till the excessive sweetness of the apple is removed and has given way to a vinous taste: five or six days is generally sufficient. When the liquor ceases to ferment, or very little, it must be drawn off, and it is to be strained and received into smaller clean casks, which, when full, are to be bunged and kept for draught: after remaining for two or three weeks, the liquor may be bottled, when it will soon be ripe. Cider made in cold weather takes longer time to clear, and sometimes requires to be fined. One man pounding the fruit, and another to press and assist, will produce ten gallons of juice in a day. The juice should not be allowed to remain long in the tin tray, lest it should corrode the metal. The pounding and pressing should be as complete as possible.

In this manner, in the early part of the cider season, says Mr. Donovan, "the whole process, from the pressing out the juice to the bottling of the cider, may be completed in the space of four days; and in three other days it may be fit for drinking, of a delightful flavour, highly effervescent, and almost perfectly transparent." Those who add the ciderkin to the cider usually add brandy with a little sugar, in the proportion of a gallon of brandy to a hogshead, to supply the strength; but if pure juice only be used, this is not necessary.

3608. *Although in Herfordshire and Devonshire* they are very solicitous about the quality of the apples from which cider is made, Mr. Donovan is of opinion that this quality is of less consequence than is commonly supposed; and that good cider may be made from a mixture of all kinds of apples. Eight gallons of juice may be obtained from one hundred weight of apples, which will consist of 600 in number if the apples are large, and of six times that number when of the smallest size.

The finest cider and perry of Herefordshire is brought for exportation to the East and West Indies, and America.

3609. *If the apple juice is weak or defective in sweetness*, good cider cannot be made, and some saccharine matter should be added, as raisins, honey, or sugar, to afford more spirit, and overcome the acid. In the Lancashire Agricultural Report, by Dickson and Stevenson, p. 434, there is a receipt for making cider with honey, so as to produce a liquor of excellent quality.

3610. *The Pomona wine of Dr. Rush* is made from apples. He boiled down two barrels of cider fresh from the press into one, fermenting it afterward; if kept two or three years in a dry cellar, it affords a liquor which, according to the quality of the apple from which the cider is made, has the taste of Malaga or Rhenish wine. It is a pleasant drink in summer mixed with water.

3611. *The quantity of alcohol in cider* is inconsiderable; and when extracted by distillation is of a bad quality, except it be repeatedly rectified. In Normandy they make a great deal of what is called *eau-de-vie* from their cider; but it is very inferior to brandy from wine, though often employed to adulterate the latter.

3612. *Cider is not so nutritious as malt liquor;* but it forms an excellent beverage for labouring men in the summer months, its acid assisting materially in quenching thirst. Rough Herefordshire cider has been recommended as an antiseptic in cases of low contagious fever instead of port wine, when the latter cannot be procured.

Sect. II.—Perry.

3613. This beverage is made from the fruit of the pear-tree, which is of the orchard kind. There are many varieties; but for the purpose of perry the Tinton squash pear is in the highest esteem in Gloucestershire. It is an early fruit, remarkable for the tenderness of its flesh. The liquor made from this fruit is pale, sweet, yet remarkably fine, and of a strong body. The Oldfield pear is a favourite, remarkable for the fine flavour of its liquor. The Barland pear of Worcestershire is in great repute, as is also the red pear. Besides these, there are many others of great merit among those of Herefordshire and the adjacent counties.

3614. *The pear is more properly a naturalized than an indigenous fruit* in this country; it is more hardy than the apple, and may be cultivated in almost every part of England with nearly as much success as in Herefordshire. Like the apple, it grows with the greatest luxuriance in strong deep soils, and in these the finest liquors are at present obtained; but inferior kinds will flourish in almost any soil that is not incommoded with water, even such as will scarcely produce herbage. The pear is an extremely long-lived tree, and the same variety may in consequence be very long kept in cultivation.

3615. *Every variety of this fruit which possesses colour and richness is capable of making perry;* but a good perry pear requires an assemblage of qualities which will be rarely found in the same fruit. It must contain a large proportion of sugar, or its juice can never possess sufficient strength; and unless it be at the same time astringent, the liquor produced from it will be acetous whenever it ceases to be saccharine; in the latter state it will agree with few constitutions; in the former with none. The juice of the best perry pears, according to Mr. Knight, "is so harsh and rough as to occasion a long-continued heat and irritation in the throat when the fruit is attempted to be eaten; yet by being simply pressed from the pulp, it becomes rich and sweet, without more roughness than is agreeable to almost every palate." This circumstance, though extraordinary, does not stand alone in the vegetable world; there are many cases where similar changes take place with acrid vegetable substances.

3616. *The pear requires a certain state of maturity* to afford perry in the greatest perfection; it should be ripe without being mellow or decaying; when it has not obtained the proper degree of ripeness, an excess of fermentation cannot be prevented; and when it has exceeded it, the liquor rarely ferments kindly, and is extremely apt to become sour, probably by having lost too great a proportion of its astringency; hence few kinds are found to improve by being kept after they have fallen from the trees. The produce of the same pear-tree ripens very irregularly; the planter must therefore have a considerable number of trees of each kind he plants, or he will rarely have a sufficient quantity ready to be ground at the same time. Even when the fruit has fallen spontaneously from the trees, a fourth at least of some kinds will be found immature or decaying, and totally unfit for making fine perry; this should be (though it rarely or never is) separated from the rest. Mr. Knight attributes to this neglect a certain crude and harsh acid which dwells upon the palate, and which perry is seldom free from; and to the same cause it may be owing that perry, even when genuine, does not agree with so many constitutions as cider.

The pear, however, though generally producing a liquor inferior to cider, has many advantages over the apple; it is capable of succeeding in a greater variety of soil, and is more productive of fruit.

3617. *The best pears for perry*, or, at least, the sorts which have hitherto been deemed the fittest for making this liquor, are so excessively tart and harsh, that no one can think of eating them as fruit; for even hungry swine will not feed upon them. In Worcester, Gloucestershire, and the adjacent counties, they are planted in the hedge rows and the most common fields; a practice which, perhaps, should be more followed, as pears are capable of affording a light and agreeable nourishment, either in soups or stewed when green.

3618. *Mr. Knight states that in the making of perry the pears are ground and pressed* in exactly the same manner as those of apples in the manufacturing of cider, but that it is not usual for the reduced pulp to be suffered to remain any length of time without being pressed. It has never been the practice in Herefordshire, or in the counties in the vicinity of it, to blend the juices of the different varieties of the pear, in order to correct the defects of one kind by the opposite properties of the other. It is, however, he allows, more easy to find the required portion of sugar and of astringency, as well as of flavour, in three or four varieties than in one; hence, he supposes, a judicious mixture of fruits affords a prospect of great benefit.

3619. *The juices of the pear* and the apple are constituted of the same component parts, but the proportions are different. In the juice of the pear the *tanning principle* is predominant, with a less proportion of sugar, mucilage, and colouring matter.

3620. *The method of fermenting perry* is nearly the same as that of cider; but the former does not afford the same indications as the latter by which the proper period of racking off may be known. The thick scum that collects on the surface of cider rarely appears in the juice of the pear, and during the time of the suspension of its fermentation the excessive brightness of the former liquor is seldom seen in the latter; but where the fruit has been regularly ripe, its produce will generally become moderately clear and quiet in a few days after it is made, and it should then be drawn off from its grosser lees. An excess of fermentation is prevented by the means used in the making of cider, and the liquor is rendered bright, if necessary, by isinglass.

3621. *In the after-management of perry*, the method is the same as that of cider; but it does not so well bear situations where it is much exposed to change of temperature. In the bottle it almost always retains its good qualities, and in that situation it is always advisable to put it, if it remains sound and perfect at the conclusion of the first succeeding summer.

3622. *On the whole, the pear-tree furnishes a less popular liquor than the apple*, but is more productive, furnishing in the proportion of 600 gallons of liquor to the acre, when the trees are full grown and in good bearing: the produce of a single tree will often be twenty gallons of perry. It is to be observed that, though perry is made in a much smaller quantity than cider, yet the former, of the best kind, and bottled, is generally esteemed as quite equal to the latter.

3623. *Mr. Booth, in his work on wine-making*, thus describes a sort of wine in which pears were employed: "In the north of France, having heated fifty-five pounds of the juice of wild pears to 180°, I added about a tenth of that weight of raisins, and bunged up the whole in a cask. In a short time the heat of the liquor had fallen to 77°, when I drained out the raisins, bruised them, returned them into the must, and closed the cask, so as to allow the fermentation to take place. A fortnight after, the wine or perry was racked into stone cans, and, after standing three months in the cellar, it was reckoned by good judges equal to the best wine from grapes."

Sect. III.—Mead.

3624. *Mead is a vinous liquor prepared from honey* diluted with water and fermented, and which was formerly much used in England, as well as among many northern nations. It appears to have been a beverage of great antiquity, being, perhaps, the only fermented liquor made in the northern parts of Europe to which the cultivation of corn had not yet extended, and where the climate was too cold for the vine; it therefore rivalled the wines of the south. It is the Hydromel of the Romans; Pliny records, and Virgil celebrates, the drinks made with honey mixed with fruits. By the Saxons it was called *Meda*, whence the *mead* and *metheglin* of modern times. It was drunk in great excess at the festivals among the Norsemen, and filled the scull-cups in the hall of Odin. It is said that Attila, king of the Huns, died from indulging too freely in this favourite liquor.

Mead vas well known to the ancient Britons, and was highly valued by their posterity long after they were acquainted with other liquors. The mead-maker held a considerable rank in the courts of British princes. Honey appears to have been more abundant formerly than at present, when the extension of agriculture has deprived the bees of much of their favourite wild food. The introduction of sugar has likewise, to a considerable degree, driven honey out of the field, and the production of corn has given rise to the manufacture of ale. Of late, mead has been little used in England, and is now scarcely known.

Though mead and metheglin appear to have been the same, yet some have drawn a distinction, considering the latter to be the superior beverage. It is said that Queen Elizabeth was so fond of metheglin, that she had some made for her special drinking every year.

3625. *The composition of honey* will be stated in our account of that substance, Book X., Chap. XIV. Diluted with water, it is susceptible of the vinous fermentation without the addition of yeast: but mead, when made from honey and water only, is flavourless and heavy; it is much improved by the addition of fruit-juice and spices.

3626. *The method of making mead without fruit, as commonly practised in England,* is as follows: Boil honey in water for an hour, in the proportion of three to four pounds of honey to a gallon of water. Skim it carefully, draining the skimmings through a hair sieve, and returning what runs through. When of the proper coolness, stir in yeast, a tea-cupful for nine gallons, and let it ferment. Some add half an ounce of hops to preserve it; but this is not usual. Tun or transfer it to the cask, and ferment it in the usual manner. Put it in a cool cellar, and in a year it will be fit to bottle. Strong mead, if well made, will keep many years, and, indeed, requires to be kept one or two before it is sufficiently meliorated; it improves by time. Some put two lemon peels to each gallon while it is fermenting; others add cinnamon, ginger, cloves, mace, and rosemary. It was formerly a custom to add some ale wort, and it was then called *Welsh braggart.* Mead may be made into a very agreeable beverage, not inferior to many foreign wines.

3627. *Macquer, in his "Dictionary of Chemistry," directs* to choose the whitest, purest, and best-tasted honey, and to put it into a kettle with more than its weight of water; a part of this liquor must be evaporated by boiling, and the liquor scummed till its consistence is such that a fresh egg shall be supported on its surface without sinking more than half its thickness; then the liquor is to be strained and poured into a barrel, which, when nearly full, must be kept in a warm place, taking care that the bung-hole be slightly covered, but not closed. The fermentation which ensues will subsist during two or three months, according to the degree of heat. During the fermentation the barrel must be filled up occasionally with more of the same kind of liquor of honey (some of which ought to be kept apart), to supply what works out of the barrel. When the fermentation ceases, and the liquor has become vinous, the barrel is to be put into a cellar and bunged up. In about a year the mead will be fit to be bottled.

3628. *Mead is still a favourite beverage among the northern nations,* and is still drunk in large quantity in some parts of Europe, particularly in Russia, Poland, and Lithuania, where a vast deal of honey is produced in the forests.

"*The process of brewing mead in Poland* is very simple; the proportions of the ingredients are three parts of water to one of honey, and 50 lbs. of mild hops are used to 163 gallons. When the water is boiling, and it is kept stirring till it is milk-warm, it is then put into a large cask, and allowed to ferment for a few days; it is then drawn off into another cask, wherein there has been aqua vitæ or whiskey, bunged quite close, and afterward taken to the cellars, which in this country are excellent and cool. This mead becomes good in three years' time; and, by keeping, it improves, like many sorts of wine. The mead for immediate drink is made from malt, hops, and honey, in the same proportion, and it undergoes a similar process. In Hungary, it is usual to put ginger in the mead. There are also various other sorts of mead in Poland, made of honey, wild cherries, berries of the Cornus mascula, and raspberries; they all undergo the same process, and are excellent after a few years' keeping."—*Loudon's Encyclopædia of Agriculture.*

3629. *Mead is made in Russia in great perfection.* It is there, according to Mr. Tooke, of two kinds, white and red. To make the first, two poods of white honey are mixed in five ankers of clear river or soft water, and boiled and skimmed till nearly an anker is boiled away. The liquor is then strained through a fine sieve or piece of linen into a broad, open vessel, and mixed with a couple of spoonfuls of beer lees and a pound of white bread, *kalatsch.* After it has stood in this vessel in a moderately warm place, and fermented for thirty-six hours, it is poured through another sieve or piece of linen into a cask, in which has been previously put a pound of small-shred isinglass for clarifying it. For red mead, to one pood of honey they add eight vedross of water, and reduce them by boiling to six vedross. When cold, the juice of about half a chetverick of pressed or bruised cranberries, strained through a sieve, is mixed with it. A small complement of yeast is then added, and some isinglass or whites of eggs are thrown in to fine the liquor. Cinnamon, cloves, ginger, mace, and other spices are infused. It is then placed in a cool cellar, and, after standing there for some weeks, it is either bottled for use, or drawn from the cask direct. Strawberries, raspberries, and cherries are sometimes mixed with the mead to improve its flavour. Honey is so abundant in some of the forests of Russia as to form a considerable article of trade, and some tribes scarcely follow any other employment than the rearing of bees. Some individuals possess thousands of hives of wild bees, which are formed in the trees.

3630. *Mead is made with a mixture of fruit juice* in a variety of ways. Together with honey, white and red currants and raspberries are employed; likewise, the rinds of oranges and lemons are added. Aromatics and spices are used occasionally; as the leaves of rosemary, lavender, and sweet briar, and cinnamon, cloves, and nutmeg. These additions are made towards the end of the fermentation, and are suspended in the cask, before it is bunged, in a muslin bag, which may have a piece of flint in it to weigh it down. The mead should be kept in the wood from six to twelve months, and from nine months to two years in the bottle.

3631. *White Currant Mead.*—Infuse two gallons of white currants bruised, thirty pounds of honey, and three ounces of tartar, in fifteen gallons and a half of boiling water. Stir this together for a quarter of an hour, and then set it to ferment. When the fermentation is complete, and the liquor clear, add one gallon of brandy, and bottle it immediately. A slow fermentation will go on in the bottle, and in a few months it will be brisk and fit to drink. If it requires to be still, the fermentation must be continued longer, according to the principles already laid down.

3632. *Red Currant Mead.*—Instead of the above-mentioned quantity of white currants, use six quarts of red currants and two of black, with twenty-five pounds of honey and a pound of red beet root cut into thin slices Proceed as before.

CHAPTER VI.

ON THE MAKING OF VINEGAR.

3633. *Although most of the vinegar used in domestic economy is purchased*, there are yet many occasions where it is useful to make it, in order to secure it of good quality; and sometimes liquors become sour, and cannot be made any use of except by converting them into vinegar. It is important, also, that the nature of a material so much employed in many culinary operations, and as an article of nutriment, should be well understood.

3634. *Vinegar was known for many ages before any other acid.* It is mentioned by Moses, and, indeed, seems to have been common among the Israelites, and other Eastern nations at a very early period. It was at first made from wine, and the formation of wine vinegar is probably as ancient as the liquid itself from which it was produced; although the improvement of the process has been the result of the observations of ages. Vinegar was much in use among the Greeks and Romans, who employed it both in their cookery, as a luxury, and as medicine. It was found highly useful in their armies, the soldiers being always obliged to carry some, for the purpose of mixing a little with water, to obtain a grateful drink, both cooling and excellent to quench thirst. This practice is still followed in some of the warmer parts of Europe, particularly among the Spanish peasantry, who are accustomed to mix about a gill of wine vinegar with a gallon of water, and a tea-spoonful of salt, for a common beverage; and with this drink alone, and bread, they frequently sustain the labours of the field, exposed to the heat of the sun in their warm climate, and are as healthy and athletic a race as any in Europe. They may occasionally, when their work is over, indulge in a glass of their *vin de pays*, or even of some kind of spirits, but during their labour they find vinegar and water sufficient. The uses to which vinegar is applied among us are too numerous and well known to be here enumerated. As a condiment, vinegar is grateful, and, used moderately, is wholesome. It appears, in general, to be a useful addition to fatty and gelatinous substances, rendering them more digestible; but if taken in too large quantities, it is highly injurious to the stomach.

3635. *The name is derived* from the French *vinaigre*, or *vin*, wine, and *aigre*, sour. Strictly, therefore, the term vinegar should be confined to what is made from wine; and that made from ale is sometimes called *alegar;* but as the acid is the same, however it may have been procured, the custom is now to call all the varieties of it by the name vinegar.

SECT. I.—GENERAL PRINCIPLES OF PRODUCING VINEGAR.

3636. In Book VIII., Chap. II., when treating of fermentation, we stated that every liquor that has completely undergone the vinous or spirituous fermentation is spontaneously disposed to pass into the acetous stage, and will do so except means are taken to prevent it. Thus, if wine, ale, beer, or any other containing spirit and mucilage, be exposed for some time to air not too cold, that is to say, from about 75° to 80°, or a temperature somewhat higher than our ordinary summer heat, they will undergo a second fermentation, and become sour; and the sourness will increase so much after some weeks or months, that they will be found converted into a weak vinegar. But if this natural process is left to itself, the change might be too gradual or slow to obtain vinegar in perfection, as the first acetified portion will become mouldy and go on to the putrefactive state before the last has become sour. It is necessary, therefore, to add either yeast or an acetous ferment to hasten the new fermentation; this new fermentation must also be stopped in time, or as soon as it has arrived at the completely acetous state, and the acid has attained the highest degree of perfection and strength, otherwise the liquor would speedily be deteriorated; the acid taste would gradually lessen, and at last disappear altogether, being succeeded by an offensive smell proceeding from the putrefactive fermentation; a mouldy watery liquor remaining, with scarcely any acidity. It therefore requires skill and experience in the vinegar-maker, not only to employ the best process for producing the acid liquor, but to determine when the vinegar is in a fit state to be drawn off and closely barrelled. Thus, as we have stated of fermentation generally, the formation of vinegar is the result of natural laws, and we can only regulate the circumstances under which they act.

SECT. II.—OF THE DIFFERENT SORTS OF VINEGAR.

3637. *The sorts of vinegar in common use may be divided into*, 1, wine vinegar; 2, raisin vinegar; 3, malt vinegar; 4, sugar vinegar; 5, fruit vinegar; 6, wood vinegar, or pyroligneous acid. All these consist of the same acid, the acetic diluted with water; containing, likewise, several impurities, as gluten, mucilage, and sometimes other vegetable acids, according to the materials from which the vinegar is made. The formation of all these, with the exception of wood vinegar, depends upon the same general principles, although, in consequence of the varied nature of the ingredients from which they are produced, the processes necessarily differ. The best vinegar is made from white wine, but ordinary vinegar is produced from malt.

Subsect. 1.—*Wine Vinegar.*

3638. We commence with the method of preparing *wine vinegar* on the Continent, not because this can be practised in English domestic economy, but because it is the most ancient, and the best mode, and likewise because our processes have been derived from it. Wine vinegar is properly the vinegar of genuine foreign wine, methodically prepared, as in Germany, France, and Italy, and does not include those which are made from cider, malt wines, or made wines of any description whatever. All wines, especially those of a weak kind, either spontaneously, or by repeated fermentations, may be converted into a kind of vinegar. Observation of the frequent and spontaneous acidity in wines no doubt gave rise to the preparation of the more permanent and pungent liquid which is obtained by a regular process, such as the following:

3639. *Method of making Wine Vinegar in France.*—Large vats, in pairs, open at top, but fitted with close, moveable covers, are placed in a row under a shed open at the south side, so as to be heated by the sunbeams by day, and exposed to the air at night. Between each pair, a capacious and strong open receiver, made of oak and well hooped, is sunk in the earth, so that the cock in each cask near the bottom may command it. In this receiver a pump is placed, and near it a stage and a ladder for a man to ascend and work the pump, and put the covers on and off the vats; a few feet from the bottom of each cask a strong, perforated false bottom is fixed, on which the substance, technically *rape*, or ferment, is placed. The rape consists of the foot-stalks of the bunches or clusters of grapes, or of the marc that has been preserved in the manner we shall afterward describe. The use of the rape is, to sour the wine, and it is disposed thus: first, a layer of vine twigs is laid, some inches thick, on the perforated or grated bottom, to prevent the rape clogging up the holes or falling through. Then the vats are filled up with wine to within about six inches of the top. This is poured over the rape until one vat is filled, and the other half full. In two or three days, according to the temperature of the atmosphere, the wine in the half-filled vat begins to heat and ferment, and the heat will increase for several days successively, without any appearance of the like during that time in the vessel that is full. The cock of the full vessel is then turned, and the wine, as it flows into the receiver, is pumped over the fermenting rape to check the fermentation, which otherwise would proceed too rapidly, and the heat excited would cause the spirituous part of the wine to dissipate and leave the liquor vapid. In two or three days, or less time, the rape in the other vessel begins to heat and ferment, when recourse must be had to the same means of checking the fermentation by pumping up the wine of the full vat from the receiver as before. This must be alternately done every day, and in very warm weather once in every twelve hours. In winter it generally takes from twenty-four to thirty-six hours to heat and ferment; both vats successively augment in heat and vigour of fermentation until the vinegar is perfected or finally made, which is usually in about fourteen or fifteen days in summer. In winter it proceeds more slowly, and that in proportion to the coldness of the weather.

During the fermentation the full vessel must be kept always open at the top; but the half-full vat should be kept accurately covered, to prevent the dissipation of the spirit of the wine by the heat, and also the loss of the carbonic acid gas that is disengaged, and to cause it to react upon the liquor fermented by being entangled in the fluid; if both vessels are kept open, the liquor may be soured, but it will be converted into a flat, instead of a sharp, pungent, strong vinegar. At the time when they pump the wine out of the full vessel, a scum rises that should be taken off; and in the half-full vessel there ought to be left a hole, stopped up with a plug, occasionally to give vent, and examine the progress of the operation, which also keeps in the volatile acescent vapour generated by the fermentation; the latter is known to be completed when the hissing noise in the half-full vessel ceases.

3640. It will improve the vinegar, after it is made, to let it stand some time on the rape. If the weather or climate is warm, wine vinegar may be made in the summer season in the open air; if cold, artificial heat within doors will be necessary.

Since, in casks that have never been used for this purpose, vinegar is made more slowly and with greater difficulty than in those which have previously served this purpose, the latter are preferred, and are called in France *mères de vinaigre*, mothers of vinegar.

3641. *In the acetous as well as in the vinous fermentation, an intestine motion,* a swelling, a hissing noise, and an ebullition, may be perceived; but the heat produced by the latter is scarcely sensible, whereas that produced by the former is very considerable. The vapour, also, which comes from vinegar is not so vinous as that of fermenting wine.

3642. *Vinegar does not deposite tartar* as wine does, even though it has been made with wine that has not deposited its tartar, which proves that this substance is decomposed in the process.

3643. *Wine is also converted into vinegar* without the additions mentioned above, simply by adding wine, especially when on the fret, to vinegar already made, and exposing it to a proper heat. The casks are always kept nearly full, by taking out of them at intervals about a third or a fourth part, replenishing them with wine, and again bringing the contents to the state of vinegar. In this manner the best white wine vinegar of Orleans is made.

In France vinegar is usually made from poor wines, or from such as have become too sour. Wine vinegar is considered purer than any other kind, and it is generally stronger than the usual malt vinegars of this country. They have there both white and red vinegar made from white and red wines. Red vinegar may be deprived of its colour by making it pass through animal charcoal, produced by calcining bones out of contact of the air till they are black; the product is not, however, pure animal charcoal, but it contains a large quantity of this substance, together with a little phosphate and carbonate of lime; it is therefore necessary afterward to digest the burned bones in diluted muriatic acid, to remove their earthy salts, which otherwise would be taken up by the vinegar. Red vinegar may likewise be rendered white by mixing it with milk and agitating the mixture; the colouring matter of the wine will combine with part of the milk, and will fall down as a sediment.

SUBSECT. 2.—*Raisin Vinegar.*

3644. *A superior kind of vinegar, sometimes used in pickling, is occasionally prepared in this country from raisins,* and the manner of making it is evidently an imitation of the processes used on the Continent for producing wine vinegars. The cheapest kind of raisins are employed, and an equal quantity of coarse sugar is added to increase the quantity of the fermentable matter, as, in this case, the process of vinous fermentation is to begin.

To every hundred pounds of raisins, and as many of sugar, a hundred gallons of water are added, of the temperature of 65° or 70°. The mixture being well stirred, spontaneous fermentation commences in a few hours, the raisins containing a natural ferment. The fermentation continues three or four days, the temperature rising to about 80°; when this has proceeded as far as it is judged necessary for the production of spirit, it is checked by racking off the liquor, which is put into casks having false bottoms pierced with holes, into which had been previously put the rape, consisting of the residuum of husks, stalks, &c., of raisins from a former process of the same kind, and which have been soured, in order to cause the acetous fermentation to begin. The casks are placed in a line, and each is filled entirely, and only half, alternately, with the wash, which is a kind of raisin wine that has been brewed. Were the liquor to remain so, it would soon heat and ferment too rapidly, so as to pass into the putrefactive stage; therefore the fermentation must be checked in the full cask by drawing some of the liquor out into that which is half full. Next day the process is reversed by putting back the liquor that was taken out, and leaving the casks, now full, to be again half empty; and so on each day, or oftener, if necessary, in order to check the fermentation, precisely as in the French method, which we have described, until the acetification is complete. The casks are placed in an apartment heated to about 80° by means of a tube that opens into the external air, passes through a furnace, and thus delivers the air within it in a heated state into the apartment. The admission of heated air demands the exit of an equal quantity from the apartment; and thus a constant circulation of air is kept up, which occasions a ventilation very useful in stopping the progress of putrefaction. When the vinegar is formed, it is clarified by means of isinglass, and put into well-closed casks.

It is to be observed that genuine wine vinegar or raisin vinegar differs from that formed either from sugar, beer, apples, &c., in containing tartar, by which peculiarity it may be distinguished, except where tartar has been added to other vinegar for the purpose of disguising it.

SUBSECT. 3.—*Common Vinegar.*

3645. *Common vinegar is most usually prepared in this country from malt.* From what we have already said here, and on the subject of brewing, it must be obvious that all that is necessary for the formation of vinegar is to ferment the wort from malt, and to suffer the vinous fermentation to pass on to the acetous stage, instead of checking it as in the brewing of beer.

3646. *Malt vinegar is prepared in manufactories.* The first operations are nearly the same with those of the brewer. A mash of ground malt and hot water is made, and, after infusion for an hour and a half, it is conveyed into a cooler a few inches deep, and thence, when sufficiently cooled, is transferred to the fermenting tun, where it is mixed with yeast, and kept in fermentation for four or five days. The liquor (which is a strong ale without hops) is then distributed into smaller barrels, set close together in a chamber, in which a moderate heat is maintained for about six weeks by a flue that goes all round, or by hot air, or by the sun, during which time the fermentation goes on equally and uniformly, and passes from the vinous to the acetous fermentation. The sour liquor is then emptied into barrels, which, in the summer, are set in rows in a field in the open air, the bung-hole being only covered with a loose tile, that the air may have free admission; in the winter they are kept in a room with a *stove*, to increase the acetification. It would require a very long time to complete this process if no ferment was used; but for this purpose they sometimes introduce into the barrels, upon a false bottom pierced with holes, a quantity of the refuse of raisins, or other fruit, left by the makers of raisin and other made wines. This, called *rape*, acts as an acetous ferment, and abridges the time that otherwise would be necessary, and prevents failure, to which the process would be liable. By this means the operation is finished in four or five months. These *rape tuns* are worked by pairs, in the same manner as was described in making vinegar from wine. One of the pairs is quite filled with the vinegar from the barrels, and the other only three quarters full, so that the fermentation is excited more easily in the latter than in the former, and every day a portion of the vinegar is laded from the one to the other, till the whole is completely finished.

As soon as the vinegar has acquired its greatest degree of sourness, the process is stopped; otherwise, by a continuance of the fermentation, the next stage, the putrefactive, would commence, and then the acidity will diminish, and ultimately disappear. For this purpose, as soon as the vinegar has acquired the requisite degree of strength, as indicated by its taste, it is racked off its lees into other casks, in the same manner as in the case of ale or wine.

The vinegar in this state, however, though sufficiently strong, is yet thick and foul, and requires to be *clarified* before it is fit for use or for keeping. To render it clear and transparent, isinglass is dissolved in a small quantity of the vinegar, and the solution is put to that in the casks. After this the feculencies will subside, and, as soon as it is quite clear, it is again racked off, and is fit for sale. The usual calculation is that one barrel of malt will make thirty gallons of good house vinegar.

From the above account, it is evident that common vinegar is very impure and very dilute acetic acid, containing, besides the acid and water, a large quantity of mucilage, some colouring matter, a little spirit, and a little sulphuric acid added by the manufacturer, which is permitted by the excise. Its agreeable odour and taste are well known, and its colour varies from straw-yellow to deep brownish red.

3647. *The colour of vinegar* varies according to the materials from which it has been obtained; what is manufactured in England is usually artificially coloured by burned sugar.

3648. *Alegar* is made by fermenting strong ale upon the cuttings of the vine, unripe grapes, or cheap raisins, and proceeding as in common vinegar.

Subsect. 4.—*Vinegar from various Substances.*

3649. *As vinegar may be made from all substances capable of being fermented,* or which contain saccharine matter, the sources from which vinegar may be obtained are numerous. For this purpose, in domestic economy, various materials are occasionally employed, as sugar, either white or brown, raisins and sugar, currants, gooseberries, apples, or other fruit; and, if attention be given to the right principles, the process of making vinegar from all of these is by no means difficult.

3650. *To make Sugar Vinegar.*—Take four pounds of the cheapest loaf sugar, and add to it three gallons of boiling water in a tub; this is about the proportion that would make a strong wine. When the solution has cooled to blood heat, ferment it with two or three table-spoonfuls of yeast, in the same manner as beer is fermented. Continue the fermentation for a few days, until the vinous fermentation is completely at an end, which is known by the sweetness having disappeared. The yeast must then be skimmed off, and the liquor poured into a small cask, leaving the dregs at the bottom. The cask should not be above three parts full, and it should be set either in the sun or near the kitchen fire, with its bung-hole only covered with a loose tile or slate. The temperature in which it is kept should be as uniform as possible, about 80°; after a few weeks the liquor will be found sour; this sourness will increase, and in about eight months will be sufficient. A quantity of sediment will be deposited in the cask, and the vinegar must be drawn off by a gimlet hole, made a little way above the bottom. If it is not transparent, it may be fined by isinglass, after which it may be bottled: the bottles should be kept in a cool place. If, after some months, the vinegar appears turbid, it should be decanted, strained, and bottled again; and it may be necessary to repeat this more than once, for all common vinegar, home-made or purchased, is liable to this change.

3651. *Another method,* which is considered by some as superior, is the following: Dissolve sugar in hot water in the proportion of eighteen ounces of sugar to every gallon of hot water; when the solution has cooled down to 75°, add a sufficient quantity of yeast to cause it to ferment. In two or three days the fermentation will have pretty well advanced; then pour off the clear wash from the lees into a cask, and add an ounce of crude tartar, and one of bruised raisins, for every gallon of water. Expose the whole to the acetifying process for the usual time, as in the last method; then rack off the vinegar and fine it; bottle it.

3652. *Fruit vinegar* is made by fermenting the juice of various fruits; but as they must possess saccharine matter sufficient to bring on the vinous fermentation, some fruits which have too little sugar, as currants and gooseberries, must have some added to their juice. Some persons, from economy, make vinegar from the pulp and husks of grapes, gooseberries, raisins, or other fruits, after wine has been made from the juice. Add half its weight of coarse sugar to the pulp; when it begins to ferment, add a gallon of boiling water for every two pounds; stir it well, and let it steep for two days; then strain it; when cool, ferment it with yeast for a week or ten days, and then put it into a barrel, with a pint of vinegar and two ounces of loaf-sugar for every gallon. Lay a loose tile over the bung of the cask; set it in a warm place, and in three months it will be complete; then bung it.

3653. *Treacle vinegar* may be made in a similar manner.

3654. *Cider vinegar* is made by fermenting the juice of good apples, which require no sugar; or it is made from cider which has become too sour to drink, or any poor cider. A cask that has been previously used for holding vinegar is best to make it in. Some mix cider and honey for making vinegar.

3655. *Any sort of wine,* whether foreign or domestic, that has not turned out well, may be easily converted into vinegar, by infusing it in pounded gooseberries, currants, raisins, or the *marc* remaining after making home made wine of any kind; then straining it off, and exposing it to the air in the proper temperature.

3656. *Gooseberry Vinegar.*—Take gooseberries when full ripe; mash them in a tub or marble mortar, and to every quart of the mashed fruit add three quarts of water; stir this well, let it stand twenty-four hours, and strain it through a coarse bag. To every gallon of the strained liquor add four pounds of brown sugar, or four pounds and a half of honey; the latter is preferable. Put the mixture into a barrel, which it should fill about three fourths, and add to eight or nine gallons of it one pint of good ale yeast; cover the bung-hole of the cask with a slate, to exclude the dust, and place the barrel in the sun in summer, or a litttle away from the fire in winter. The mixture will soon begin to ferment. Continue the fermentation, by keeping the liquor at the same temperature, till the taste and odour indicate that the vinegar is complete. When the liquor has become perfectly clear, draw it off into bottles. It will keep much better if it be heated nearly to the boiling point, which is best accomplished by putting the bottles containing it in a sauce-pan of water, and causing the water to boil for about a quarter of an hour; when this has been done, remove the bottles, and when quite cold cork them. Earthen-ware bottles are much less liable to crack during this process than glass bottles.

3657. *The aromatic vinegar* of the apothecaries is a preparation possessing an agreeable pungent scent or fragrant odour, that renders it peculiarly grateful and refreshing in crowded rooms and the apartments of the sick; and it affords relief in headaches, fainting fits, &c.; but its anti-epidemic qualities are only imaginary. It is said to be prepared by taking rosemary tops dried, and sage leaves dried, of each four ounces; lavender flowers dried, two ounces; bruised cloves, two drachms; distilled vinegar, eight pounds; macerating these ingredients for seven days, and filtering the expressed liquor through paper. Some add camphor. What is met with in the shops, under the name of "salts of vinegar," is nothing but sulphate of potash put up in small vials, and impregnated with acetic acid, made aromatic with oil of rosemary or lavender.

SUBSECT. 5.—*Preservation and Purifying of Vinegar.*

3658. *The preservation of vinegar* is an object of consideration. In the way in which it is usually manufactured, it contains a considerable quantity of mucilaginous matters in addition to the acetic acid which has been formed; these are liable to farther change, and they pass at length into the putrid fermentation. If vinegar be long kept, and particularly if it be exposed to the air, it will become muddy and ropy, acquiring an unpleasant smell, losing its acidity, and putrefying. This last stage depends upon the same cause as the first, the presence of gluten, or some other substance that acts as a ferment.

3659. The methods of preserving vinegar are well described in one of Scheele's essays: "It is a fact generally known that vinegar, of whatever kind, will not keep long, but in the course of a few weeks, especially in the warm temperature of summer, grows turbid; its surface is then covered with a thick, mucilaginous substance, during which time the acid disappears by degrees, and at last is entirely lost; whence the vinegar must very often be thrown away. Now, in order to avoid this spoiling of the vinegar, five methods are known. The first is to prepare the vinegar very strong and sour at first, by using more sugar or other materials. It is well known that such vinegar will keep for several years; but as few people prepare their own vinegar, most persons contenting themselves with buying it at the shops, there are of course but few who can make use of this method. The second method is, to concentrate the vinegar by freezing; after which a hole is made in the crust of ice which covers it, through which the part that is not congealed is let out, and afterward put into bottles. This manipulation answers well enough; but nearly one half being lost, because that which forms the crust of ice is nothing, for the most part, but water, good economists dislike it. The third method is, to prevent the access of air, by filling the bottles full, and keeping them corked. Though vinegar is kept long by this method, it is not much employed, probably because it is troublesome to fill up the bottle with clear vinegar from another bottle every time you have made use of part of its contents. The fourth method is, to distil the vinegar, and thus leave behind the impurities. Distilled vinegar does not suffer the least change, though exposed to a warm air for years; but the expense of distilling is often thought too much."

3660. *The following method of purifying vinegar is the easiest, and answers sufficiently:* Put the vinegar into a well-tinned vessel, and make it boil for a minute over a strong fire, or the vinegar may be put into bottles, and then into a kettle of water upon the fire, and boiled; this will coagulate the glutinous and mucilaginous matter which all vinegar contains, and this may be separated by straining; after which the clear liquid should be kept in well-corked bottles. Vinegar prepared in this way keeps long without spoiling, and should be so treated when intended for pickling vegetables.

3661. *To render pickling vinegar colourless*, which is necessary for some kinds of pickles, stir together one gallon of the best pickling vinegar and six ounces of bone-black (animal charcoal), and let the mixture stand at rest for two or three days; then decant off the clear vinegar.

3662. *If a vinegar be required of an extraordinary degree of strength*, a greater quantity of saccharine matter may be used in the first or vinous fermentation; but this will require longer time to acetify, and there are some peculiar difficulties in the process where much sugar is employed, which require considerable scientific skill; and still there is a great chance of failure. Vinegar and water, also, cannot be separated from each other by common distillation. To concentrate vinegar, therefore, after it is made, or to obtain a very strong vinegar by an easy process, has been a desideratum. One method of strengthening it is to dissolve some sugar in it, which, by its decomposition, changes into vinegar; for, after some weeks, the taste of the sugar has disappeared, and the strength of the vinegar has increased. The sugar must be added by little at a time, and the warmth of the place should be kept up; one of the advantages of wood vinegar is the great strength of which it may be had. See "Wood Vinegar."

3663. *Vinegar may be freed from most of its impurities by distillation;* the acetic acid, which forms the basis of vinegar, is very volatile. When vinegar is distilled till about two thirds, or rather more, has passed over, nearly all the impurities are left behind as empyreumatic matter, remaining in the still; and the product of the distillation is acetic acid, almost quite pure, but diluted with water, which has come over with it. This is called *distilled vinegar.*

3664. *Distilled vinegar* is colourless, and of an odour somewhat different, but less agreeable than that of common vinegar. It may be preserved for any length of time without alteration in close vessels. When exposed to moderate heat, it evaporates completely, and without undergoing any change in its properties. By the action of severe cold, the watery part congeals, and separates from the pure acetic acid, which may thus be obtained in the highest state of concentration. Chemists have also other modes of preparing the pure acid, but these are of a nature rather complicated. Distilled vinegar is only employed for pharmaceutical purposes, and for perfumes; for it would be too expensive in domestic economy, neither would its flavour be agreeable as a condiment. It is sometimes improperly called acetic acid, for the latter contains no water.

3665. *Pure acetic acid is prepared from distilled vinegar.* It has an extremely pungent odour. Its taste is eminently acid, and it excoriates and blisters the skin when applied to it. It is so volatile, that it is converted into vapour at a very moderate temperature, without undergoing any change; and its vapour is inflammable, and burns with a white light.

It is pure acetic acid that gives sourness to every kind of vinegar, which consists of water, mucilage, and a certain quantity of this acid, greater or less, according to its degree of sourness; and it is this which is always generated by the acetous fermentation.

It exists ready formed in the juices of many plants, combined with potash and lime; but the quantity is never sufficient to render it available for domestic purposes. The strongest kind of common vinegar contains about five parts acetic acid in every hundred parts.

By its flavour, odour, and volatility it is easily distinguished from all other acids: when diluted with water, it is the same thing as distilled vinegar; its chemical constitution is, that it consists of oxygen, hydrogen, and carbon; the latter element in the proportion of 47 per cent., and the other two in the exact proportion necessary to form water; but we must not consider it as consisting of carbon and water, for oxygen and hydrogen compose water only when they are combined together in a certain proportion, *without any other element.*

Subsect. 6.—*Wood Vinegar.*

3666. It was formerly thought that acetic acid could only be prepared from liquors which had undergone the acetous fermentation; but it is now known that fermentation is not essential to its formation by art, since it can be procured by the destructive distillation of any vegetable matter, such as wood. But it must not be supposed that vinegar exists ready formed in wood, though we have stated this to be the case in small quantities in many sour plants.

3667. *The formation of wood vinegar depends upon principles which can be explained by chemistry,* and furnishes an interesting instance of its application; for it must appear extraordinary to those hitherto unacquainted with the fact, that an acid such as vinegar can be distilled from an insipid material like common wood. But the theory of it will be easily comprehended by those who have perused what we have said upon the component parts of vegetables, and the possibility of the conversion of one proximate principle into another. Vinegar, or acetic acid, consists of certain proportions of oxygen, hydrogen, and carbon: these elements are contained in wood; and it is obvious that if they could be detached from their combinations in the wood, and re-combined in that particular proportion requisite to constitute acetic acid, we should procure this liquid. Now this is effected simply by the application of a considerable heat to the wood confined in a closed vessel having a tube proceeding from it in the manner of a retort, or a distilling apparatus. In this, when placed in a furnace, the wood is decomposed into its elementary principles, which then recombine in another manner; one of the products of this new combination being acetic acid.

The process is extremely simple, and is employed to a very great extent. Nor is this, although but lately put in practice for making vinegar for common use, a new discovery; for it was known two centuries ago to Glauber, the chemist, whose name is attached to a well-known salt; and as this is a curious example of discoveries made and neglected, we may quote his account of wood vinegar in his work entitled "*Miraculum Mundi*:" "If the juice of wood be rectified, it may be used in the preparation of good medicines; in mechanic arts; in the making of many fair colours from the extraction of metals, minerals, and stones; and for all things for which common vinegar is used; yea, far more commodiously, because it much exceedeth common wine and beer vinegar in sharpness."

Apparatus of a great variety of form have been constructed by various manufacturers of wood vinegar for the purpose of producing it; but the principle of all is the same. The wood is put into a cylindrical iron retort laid horizontally, placed in brick-work, and with a fire beneath; from this vessel proceeds a tube, which terminates in a worm placed in a cistern of cold water; when the fire is lighted and the wood heats, the water which naturally existed in it first rises as steam; and, being condensed in the worm, falls into the receiving vessel, drop by drop. But when, by the continuance of the heat, the vessel becomes red-hot, the wood begins to be decomposed, and some of its oxygen and hydrogen unite together, and compose water, which likewise comes over. This water soon begins to taste acid, which demonstrates the commencement of the formation of vinegar by part of the carbon also separating, which, joined to the oxygen and hydrogen, compose that acid.

The acetic acid, however, does not in this manner come over quite pure; for it is mixed with a considerable quantity of a dark-coloured oil, or tar, which becomes thicker as the process goes on, and which is another product of the decomposition of the wood; this partly floats, and partly sinks in the liquor. Together with these, carburetted hydrogen, or imflammable gas, and some other gases, are generated abundantly. The acidity of the liquor continues to increase, but is somewhat disguised by the strong taste and odour of the tar, which gives it a reddish-brown colour. The whole of what then comes over, water, acetic acid, and tar, is called, in commerce, *rough* or *crude pyroligneous acid*, or the acid of wood, which received this name from its being supposed to be a peculiar acid; but chemists have since found that, when purified, it is actually acetic acid. The carbon that does not come over remains in the still in the state of charcoal, preserving the form of the wood first put in.

The wood employed must not be of the resinous kinds; but any refuse spray of other species will do: the densest wood is the best. In the late improvements in the process, the water of the wood is dissipated by heat in the forest where it is cut, before it is put into the retort, and other improvements are made in the apparatus, which it is not necessary for our purpose to specify. The crude pyroligneous acid is rectified by a second distillation, by which much viscid tarry matter is left in the still, and it is now a transparent brown vinegar, but having a strong, smoky flavour, from a slight admixture of empyreumatic oil.

3668. *A very pure vinegar* is obtained by saturating the rectified pyroligneous acid by quicklime, evaporating the acetate of lime thus formed to dryness, and destroying the empyreumatic matter by gentle torrefaction, which leaves the acetate of lime pure: the lime is now removed by adding sulphuric acid, which attracts the lime more strongly than the acetic acid, forming sulphate of lime; and in this manner this latter acid is procured similar to that which is prepared by the acetous fermentation already described. When well prepared, it has no peculiar taste nor smell; it contains no vegetable gluten nor mucilage, &c., and is therefore purer than the vinegar from malt, sugar, fruit, or wine.

It succeeds well as a pickling vinegar, because it may be concentrated to any degree of strength. At Beaufoy & Co's., Lambeth, there is a manufactory of wood vinegar on a large scale, where it is prepared quite colourless, and of such strength that, when diluted with seven times its weight of water, it makes the distilled vinegar at present employed by the apothecaries, and is used by some as the best pickling vinegar.

3669. *The pyroligneous acid* which comes over first, in its unpurified state, possesses the remarkable property of preventing the putrefaction of animal substances; it is well known that meat that has been smoked keeps better than that which was dried without smoke; and it is now ascertained that this effect depends upon the pyroligneous acid that rises with the smoke of the wood or turf which is employed in smoking it. This subject will be considered when treating on the "Preservation of Food."

3670. *A peculiar liquid called wood spirit*, or *pyroxylic spirit*, is procured in the second distillation of the pyroligneous acid, for the purpose of obtaining the pure vinegar from it. This wood spirit considerably resembles ether, but differs from it. Like ether, it dissolves Indian-rubber, and is used in making the water-proof cloth; it also dissolves resins, and, being cheaper than alcohol, is employed in the manufacture of water-proof hats. It is colourless, and highly inflammable, so as to be employed in lamps instead of spirit of wine. It was discovered by Mr. P. Taylor in 1812, and is manufactured by Messrs. Turnbull and Ramsey of Glasgow.

Subsect. 7.—*Adulteration of Vinegar.*

3671. *Vinegar, like most manufactured articles of food and drink, is frequently adulterated.* One of the most frequent sophistications is the addition of some cheaper acid, to increase the strength of the vinegar, as the sulphuric or nitric acids.

3672. *Sulphuric acid in vinegar may be detected* by the nitrate of barytes, or even by the acetate of lead, each of which will occasion a white precipitate if the vinegar contains this acid. To detect nitric acid, pour a little of the vinegar in a watch-glass, and add a few drops of muriatic acid; then put a small piece of gold leaf into the mixture, and if nitric acid be present, the gold leaf will be dissolved; the reason of which is that gold is only soluble in the nitro-muriatic acid; but, by the addition of muriatic to the nitric in the vinegar, the nitro-muriatic is produced. It must be observed, however, that the manufacturer is allowed by law to add to his vinegar one-thousandth part of sulphuric acid; but this prescribed quantity is often exceeded.

3673. *Vinegar is frequently made of too little strength, and, to conceal this, acrid substances* are added, as pimento, mustard-seed, and pellitory of Spain. To detect these, mix some of the suspected vinegar with carbonate of potash till the acid taste is totally destroyed, and then the burning taste of the acrid substances will be perceived, whereas pure vinegar leaves a sense of cold; or evaporate a little of the vinegar to be tried in a watch-glass or saucer, and likewise a little vinegar known to be pure; by touching with the tongue what remains, the hot substances will be discovered.

3674. *To ascertain the strength of vinegar*, find how much chalk or marble powder it will dissolve with moderate heat. As a guide, good wine vinegar will dissolve rather more than the twelfth part of its weight of carbonate of lime. It will dissolve less in proportion as it is weaker. By observing how much any good vinegar will dissolve, it is easy to compare any other sample with it.

3675. *Various substances are used to flavour vinegar, as condiments;* thus we have cucumber vinegar, capsicum vin., garlic vin., shallot vin., onion vin., caper vin., cress-seed vin., celery-seed vin., truffle vin., Seville orange-peel vin., ginger vin., black pepper vin., white pepper vin., Chillie vin., horse-radish vin., tarragon vin., basil vin., green mint vin., elder-flower vin., celery vin., Cherville vin., Burnet vin., orange-flower vin.; all these are made by steeping about an ounce of the several articles each in a pint of the best vinegar for fourteen days, and straining; it is then bottled. For the particular receipts for making them, see the article "Flavouring Ingredients," under the Section "Cookery." The wood vinegar, or crystal vinegar of the shops, is the best for receiving flavours, having scarcely any of its own.

CHAPTER VII.

ON THE PRODUCTION OF COLD, PARTICULARLY FOR COOLING LIQUIDS, AND THE CONSTRUCTION OF AN ICE-HOUSE.

3676. *The cooling of liquors in domestic economy has at all times been a practice* of general prevalence in warm countries, and during the heat of summer even in colder climates. When the temperature of the air is above 70°, cooled liquors become not merely a luxury, but are considered in some countries as an article of the first necessity. The langour which is induced by heat is, in a great measure, relieved by artificial cooling; and invalids, in many cases, receive great benefit from the use of cooled liquors.

3677. *The custom of preserving snow during the summer for this purpose* has prevailed among Oriental nations from the earliest ages. In the Book of Proverbs we read, "as the cold of snow in the time of harvest, so is a faithful messenger to those who send him; for he refreshes the soul of his masters:" and we learn, from various passages in the writings of ancient authors, that the Greeks and Romans were long familiar with this luxury. In the time of Seneca, snow collected from the mountains, and preserved in deep pits, had become an important article of merchandise in Rome, was sold in the shops, and even hawked about the streets.

The following passage from Mr. Lumisden's "Remarks on the Antiquities of Rome" describes the present method of managing this matter: "A little above Rocca di Pappa (on the ancient Mons Albanus) is a plain called Hannibal's Camp. It is here that the snow is collected annually for the use of Rome. On this dry plain they dig pits, without any buildings, about fifty feet deep, and twenty-five broad at top, in the form of a sugar-loaf or cone. The larger the pit, the snow, no doubt, will preserve the better. About three feet from the bottom they commonly fix a wooden grate, which serves for a drain if any of the snow should happen to melt, which otherwise would stagnate, and hasten the dissolution of the rest. The pit thus formed, and lined with straw and prunings of trees, is filled with snow, which is beat down as hard as possible, till it becomes a solid body. It is afterward covered with more prunings of trees, and a roof raised in form of a low cone, well thatched over with straw. A door is left at the side, covered likewise with straw, by which men enter and cut out the ice, for such it becomes, with a mattock. The quantity daily demanded is carried to Rome in the night-time in carts well covered with straw. It is found by experience that snow thus pressed down is not only colder, but preserves longer than cakes of ice taken from ponds or ditches."

3678. *The use of snow to cool liquors at the tables of the great* does not appear to have been common in any country, besides Italy and the neighbouring states, before the end of the sixteenth century. At that time there were no ice-cellars in France. But, towards the end of that century, under the reign of Henry III., this refinement was well known at the French court; and although, at first, it was considered as a mark of excessive and effeminate luxury, it soon became general in France, and towards the end of the seventeenth century dealers found the sale of snow and ice a profitable trade.

3679. *The method of improving the cooling power of snow by mixing with it various salts* is a modern invention. The Italians were the first by whom it was employed. About the year 1550, all the water as well as wine drunk by the wealthy in Rome was cooled by a mixture of snow and saltpetre, and afterward common salt was substituted for the latter. Lord Bacon, who died in 1626, was acquainted with the cooling properties of snow with saltpetre, or with common salt, so as to freeze water, but says that he had never tried the experiment. Soon after this time the French made the discovery in the art of cookery of congealing by cold a variety of agreeable juices, and of forming ice-creams and other luxuries of that class.

3680. *The most ancient method of using snow or ice* was by putting a small quantity of it into the liquor to be drunk; but afterward a more elegant method was employed by putting the beverage into a vessel of thin glass or metal, and surrounding this with the snow.

3681. *In the south of Italy and Sicily, at present, iced water is become an article of prime necessity,* and is sought for at all seasons, both in summer and winter, with an avidity which, to a native of a northern clime, appears, at first view, quite unaccountable. Snow for this purpose is preserved in several caverns in Etna, and is brought down from the mountain to be sold in the shops, which are often surrounded by a clamorous mob of purchasers, who express an eagerness to procure it that naturally excites the astonishment of an Englishman. Ice is now transported in ships from cold to tropical countries; and a cargo of it carried to India or South America is not uncommon.

3682. *Various methods have been employed for the production of artificial cold.* The methods at present in use may be reduced to three: 1, the application of some body naturally colder than that to be cooled; 2, by evaporation; 3, by the solution of certain saline substances. Sometimes two or more of these methods are combined to increase the effect.

3683. *For the first method, the use of ice and snow is the most generally practised;* and for this purpose they are preserved in ice-houses, or other proper places for cooling liquors in the summer, or during the whole year. A little ice, placed round a bottle of water or wine, in any convenient vessel (wood is the best material, as being the worst conductor), soon cools it to the desired degree; and, if the effect is to be increased, so as to freeze creams, fruit, &c., by breaking the ice into small pieces, or pounding it, and mixing common salt with it, the desired end will be accomplished. This method is employed by the confectioners. The principle upon which ice cools any liquor is, that it abstracts heat from every body surrounding it, till the temperature of the whole is equalized; and, of course, it melts itself in cooling other bodies, the heat which it takes from them being necessary to render it fluid; this heat becomes latent in the melted ice. See "Heat," Book II., Chap. I.

3684. *When ice is used to cool wine,* it will not be very effectual, if applied, as is sometimes the case, only to the bottom of the bottle; for the coldest part of the liquid, being already at the bottom, cannot ascend; nor can the upper part, which is the warmest, change places to be cooled; therefore no motion can happen in the wine, and the cooling will therefore be very imperfect. To cool the wine effectually, it is necessary to plunge the whole bottle in ice; but, before this is done, it is proper to decant it into a fresh bottle for the following reason: If there be any sediment in the wine that is of the same specific gravity, it will mix with it as if it had been shaken, from the up and down currents that always take place during the cooling.

3685. *When ice cannot be procured, well water forms a useful substitute to a certain degree.* A well of about forty or fifty feet in depth constantly preserves the mean temperature of the country, and, consequently, is colder than the summer heat of the place, hence, if a pail of water be drawn, and a bottle of wine or other liquor be immediately placed in it, it may be cooled considerably. In London, where the heat of summer may be above 65°, or even 70°, the temperature of well water will always be 50°; therefore, by this alone, liquors may be sometimes cooled 12° or 15°.

3686. *One of the most general and useful modes of cooling is by evaporation.* When any liquid is converted into vapour, a certain quantity of heat to be combined with it is necessary for this purpose, and the portion which rises in vapour abstracts caloric from the mass, which is, consequently, in proportion cooled. Any substance which is wetted with water, and kept in the air, will therefore be cooled by the evaporation of the water, and the more rapidly if it is held in the wind, because then the evaporation will be greater by the succession of particles of air, each carrying off so much heat. Take two thermometers, and wet the bulb of one, and not the other; hold them in the air, and the mercury in that only which is wetted will fall, through the cold produced, as the bulb dries. If a liquid be used that evaporates more quickly than water, as spirit of wine, and still more, ether, the cold produced will be more considerable.

Cooling by the wind is a method that can be employed only occasionally. If any part of the naked body, as the hand, be exposed to the wind, it will be cooled, because there is an evaporation from the surface. A practice among sailors for telling which way a very gentle breeze blows in the night is founded upon this fact. They wet a finger all over, and hold it above their head; the side that is most cooled is that which the wind blows upon, and, of course, points to the quarter from whence it comes. Should, however, the current of wind be warmer than the body it blows against, the latter will be heated, as is the case with the hot winds from sandy deserts.

3687. *As an example of the various degrees of cold occasioned by the evaporation of different substances,* we may cite the result of some experiments made by M. Cavallo, and described in the "Philosophical Transactions," 1781.

A small stream of several liquids was poured upon the bulb of a mercurial thermometer when the temperature of the atmosphere, and, consequently, of the thermometer, was at 64°. Water lowered the thermometer to 56°; spirit of wine to 48°; spirit of turpentine to 61°; olive, and other oils that do not evaporate, did not affect the thermometer; ether reduced the thermometer to 20° below the freezing point; and with a small bulb, it required only twenty drops of ether to produce this effect in ten minutes. If a small, thin glass tube be filled with water and wetted with ether, the water will be converted into ice in a minute or two, from the rapid evaporation of the ether.

The practice of cooling on this principle has been known from time immemorial. It is a common thing in the southern parts of Europe to wrap up a bottle of wine, water, or other liquor required to be cooled, in a wet cloth, and thus to suspend it in a shady place, either under a tree or in a passage, so as to expose it to the briskest current of air that can be obtained; by this means the liquor will be cooled several degrees; care must be taken to sprinkle more water upon the cloth which surrounds the bottle in proportion as the former evaporates. In India it is the general custom, in order to keep the wine cool, to clothe the bottles in wetted cloths fancifully ornamented with flowers, and to cause them to make the circuit of the table in this grotesque dress, instead of pouring the wine into decanters. Port, Claret, and Burgundy are characteristically attired in crimson with white flowers; while Sherry and Madeira appear in bridal costumes. It is upon this principle, namely, the cold produced by evaporation, that persons sustain much injury by sitting in wet clothes.

3688. *Vessels called Alcarrazas* are much employed in Spain for cooling water, and there is scarcely a house in that country where they are not in constant use. What distinguishes them from other kinds of earthen-ware is their porosity, which is so considerable, that being filled with water, the liquid oozes slowly through, and stands in minute drops, like dew, on the outside; this evaporates and produces cold, particularly when the air is warm, or when there is some wind. This loss of heat from the outside is supplied from the water within the vessel, and the continued evaporation produces more and more cold; and the agreeable coolness thus given to water in a warm climate is extremely grateful. These vessels appear to have been introduced into Spain by the Saracens, and their use has since been extended to all the Spanish colonies in America and India. Vessels of a similar kind have, however, been known from time immemorial in China, Hindostan, Persia, Arabia, Egypt, and Syria.

The most celebrated manufactory of this kind in Spain is at Anduxar, in Andalusia, the best earth for the purpose being found on the banks of the River Tamusoro. After being well tempered, it is mixed with a little salt, and the heat in baking is not so great as to render the salt insoluble in water; the salt being dissolved out, produces the necessary porosity in the vessels.

In the neighbourhood of the convents of Vittoria, near Malaga, the country people find a useful clay, of which they make the large red jars called *beccaras*, used for cooling water, though inferior to the alcarrazas. Without these contrivances the inhabitants of these sultry shores would be deprived of one of their most essential luxuries.

The dryness of the air in these climates, and particularly in Italy and Egypt, causes it to absorb moisture rapidly, and hence assists the refrigeration; but the same vessels, having been brought over to this country, have been found to cool the contained liquor only in a very trifling degree, owing to the state of the air in Britain, which is much less hot, and much less dry than in the above-mentioned places, therefore much less apt to promote evaporation. One of the Egyptian vessels was tried in London at a time when the temperature of the atmosphere was at a mean; and after about half an hour, when almost three quarters of the water had passed through it, and had dropped down, the remaining quantity was found barely 3° colder than the surrounding air.

3689. *Coolers of earthen-ware of a similar kind for wine or butter are manufactured in England*, and are at present to be found in many of the earthen-ware shops in London. They are made of a light-coloured, porous ware, and of elegant forms, with ornaments in bass-relief. Half an hour before they are to be used, they are put to soak in cold water, of which they will imbibe a considerable quantity. When wanted for use they are taken out of the water, and the decanter of wine placed in them. The evaporation from the surface of the cooler, of the water which has been imbibed, abstracts the heat from the air of the interior, and, consequently, from the wine. The cooling effect, however, not exceeding a few degrees, is seldom sufficient for wine. Some are made double, with a space between, for ice or ice-water. When these coolers want cleaning, a hard brush and a coarse cloth with sand only should be used; no soap should be employed.

3690. *The process of making ice in the East Indies* has been particularly described by Sir Robert Barker, Phil. Trans., vol. lxv. Natural ice is never seen in the warmest parts of that country. To procure ice by artificial means, they dig, on a large open plain, not far from Calcutta, three or four pits about thirty feet square, and two feet deep each; the bottoms of which they cover about eight inches or a foot thick with sugar-cane, or the stems of the large Indian corn dried. On this bed are placed, in rows, a number of small, shallow, unglazed, earthen pans, formed of a very porous earth, a quarter of an inch thick, and about an inch and a quarter deep; which, at the dusk of evening, they fill with soft water that had been boiled. In the morning, before sunrise, the ice-makers attend at the pits, and collect what was frozen in baskets, which they convey to the place of preservation. This is generally prepared on some high, dry situation, by sinking a pit fourteen or fifteen feet deep, lining it first with straw, and then with a coarse kind of blanketing. The ice is deposited in this pit, and beat down with rammers, till at length its own accumulated cold again freezes it, and forms one solid mass. The mouth of the pit is well secured from the exterior air with straw and blankets, and a thatched roof is thrown over the whole. The quantity of ice formed by the method above described depends on a light atmosphere, and clear, serene weather. Three hundred persons are employed in this operation in one place.

At first sight, this curious process may appear to be an effect of evaporation; but this is not the case; for it is remarkable that it is essential to its success, that the straw in which the vessels are placed should be dry; whereas, if evaporation were concerned in the congelation, wetting the straw would promote it. When the straw becomes wet by accident, it is obliged to be replaced by dry straw. The explanation of this process was involved in mystery till Mr. Wells published his celebrated observations on dew, which have afforded a solution of the phenomenon. The earth is continually losing heat by radiation, and it loses most on clear, starlight nights, when there are no clouds to intercept and send back the rays of heat. The straw, like all filamentous substances, is a good radiator of caloric, and it is in consequence of the heat that is thus given out by it into space on clear nights that the ice is formed. When the weather is windy and cloudy the effect does not take place.

3691. *The last method of cooling liquors that remains to be mentioned is obtained by the solution of salts.* It has been long known that certain substances generate a considerable degree of cold, particularly nitre, sal-ammoniac, Glauber's salt, muriate of lime, and several others. But most of these salts are so dear in Europe, that they are seldom made use of in this way, except in particular experiments, when it is wished to produce an intense degree of cold by a powerful freezing mixture.

In India, where nitre is very cheap, and the heat of the climate prompts the inhabitants eagerly to adopt every possibile method for counteracting it, the cooling of liquors for the table, by means of the solution of nitre in water, is very common. To effect this, the wine, water, or any other liquor, is put into a metallic bottle, generally a pewter one, having a pretty long neck. A tub is partly filled with water, and a quantity of nitre is thrown into it. Then the operator holds the bottle by the upper end of its long neck, and gently moves it about in the saline mixture while dissolving, which cools the liquor to a very considerable degree. As salts will produce cold only during their solution, when the first quantity has been thoroughly dissolved in the manner described, more nitre must be added; and when the water is completely saturated, so as not to be capable of dissolving more salt, the bottle, if to be cooled farther, must be removed to a tub with a fresh saline mixture. The nitre may be recovered again for the next day by exposing these solutions in shallow pans to the hot sun of that country.

3692. Sal-ammoniac would answer for this process; but a mixture of nitre and sal-ammoniac is the most effectual, by which a bottle of wine may even be cooled down to 32°. The best proportions are five parts nitre, five of sal-ammoniac, and sixteen of water. The solution by itself will lower in temperature several degrees below the freezing point; but when it has to abstract the heat from a vessel with wine put into it, it will not then become so cold.

3693. *In order to cool a bottle of wine in London* from the usual temperature, 50°, down to 32°, a pound of nitre, another of sal-ammoniac, and a proportionable quantity of water will be required; but to cool it to a considerable degree, half the quantity of salt will be sufficient; even this is too much for ordinary use, and mixtures of this kind in powder are sold in London for the purpose, by Mr. Fuller, of Jermyn-street, who likewise manufactures a useful freezing apparatus for making ice creams.

3694. *An intense degree of cold is produced by a mixture of snow and salt* in equal parts. The salt causes the snow to melt in consequence of the attraction which it has for water, even in the frozen state; and as they both unite, the snow is dissolved into water, and the water dissolves the salt, so that both become liquid. The cold thus generated is no less than 32° degrees below the freezing point, or down to zero of Fahrenheit's thermometer, and is a much more intense degree of cold than is required for the ordinary purposes of cooling liquids for beverage; but it may be useful to know how to increase the usual degrees of cold upon occasion. Pounded ice will do nearly as well as snow; any substance having a very strong attraction for water may be substituted for the salt.

3695. *If chloride of calcium (formerly called muriate of lime) be mixed with snow*, a still greater degree of cold will be produced; by this means 50° below the freezing point has been obtained, which is sufficient to render even mercury a solid mass; consequently, such a degree of cold can be measured only by a spirit thermometer, spirits of wine never freezing. The principle of this is the same as the last, the great attraction which chloride of calcium has for water.

3696. *No means have been discovered for depriving bodies of all their heat;* nor is it known what quantity they may still contain after these experiments. Intense degrees of cold like these act with the most destructive and rapid effect upon the living body; and to handle frozen mercury is described by those who have attempted it like touching red-hot iron; the skin would be destroyed, and the part become frost-bitten.

3697. *In using a freezing mixture* for ordinary purposes, it is sufficient to put it into a wooden vessel as a bad conductor, and then to place in that the vessel containing the liquid to be cooled. But when the most intense cold is wished for in an experiment, the vessel containing the mixture should be placed within another a little larger, being supported by corks, as in the wood-cut, *fig.* 566 (where the front of the outer vessel is supposed to be removed), and covered over with woollen cloth: the air in the space between the two vessels being a non-conductor, prevents the heat of the apartment from finding its way to the mixture, which, therefore, is obliged to rob the liquid to be cooled of its caloric.

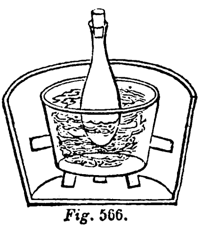


Fig. 566.

This mutual action of snow or ice and salt upon each other is well illustrated by the common practice of sprinkling salt upon a pavement that is coated with ice. The salt and ice soon dissolve and run off as liquid brine, or it may be swept off.

3698. *Mr. Walker of Oxford made a number of experiments in the production of cold* by various frigorific mixtures, and the results are published in the "Philosophical Transactions" for 1795 and 1801.

Mixtures of Salts without Snow.

Mixtures.	Parts by Weight.	Temp. falls from 50° to
Muriate of ammonia	5	10°
Nitre	5	
Water	16	
Muriate of ammonia	5	4°
Nitre	5	
Sulphate of soda	8	
Water	16	
Nitrate of ammonia	1	4°
Water	1	
Nitrate of ammonia	1	—7°
Carbonate of soda	1	
Water	1	
Sulphate of soda	3	—3°
Diluted nitrous acid	2	

Mixtures.	Parts by Weight.	Temp. falls from 50° to
Sulphate of soda	6	—10°
Muriate of ammonia	4	
Nitre	2	
Diluted nitrous acid	4	
Sulphate of soda	6	—14°
Nitrate of ammonia	5	
Diluted nitrous acid	4	
Phosphate of soda	9	—12°
Diluted nitrous acid	4	
Phosphate of soda	9	—21°
Nitrate of ammonia	6	
Diluted nitrous acid	4	
Sulphate of soda	8	0°
Muriatic acid	5	
Sulphate of soda	5	3°
Diluted sulphuric acid	4	

Mixtures of Salts with Snow.

Mixtures.	Parts by Weight.	Temp. falls to
Muriate of soda	1	—5°
Snow	2	
Muriate of soda	2	—12°
Muriate of ammonia	1	
Snow	5	
Muriate of soda	10	—18°
Muriate of ammonia	5	
Nitre	5	
Snow	24	
Muriate of soda	5	—25°
Nitrate of ammonia	5	
Snow	12	

Mixtures.	Parts by Weight.	Temp falls to
Diluted sulphuric acid	2	—23°
Snow	3	
Concentrated muriatic acid	5	—27°
Snow	8	
Concentrated nitrous acid	4	—30°
Snow	7	
Muriate of lime	5	—40°
Snow	4	
Crystallized muriate of lime	3	—50°
Snow	2	
Fused Potash	4	—51°
Snow	3	

The snow should be just fallen, dry, and uncompressed.

By first cooling the materials before they were mixed, through immersing them in other frigorific mixtures, Mr. Walker obtained a degree of cold 100° below zero, the greatest degree of cold ever produced.

3699. *A method invented by Professor Leslie of producing artificial cold, and freezing water,* depends upon the principle that water evaporates much more rapidly when the pressure of the atmosphere is withdrawn, as in the exhausted receiver of an air-pump. If some material be included in the receiver that absorbs vapour, the evaporation will proceed with still greater rapidity, and, consequently, a greater degree of refrigeration will take place. Sulphuric acid, which has a great absorbent power, is poured into a shallow dish to the depth of half an inch, in which is placed a small vessel with water that has lost its air by boiling; the whole is then placed under the receiver, and most of the air extracted. By the rarefaction of the air, the water evaporates very quickly, and its vapour is absorbed as it forms by the acid, so that in a few minutes the remaining water is frozen into a solid mass. The loss of water seldom amounts to a fifteenth part, nor is it till after repeated use that the sulphuric acid becomes so weak as not to effect the absorption. The acid can thus effect the congelation of more than twenty times its weight of water.

Mr. Leslie varied this process by substituting pounded trap-rock, well dried before the fire, instead of the sulphuric acid. This powder, by the same property of absorbing aqueous vapour, was able to freeze the sixth part of its weight of water. He also found that parched oatmeal was a convenient and powerful absorbent; and by means of the air-pump with a body of oatmeal of a foot in diameter, and rather more than an inch deep, he froze a pound and a quarter of water contained in a hemispherical porous cup. The oatmeal, which is less hazardous than acid to those little used to experimenting, is easily dried and restored again to the same action. It would appear from this experiment that, with an air-pump, it would be easy to procure ice in a hot climate, or at sea.

3700. This method of keeping the air in a vessel constantly dry by an absorbent substance is not only useful in producing cold, but also in drying many articles; and it has lately been in much use for the latter purpose.

3701. *The principle of preserving ice itself* depends upon surrounding it with what are termed *non-conducting* substances, or substances which heat cannot pass through, for an account of which we refer the reader to Book II., Chap. I., "On Heat." This is necessary in order to defend it from the common air of a temperature above the freezing point, and from moisture of water, which must necessarily be warmer than 32°.

If ice could be kept always from the contact of other bodies of higher temperature than itself, or be surrounded by substances which heat could not pass through to reach it, it must always remain in the same state. But we know of no substances that are *absolute* non-conductors, and certain bodies receive that name only because heat passes them with very great difficulty. The substances of this kind are chiefly air, water, and materials of loose and porous texture, as wool, straw, charcoal, cork, wood, &c. Metals and hard stones allow heat to penetrate them with most facility, and consequently they are conductors of heat.

3702. *The method of transporting ice and snow to a distance is very simple;* it is only necessary to enclose them in some substances that are good non-conductors, as chaff, straw, woollen, &c.; and if the package be put into a box an inch or two larger, and wedged in with pieces of cork, this would be a still farther security, when the quantity is small. It is in this manner that the Neapolitan peasants carry snow from the repositories on Vesuvius to Naples during the heat of summer.

3703. *Ice preservers* are chests of stout deal lined within with cork, as being a bad conductor of heat; into these a quantity of ice is put, to prevent going frequently to the ice-house. Ice may be kept in them for three weeks in summer. If cork cannot be got easily, the sides of the ice preserver may be made double, with a space of two or three inches between, which space should be filled with charcoal reduced to powder, than which no better non-conductor is known.

3704. *Ice pails* are likewise kept for icing creams, cooling wines, butter, &c.

3705. *Ice may be kept in the open air for a year* by making a pile of it on dry ground (the north side of a hill is the best place), in a steep, conical form, of considerable size in winter, during a hard frost, and covering it over, first, a foot thick with a layer of fagot wood, then with another layer of straw, and, lastly, thatch. This should be placed on an elevated mound, or platform raised on purpose, that the water may drain off from it. If shaded by trees, or a shed roof, so much the better. If the pile be sprinkled occasionally with water while it is building, in frosty weather, the water will, by freezing, cement the masses of ice together, and make them last longer. The steeper the conical pile is made, the better.

3706. *Ice may also be preserved in cellars*, which should have no windows, and be provided with double doors. The floor and sides of the cellar should be lined with straw; or a better method would be to form a framing of bars of wood for the floor and sides, insulated, and covered with straw.

ICE-HOUSE.

3707. It has long been the custom here to connect the subject of an ice-house with that of the dairy; and where the former is entirely detached, and at some distance from the house, the two may very properly be associated. The most useful mode of constructing an ice-house is the following:

A well is sunk in the ground in the form of an inverted cone, *a b* (*fig.* 567), which is lined with brick-work of a brick and a half thick, and arched over. Into this the ice is put, through an opening *g*, left in the top of the arch. A door is made on one side, *c*, for taking out the ice, or putting things in, and a drain, *d e*, is constructed from the bottom to carry off the water which is formed by the melting of the ice in summer. The advantage of the conical form of the well is supposed to be, that as fast as the ice thaws the remainder slides down the sides of the cone, and still keeps in a compact body. Another advantage is, that the circular form of the cone is stronger than a square or any other shape, thus resisting better the pressure of the earth.

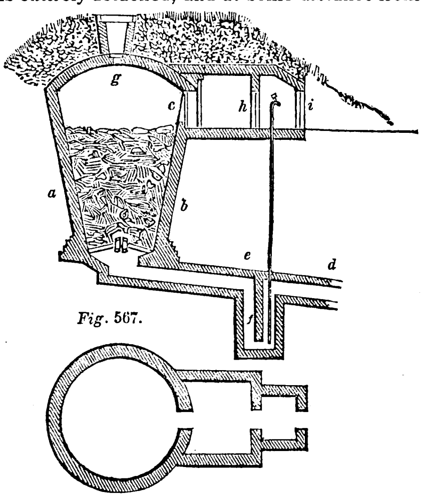


Fig. 567.

Some recommend to have the brick lining double, with an empty space between, to form a more complete non-conductor of heat; but this additional expense is unnecessary under ground. The draining is essential, some ice-houses failing through want of attention to it.

The walls of the cone should be built with Roman cement, or, at least, with very good mortar that will set hard. To support the ice at bottom, it should be placed on a strong wooden grating, or, what is found to answer very well, an old cart-wheel, as represented in the wood-cut, being very strong from its form: this permits the water produced by the partial thawing of the ice to pass off into the drain, *c d*; the latter should have a trap, *e*, to prevent the external air from communicating with that of the ice-house. Should the situation of the ground not admit of a drain being carried out from the bottom of the ice-well, it may terminate in a small well, *f*, sunk deeper to receive the water; and as this water will always be ice-cold, it may be raised up, when wanted for cooling wine, butter, &c., by a small pump placed in the porch of the ice-house.

The door for taking out the ice, *c*, should be double, with straw stuffed between both; and the same precaution should be used with the aperture, *g*, for putting in the ice. There should be a long passage leading to the door, *c*, having in it two more doors, *h* and *i*. In the space between *h* and *c* there may be an ice-cold room; and the space between *h* and *i* is to admit of the door *i* being shut before the door *h* of the cold room is opened, to hinder the access of the external air. The top of the ice-house may be finished in various ways. It may be covered over with tough clay, and then with earth, and planted with shrubs as a mound ; or it may appear as a low building covered with plenty of thatch. The closer the ice is packed the better.

3708. *An ice-house may be formed above ground* by building the walls and arched roof double, a foot apart, the better to keep out the heat ; and the whole may be thatched, or covered over with giant ivy, or some other creeping plants. The ice should be laid hollow, with a drain from it, and all the precautions above mentioned taken. When ice cannot be had, snow packed and beaten down well may serve as a substitute.

3709. *A succedaneum for an ice-house* may be made as follows: Take an iron-bound butt or puncheon, and knock out the head ; then cut a small hole in the bottom about the size of a wine-cock ; place inside of it a wooden tub having a similar hole, resting it upon three pieces of wood, which are to keep it from touching the bottom ; fill the space round the inner tub with pounded charcoal, and fit to the tub a cover having a convenient handle ; place on the lid a circular flat bag of pounded charcoal about three inches thick, that will cover it entirely, and over all put another wooden cover. When this apparatus is prepared, bury it for four fifths of its height in the earth of a cold cellar that is dry, keeping it a few inches from the earth at the bottom by means of pieces of bricks. Fill the inner tub nearly with ice or snow beaten hard down, leaving room to place any vessel holding the substances to be iced. When the cover is taken off to place these in, care must be taken that it is replaced when the icing is finished ; the congelation will, in general, be effected in half an hour.

3710. *In London, ice is sometimes supplied to the confectioners* almost daily in the summer from ice-cellars kept by persons who make this a business, and carry the ice round to the shops in carts. The ice is then put into a large tub in the cellar. The ice-creams are made there in pewter vessels about a foot in depth and three inches in diameter; these are brought up into the shop, and placed in a wooden reservoir full of ice, with a cover, to supply customers.

3711. *Ice-cold rooms* would be found useful additions to the domestic offices of a mansion. They might be connected with the ice-house, which should be considered as the focus of cold, and should always have double doors, double windows, and the walls should be built hollow for the purpose of preserving an even temperature. A small inner room might have a well to contain ice; thus several degrees of cold might be obtained by different apartments. The usual idea of an ice-house in England is, that it must be a detached building at a little distance from the house ; but, though this situation has some advantages, yet it is not absolutely necessary ; and it might often be more convenient to connect it with the pantries, or to place it in a cellar to which access might easily be had.

3712. *There are some curious facts respecting the freezing of water*, which, although not essential to our subject, it may be interesting to notice. This process begins by numerous minute spiculæ appearing and shooting across the surface of the water, and always making angles with each other of 60° and 180° ; as these accumulate, the ice becomes more solid ; but its specific gravity is always one ninth less than that of water, in consequence of which it floats. Water, in cooling, becomes more dense, not at the freezing point, 32°, as might be expected, but before it arrives at that point, as at about 39° ; and in cooling still farther down to 32°, it actually expands, so as to be at the same degree of density as it was at 35°, expanding equally by cooling or heating below or above 38°. If water be exposed to cold and agitation, it cannot be cooled below 32° without freezing ; but if the water be kept quite still in a large vessel, it may be cooled down to 25°, considerably below the freezing point, without becoming ice ; if, however, any tremulous motion takes place, it instantly freezes, and the temperature then suddenly rises to 32°. If water be confined in the bulb of a thermometer, it is very difficult to freeze it by any cold mixture above 15° ; but, if the cold be below that, it cannot be prevented from freezing. When cooled down to 15°, the water in the bulb remains perfectly transparent ; but, if it accidentally freezes, the congelation is instantaneous, the bulb becoming in a moment opaque and white like snow, and the ice is projected up into the stem. The freezing of water is an actual crystallization, and these facts depend upon the laws which regulate that natural process.

The expansion of ice in forming is a phenomenon of great importance, and is attributed to the mode of the crystallization, and not to the ice enclosing air ; for water parts with its air on becoming ice, and on this account it is that water freezes sooner for having been boiled. Boiled water affords the most compact and beautiful ice.

3713. *Water which has just been produced from melted snow or ice* is very nearly as cold as the ice itself before it began to thaw ; for although it may be easily supposed that it must have imbibed much heat in order to thaw, yet, by a singular fact in the economy of nature, this quantity of heat is not rendered sensible to the thermometer—a fact not only extremely curious, but very important to be understood. It is well known that ice may be much colder than the freezing point, but that, when its temperature rises to 32°, it begins to melt ; it melts very slowly, and is imbibing heat the whole time ; and yet, if the thermometer be put in among the thawing ice or snow, it will still indicate only 32°, nor will any difference be perceived until a short time after the whole has been thawed ; so long as any ice remains unthawed, no addition of heat will be perceived ; what, then, has become of all the heat that has undoubtedly been absorbed by the ice ? that heat has entered the ice, but only for the purpose of converting it into water ; and it remains in the water in what is called a *latent* state, so intimately combined with it that it cannot be separated, and is, in fact, essential to keep the water in its fluid condition ; if the water be deprived of this heat it freezes ; but, though the heat is given out again while the water is freezing, it is immediately carried off by the atmosphere and diffused, so as not to be felt. It is this gradual absorption of so much heat by melting ice that makes a thaw often colder than a frost.

3714. *Cold has been imagined to be something positive, like heat*, and that there are rays of cold like those of heat ; but this is an error. Cold is, in fact, nothing more than a very low degree of heat or temperature.

CHAPTER VIII.

ON THE VARIOUS SPIRITUOUS LIQUORS.

3715. The term *spirit* was formerly applied by chemists to all volatile substances collected by distillation. Three principal kinds were distinguished : inflammable or ardent spirits, acid spirits, and alkaline spirits; at present the name of spirit is almost exclusively confined to the first.

3716. The formation of ardent spirits (*fortunately*, we were about to say) cannot be considered as a necessary part of domestic economy, in its ordinary state in this country; and, therefore, perhaps the following account of it would not have found a place here, but from the obvious utility of understanding clearly the nature of all articles of domestic consumption, which it is impossible to do without referring to their mode of manufacture, and to the principles upon which their production depends. By this alone, likewise, we can be enabled to judge of the goodness or the bad qualities of the several articles.

Sect. I.—History of Ardent Spirits.

3717. Although the ancient nations were sufficiently acquainted with the art of preparing fermented liquors of various kinds, which necessarily contain alcohol or ardent spirit, and though they used many methods for rendering their wine more potent, yet they did not possess the means of procuring from it, in a separate form, the pure alcohol in which the intoxicating property resides.

Neither Pliny, who left a treatise on wine, nor any others of the ancient Greek and Roman authors who have written so much in praise of the fermented juice of the grape, make the least mention of its *spirit*, which certainly would not have escaped notice had it been known in their time. Galen, a century after Pliny, speaks of the aroma or essential oil obtained from fruits and flowers, but is silent on the distillation of ardent spirit. The discovery of the art of distillation, which may well be said to form an era in the history of mankind, appears to have been made by the Arabian alchemists of the twelfth century, in their search after the elixir of life. The art of extracting a spirituous liquor from wine was long kept a secret, and was in the sole possession of the physicians, who employed it only as a medicine, ascribing to it the most extraordinary properties, and among others that of prolonging life; hence the name of *aqua vitæ*. Brandy, or the spirit distilled from wine, was first produced, according to Le Grand, by Arnold de Villeneuve in Languedoc, as early as 1313, and it was then made into a liquor with aromatic spices. The art of distilling a cheaper spirit from malt was afterward discovered, and seems to have been better understood and more extensively practised in Ireland, at an earlier period than in England, where ale and mead were the favourite beverages; but the Irish "usquebach" appears also, at first, to have been a sort of liquor with aromatics. Whiskey is a corruption of *usque*, and in 1560 was made in the High lands of Scotland as well as in Ireland.

Sect. II.—General Principles of the Production of Ardent Spirits.

3718. *All kinds of spirituous liquors or ardent spirits*, whether brandy, rum, malt spirits, &c., owe their hot, fiery taste, their inflammability, and their intoxicating qualities to their containing more or less of the liquid called by chemists *alcohol*, a word of Arabian origin, which is spirit in its purest state, entirely free from water and other substances.

3719. It has been already shown, when treating on "Fermentation," Book VIII., Chapter II., that alcohol cannot be produced but by means of the process called *vinous fermentation*, or, as it might be named, the *spirituous fermentation;* and that it never exists ready formed by nature. When we hear, therefore, persons say, as they sometimes do, that there is a *spirit* in sugar, in carrots, or any other vegetable substance, we are to understand that such expression is not strictly correct; and that these substances only contain the materials from which spirit may be generated. The difference between brandy, rum, wine, ale, table-beer, and other liquors of this class, is merely that they contain different proportions of pure spirit, upon which their *strength*, that is, their intoxicating power, depends; and, likewise, that they have various proportions of water, mucilage, essential oils, and other flavouring matters, to which they owe their several peculiarities. The pure spirit which all these fermented liquors contain, and which may be extracted from them, is exactly of the same nature in each, though extremely different in quantity. This spirit, in the purest state in which *it is usually prepared*, is called *spirit of wine*, because it was originally procured from wine only; but it is now made from other liquors. This, however, is not the purest state of spirit, but contains a quantity of water.

We likewise stated that no substance can undergo the vinous or spirituous fermentation except it contain sugar or starch, which is capable of being converted into sugar; and that every vegetable containing either of these principles can afford a fermented liquor of some kind, that is, a liquor containing alcohol or spirit. If any fermented liquor is thus produced, no matter how weak, it will yield some spirit, more or less, by the process of distillation to be afterward described. It must, therefore, be kept in mind that, to produce spirit, the natural process of the vinous fermentation must be first resorted to; and, in order to separate the spirit so produced from the water and other matters with which it was mixed during the fermentation, the artificial process of distillation must be employed; in this, when the fermented liquor is put into the still, and heat is applied, the spirit rises, and is carried into the receiver, leaving the remaining portion behind. See "Distillation," Sect. III.

3720. *The vegetable substances most usually fermented for the production of ardent spirits* are, the various grains for malt spirit, the juice of the sugar-cane for rum, the juice of the grape for brandy, and potatoes, carrots, or other sweet vegetables for various spirits named after them. In other countries, the juice of the palm is employed, also rice for arrack, the juice of cocoanuts, and of the sugar maple: even milk fermented affords a spirit to the Tartars.

Sect. III.—distillation.

3721. *Distillation is the application of heat to a fluid* so as to make it boil or be converted into the vaporous state, and afterward condensing this vapour into a fluid again by means of cold. A familiar instance of this effect may be observed in a common tea-kettle; when it boils, steam, or the vapour of the water, is seen coming out of the spout; and if any cold body, as a plate, be held against this steam, it will be condensed upon it into drops of water. In the same manner, the steam may be conveyed to any distance by means of a tube, and may be condensed, where it is required, by the application of a cold body to the outside of the tube.

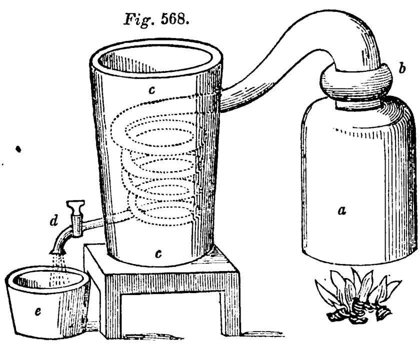
By means of this process of distillation, the most volatile of the component parts of a liquid may be separated from those which are more fixed by applying a degree of heat sufficient to convert them into vapour, and afterward condensing them, while the rest of the substance subjected to distillation remains behind.

3722. *Distillation is a process not solely employed in the formation of ardent spirit*, but is applied to many other purposes, as the obtaining the essential oils of vegetables, and even pure water.

All liquids boil, or become converted into vapour at a certain temperature; but various liquids require very different degrees of heat to make them boil; thus, water boils at 212°; alcohol at 176°; linseed oil at 600°; and mercury at 662°. From this it is evident that, if water and alcohol be mixed together, and put into a vessel over the fire, when the latter boils, the former will not be near the boiling point. The spirit, therefore, will rise in vapour at 176°, leaving the water behind; and thus these two substances may be separated from each other. But if no contrivance were used, the vapour or steam of the spirit would escape into the atmosphere and be lost; the method of condensing and collecting in a liquid form the vapour so raised is, therefore, an essential part of the art of distillation, and is effected by a particular construction of the distilling vessels.

3723. *The apparatus that has been most usually employed here for distilling is the still*, and although there are many improvements in this apparatus, it will be sufficient at present to describe the simplest: *a*, *fig.* 568, is a copper vessel called the still, into which the materials to be distilled are put; suppose water and spirit. The still is generally set or built up in brick-work, and a fire is made beneath it, as in the case of a washing copper; *b* is the head of the still, which takes off. When the heat is applied, *the spirit* will boil at 176°, as has been stated, and will consequently rise in vapour; and if the head of the still were off, this vapour would escape; but when the head is on, it is forced to pass through the bent tube, *c*, *c*, called the *worm:* now during this passage through so long a distance, it would be somewhat cooled, and partly condensed into a liquid, which would drop out at *d;* but, that this condensation may go on more rapidly, and none of the vapour escape uncondensed, the worm is made to wind in a spiral form many times round in a vessel kept full of cold water, called the refrigeratory, by which the condensation is more complete, and all the spirit raised in vapour by the boiler is obtained in the receiver, *e*, in a pure state, the water alone remaining behind in the still.

Fig. 568.



Sect. IV.—various kinds of ardent spirits.

Subsect. 1.—*Brandy.*

3724. *Brandy is produced by the distillation of wine only*, and not from any other fermented liquor; any spirits made from other liquors than wine *are improperly termed brandy.* But brandy consists not merely of the spirit drawn from wine; it contains also some water, and is flavoured by the essential oil of the grape, which has been dissolved by the alcohol produced during fermentation. As this essential oil, which rises with the spirit during the process of distilling it, is of a more agreeable flavour than that of malt or of molasses, genuine brandy, possessing this advantage, is very generally esteemed above every other distilled spirit.

3725. *Brandy is prepared in all the wine countries of Europe*, but particularly in France, where, however, the localities of the best French brandy are extremely limited. The grapes most proper for wines are not the fittest for brandy. All wines will yield a portion of this spirit; but the strong, heavy wines are in general preferred, on account of the quantity they give: in general, however, brandy is never distilled from wines that will fetch a good price, since the profits from the sale of these as wine are much higher than when reduced to the state of brandy. The weak wines often afford brandy of a fine flavour; those of Cognac and Andaye, from which some of the finest brandy is made, are the least drunk in France. The brandy of Cognac is not less than 60 per cent. better than that of Bordeaux, though the wines of the latter place are so much superior.

The brandies imported into this country are chiefly from Bordeaux, Rochelle, and Cognac; but they are inferior to those made in the neighbourhood of Nantes and Poictou, from whence private families in Paris, who are very choice in having the very best quality of the spirit, supply themselves.

The brandies of Spain, Portugal, and other wine countries of Europe are much inferior to those of France; but those of Spain are next in excellence.

3726. *Brandy varies in quality*, not only according to the mode of manufacturing it, but also from the difference that exists in the grapes, together with the soil and climate; and the variations would be still more considerable if every kind of wine was used for distillation.

The large proportion of small wines with which they are overrun in France accounts for their making such quantities of brandy more than in any other country; where the climate is warm, the grapes become sweet, and are often converted into raisins.

3727. *The general mode of preparing brandy is extremely simple*, being nothing more than a well-regulated distillation of wine in suitable vessels. At the commencement of the vintage, they collect all the grapes that are not fit for good wine, ferment their juices, and distil them for brandy; they also use for this purpose all wines that have failed in the making, although, if they have become at all acid, their brandy is tainted.

3728. *The art of distillation is far better understood in France* than in any other part of the Continent, and hence one cause of the great superiority of the brandies of that country. There is a great difference, however, in the flavour even of French brandies, according to the wine that has been made use of, and this is easily discriminated by good judges. Much also depends upon the care employed in the distillation, which originally was performed by means of large alembics, but of late several newly-invented apparatus have superseded these.

3729. *The process for making brandy in France* is as follows:

The still is filled three parts with wine, and very great attention is given to the management of the fire, that the liquid may remain at a uniform temperature. A small quantity of the product at the beginning of the distillation is weak, and not well flavoured; it is returned, therefore, into the still; what rises next is the richest and strongest product, and has the highest flavour of the essential oil of the wine it is prepared from; this is called *eau de vie première*, or brandy of the first quality.

As the process of distillation continues, the brandy becomes weaker and less flavoured; the last portions being set aside by the manufacturer, and re-distilled with fresh wine. The strength is tried by various methods: by the hydrometer, by observing the head, or by putting a small quantity on the head of the hot still to see if it will take fire. Another test of strength is by a drop of oil; when this sinks, if suffered to fall into the spirit, the latter is considered strong enough; this mode of testing is called *preuve de huile*, and indicates the strongest brandy that is drunk. When all the brandy of this strength has come over, they put it aside, and this operation they style *couper à la serpente*, which means to "stop the worm from running." The purest and most volatile essential oil rising with the first product, what comes afterward is not so agreeable, and of course the brandy, being both weaker and not of so fine a flavour, is considered as of an inferior kind, and is called *eau de vie second*, which is sometimes purified by a second distillation, but sold at a lower price.

It is said that the Cognac sent to England scarcely ever has the fine bouquet of the first distillation, because in this country the flavour and colour given by burned sugar is generally preferred. Hence, for exportation, the French re-distil the second brandy to make it stronger, and then flavour it for the English market. It is said that the flavour of the wine is so distinct in the best brandy, that persons in France accustomed to it can tell from the taste what wine it has been made from; and the manufacturers can at pleasure increase or diminish the quantity of aroma by a more rapid or slower distillation.

In distilling from very weak and poor wines, it is not customary to put aside "eau de vie première" in the first distillation, but to carry on the process till all the spirit is obtained, called *petite eau de vie*, and then to strengthen it by a second distillation. This the manufacturer who wishes to export finds it most profitable to do, in order to save the expense of the casks and carriage of a weaker brandy. For exportation they bring all to the strength of *trois-six*, which is in proportion to water as eight hundred and forty to a thousand. Brandy beyond "preuve de huile" is called *eau de vie double*; but it is seldom made above what they reckon twenty-two degrees of strength, because all above that pay nearly double duty. The best Cognac is twenty-one degrees and three quarters.

3730. *An inferior kind of brandy*, called *eau de vie de marc*, is also made from the *marc* of grapes, or the residue after the juice has been pressed out for making wine vinegar, which still retains enough of the grape juice to be readily brought into fermentation when properly arranged, and therefore is capable of yielding afterward a spirit by distillation; but the grape stones, and the resinous colouring matter of the fruit, together with the lees of wine and the scrapings of the casks, all put into the still, communicate a flavour which some consider bitterish and austere; others call it nutty, and relish it. But this inferior kind of brandy is twenty-five or thirty per cent. cheaper than the best, and is drunk only by the lower classes in France; this is sometimes preferred in England and in the north of Europe, where the burned flavour of sugar added to it, though actually a blemish, is by some considered as an indispensable quality.

The best Cognac brandy is distilled with a very gentle heat, not sufficient to raise too much of the essential oil of the wine; the palest white wines are chiefly used. Common French brandy, *eau de vie ordinaire*, is made from high-coloured white wine, or pale red wine: white wines give a softer brandy than red. Brandy made in France is often sophisticated by the manufacturers, who either put rectified malt or other spirit to the wine before distillation, by which the union is more complete than if added afterward.

A kind of brandy is also prepared in France by distilling a spirit from other materials; and after getting rid of the peculiar aroma, they add a portion of the best French brandy. Various sorts of agricultural produce are thus employed, as garden and orchard fruits, honey, molasses, corn, potatoes, beet root, or any other substances containing sugar. This in England is prevented by the excise.

3731. *The best French brandy* is naturally free from colour; it is clear and transparent as water, and in France it is often preserved so for use by being put into glass or stone bottles.

The general opinion in England, that a brownish yellow colour belongs essentially to brandy, is erroneous, and requires explanation. It had been remarked that all the fine foreign brandies that had an agreeable mellowness had also a yellow colour. The colour in this case had really nothing to do with their flavour; but the same age that was necessary to give them mellowness gave also a colour to the spirit, extracted from the wood of the casks in which it had been kept; hence the excellence of brandies was supposed to be connected with this tint. From this circumstance, great pains have been taken to colour brandies artificially to give them this appearance, which was thought to indicate age, until the English public has become so accustomed to it, that it is generally thought to be essential to the spirit. Various substances are accordingly used by French and English dealers for colouring brandies; as burned sugar, treacle, oak chips, logwood, saffron, and terra japonica. The first three are most employed. These methods may, however, be all considered properly as sophistications, though not deleterious.

3732. *Newly-distilled brandy* appears to contain a small quantity of uncombined acid. Chaptal observes that the thin or ill-fermented wines contain much *malic acid;* and that these, when distilled, yield a spirit which is of a bad quality, some of the acid having passed over in distillation at the same time; and such spirit has often an empyreumatic flavour. The richest and best brandies are freest from this acid, which disappears by age from combining intimately with the alcohol; hence the mellowness of old brandy. The union of the vegetable acids with the spirit in this natural way is so strong, that the compound bears the addition of water in any quantity, without causing a separation of the two constituents: genuine brandy, in which the fiery nature of the pure alcohol is softened through age by the combination of acid and the essential oil of wine with other matters, is considered to be less injurious to the animal fibre, and less hurtful to the constitution, than pure malt spirit. The malic acid in the brandy, in fact, forms with the alcohol a species of *malic ether.*

3733. *Spirit of wine was originally made by distilling it from brandy*, and continues still to be prepared in this manner in France, though with us it is procured from malt spirit.

3734. *It is important to be generally known*, that what is here called *British brandy is not, in fact, brandy*, this being the name for the spirit distilled from wine, as we have already stated. The *so-called* British brandy is said to be made chiefly from malt spirit, with the addition of mineral acids and various flavouring ingredients, the exact composition being kept secret. *It is merely an imitation of brandy, however nearly it may resemble it, and ought not to be called brandy*, if names are to be used for the purpose of distinguishing different substances.

3735. *Dr. Kitchener recommends travellers to carry with them*, in order to mix with water, as a beverage much safer than many others they may meet with, some brandy of the full strength, which will cost a little more than that commonly sold, which is usually ten per cent. below proof, and which, he observes, "crafty dealers put off as a fine, old, and mild spirit, though really only brandy and water, and attribute to age what they effect by aqueous adulteration; and so obtain, not only the profit arising from selling water at the price of brandy, but an extra sum for so doing, as a pretended remuneration for the immense loss of interest occasioned by having kept it till it is so exceedingly old and mild!"

3736. *A mixture of cider and rectified spirit* has been used for imitating French brandy, with the addition of wine lees. The cider and the spirit here will form *malic ether;* and such a mixture, if nothing else, or at least nothing of a deleterious kind, were added, would be less objectionable than some others, not being unwholesome; this has been recommended to be employed, where the price of French brandy is objectionable, in making certain liqueurs.

3737. *With respect to what are sometimes named brandy from potatoes*, and brandy from fruit of various kinds, it is scarcely necessary to mention, after what we have said, that such names are improper, since there can be *but one brandy*, and that is from the grape. What is distilled from other vegetables may be a strong spirit, but it cannot be brandy. It is true, as we have said, that the pure alcohol or spirit is the same, from whatever substance it is procured; but the spirits we have mentioned have not the flavour of true brandy, and differ from it in other respects. A close imitation can be effected only by the addition of other materials kept secret by the manufacturers, and therefore not to be trusted.

Among other adulterations of brandy, hot and pungent substances, such as pepper, ginger, capsicum, &c., are added for the purpose of making the brandy have the appearance of strength; they may be detected by evaporating a little of the suspected brandy nearly to dryness, when the acrid and burning taste will be sensibly increased, if such substances have been used.

Subsect. 2.—*Rum.*

3738. *Rum is prepared from materials which are the produce of the sugar-cane*, and is chiefly manufactured in the West Indies. These materials consist of molasses, or treacle, which is the uncrystallizable sirup that remains after the raw sugar has been formed. To this are added scummings of the hot cane juice from the boiling-house, which contains much of the aroma of the cane; or sometimes raw cane juice from canes expressed for the purpose; likewise lees called *Dunder*, consisting of the spent wash, or feculencies from a former distillation, and which serve the purpose of a ferment, like yeast in the brewing of beer; for though cane juice ferments of itself without yeast, yet this fermentation would be too slow.

These ingredients undergo the process of the vinous fermentation; and when the spirit is thus formed, it is separated by distillation. The flavour peculiar to this spirit, and which has rendered it famous in almost every part of the world, is derived from the essential oil of the sugar-cane, which is imparted during the fermentation, in consequence of the raw juice and fragments of the cane which are in the wash; a spirit may be distilled from sugar alone, fermented, called *sugar spirit*, but it is without the flavour of rum. Great quantities of rum are made in Jamaica, Barbadoes, Antigua, and other sugar islands. The following is the method of making it:

When the materials above mentioned are got together, they are diluted with water, and fermented in the usual manner. In Jamaica, the proportions are generally six gallons of molasses, thirty-six gallons of scummings of the sugar pans, fifty gallons of dunder from a former distillation, and eight gallons of water. If the rum is required of finer flavour, less of dunder is used, as that contains a good deal of empyreumatic matter. When this fermentation is completed, which is generally in about nine days, the fermented liquor or wash is put into a still, and the spirit, called *low wines*, is drawn off until it is no longer inflammable. To make this into rum of Jamaica proof, it undergoes a second distillation, in order to concentrate the spirit. Although the fermentation is, as we have stated, chiefly the vinous, yet so apt is the cane juice to become acid, that the acetous fermentation sets in slightly, whence it happens that the wash obtained has often a quantity of acetic acid as well as alcohol. As the heat of the distillation increases, the acid acts upon the alcohol, and distils over with the spirit, communicating to it a very disagreeable flavour and odour. Newly-distilled rum, therefore, has a peculiar bad taste, and is likewise extremely unwholesome, the acid, as well as the essential oil, being very deleterious to the nervous system; and the intoxicating power of new rum is much greater than might be expected from its proportion of alcohol. In some places, the leaves of different aromatic plants are thrown into the still to correct this flavour; but time alone, and suffering the rum to remain in the hogsheads long enough, can destroy the acidity or sharpness which it possesses when first distilled, and cause the essential oil to amalgamate with the liquor; accordingly, new spirit is stored in wooden vessels until the raw flavour is ameliorated; and hence old rum has a mildness and richness of flavour not possessed by new, and is always preferred. The wood itself appears to act a part in this process, for, if put into glass or earthen vessels, rum is said not to improve.

3739. *The best rum* is of a brown transparent colour; smooth, mellowed, oily taste; strong body and consistence: that of a clean, limpid colour, and hot, pungent taste, is either too new, or has been mixed with other spirits. *Jamaica rum* is the first in point of quality; the *Leeward Island rum* being always inferior to it in point of flavour, strength, and value: the price of the latter is usually twenty per cent. below that of the former, which occasions the Jamaica rum, it is said, to be sometimes adulterated by the latter.

3740. *Pineapple Rum.*—It is customary in some of the West India islands to put sliced pineapples in puncheons of rum, which give the spirit the peculiar flavour of that fruit. *Double-distilled rum* is rum rectified to a strength approaching to that of spirit of wine, which is convenient for carriage.

3741. *Rum is, like all other spirits, not unfrequently* "doctored," as it is called. Bad rum is made to imitate good by the addition of various ingredients. Those additions are kept secret, but are mentioned in books devoted to the purpose of exposing such frauds; as "Shannon on Brewing and Distilling," "Wine and Spirit Adulterators Unmasked," &c.

3742. *In France they make a sort of rum from the molasses* which remains after the making of beet-root sugar; but the spirit from molasses alone has not the proper flavour of rum, proving that this flavour is derived from the essential oil of the cane existing in the cane juice, and which is dissipated by the heat employed in procuring molasses. It is said that a good deal of spirit is made in this country from molasses of cane sugar by the distillers for purposes of adulteration.

SUBSECT. 3.—*Corn, or Malt Spirit.*

3743. *Various kinds of ardent spirits are produced from grain in different parts of the world;* but we propose to consider here only such as are made in this country.

When ardent spirit is prepared from grain, the first part of the process is nearly the same as in brewing: the malt is mashed and fermented for the purpose of producing the alcohol, only it is not hopped; the produce being, in fact, a kind of unhopped ale, and from this the spirit is to be separated by distillation.

3744. *In Britain the distillers do not brew entirely from pure malt*; they use chiefly raw grain, which saves the expense of malting. The proportion of malt usually varies from as little as one tenth part of the raw grain to one half of malt. The act of Parliament provides for the using of malt or raw grain, and leaves it at the discretion of the distiller to use either, on giving proper notice of his intention to that effect. But every distiller is obliged to use at least one fourth of malt, or pay duty to that amount. This mixture is ground; then the grist is infused with water at a heat of about 145°, which is considerably lower than that of the water used by the brewer, as there is more risk of setting with unmalted grain; and, for the same reason, more agitation is used in mashing.

3745. *This first process, however, differs from brewing in some important particulars:* in the latter, it is not desirable to carry the fermentation as far as possible, for the reasons which we stated when treating on brewing; but in distilling spirits, they endeavour to carry the fermentation to the utmost limit, and decompose the whole of the saccharine matter, in order to obtain all the spirit they can, the quantity of this being just in proportion to the decomposition.

3746. *The wort is drawn off and cooled in the usual way,* and fresh water poured on to exhaust the grain. The wort thus formed is not so transparent as that from malt, but its taste is nearly as sweet. It would appear, therefore, that the starch in the raw grain undergoes a certain change during the mashing, and is brought towards the state of saccharine matter as if it had been malted; a curious fact which was first discovered by the distillers. The wort is then put into the fermenting tun at a low temperature, varying from 55° to 70°, according to the quantity, the season, the goodness of the yeast, and the skill of the distiller. Here it is mixed successively with considerable portions of the best yeast that can be procured from a previous fermentation of the same kind, and the fermentation is urged as far as it can be made to go without danger of acetification. This process generally lasts about ten days, and the temperature rises usually to between 90° and 100°, and sometimes higher.

3747. *By this fermentation the saccharine matter is converted into alcohol,* and the liquor which is produced is what the distillers call *wash.* This wash is now put into the still, and the produce of the distillation is a very weak and foul spirit, called *singlings*, or, by some, *low wines*, or spirits of the first extraction. These low wines are re-distilled, or, as it is called, *doubled;* what comes over first is a very fiery spirit, tolerably pure, called *first shot;* the part which comes afterward is called *malt spirit*, which is slightly impregnated with the essential oil of the barley, and is received till its gravity diminishes to a certain degree, and it begins to acquire an ill taste and smell. What comes over afterward, and which is too strong of the essential oil of the grain, is called *faints;* and this is mixed with low wines, and rectified or submitted to a second distillation. The lower the heat, the purer will be the spirit that comes over, and the more certainly will the fetid essential oil be left behind in the water. The grains and the liquor which remain in the still after the singlings, or low wines, have been drawn off are called *still bottoms*, and are used to feed pigs, which, on that account, are often kept by distillers.

3748. *In distilling, it is an object of economy to ascertain what substances will afford the most spirit in proportion to its price.* Barley appears to produce less spirit than wheat; and if three parts of raw wheat be mixed with one of malted barley, the produce is said to be particularly fine. This is the practice of the distillers in Holland in making the best Geneva; but in England they are prohibited from using more than one part of wheat to two of other grain. Rye, however, affords more spirit than wheat. In Scotland it is the practice to use one part of malted to from four to nine parts of unmalted grain.

It is reckoned that it requires a hundred gallons of malt wash to produce twenty of spirit that contains sixty parts of alcohol and fifty of water.

3749. *The well-known whiskey is distilled from a fermented liquor, or wash, made from malt,* or malt and raw grain, either barley or oats. Wheat is sometimes used, but its high price in general limits its distillation. The peculiar flavour of Scotch and Irish whiskey has generally been supposed to be owing to the malt having been dried by turf: this does not, however, appear to be the case, since Mr. Donovan states that he was informed by an Irish distiller of the famous "Potteen whiskey," that the flavour was the same, whether the malt was made with turf or coal.

There can be little doubt that this flavour is produced by essential oil produced during distillation, which combines with the alcohol in making the wash, and which rises with the spirit in distilling with a low heat. This essential oil was obtained in small quantities, and mentioned long ago by Dr. Thomson, of Glasgow, and lately a method has been found out of procuring it by an easy process; it is extremely pungent, and a small drop is sufficient to impregnate a large quantity of pure spirit with the precise odour and flavour of whiskey. The production of this essential oil is completely prevented in the fermentation of beer by the presence of the volatile oil of the hops.

3750. *To make whiskey,* a wash is made by fermenting the materials mentioned above; this is distilled, and the spirit first obtained, or the low wines, are weak. They are redistilled, and the spirit so procured is whiskey, the strength of which is then about twenty-five per cent. above proof. Several places in Scotland and Ireland have been long celebrated for their superiority in the manufacture of this potent liquor. Dr. Thomson observes (*Sup. Encyc. Brit.*) that Lowland Scotch distillers use porter yeast in the fermenting of their wash, which gives a bad flavour to their whiskey; and that one cause of the superiority of the Highland whiskey (which has been termed "mountain dew") is, that the distillers there, particularly the smugglers, have not the means of procuring porter yeast from London. In Scotland and Ireland, much of the spirit produced by the distiller is consumed in the state of whiskey, and there are but comparatively few rectifiers in those countries; but much also is sent to London to be made into gin.

SUBSECT. 4.—*Spirit from various Vegetable Substances.*

3751. *Spirit from Potatoes.*—In some parts of the Continent a great deal of spirit is distilled from potatoes: these form an excellent material for this purpose, as they contain about five per cent. of starch. There are two methods of performing this: one is to convert potato starch into sugar, and then to ferment the sugar, and distil from the fermented liquor; the other process is to procure the spirit from the potatoes without making starch.

3752. For the first method, the following process has been employed: 75 gallons of water are put into a fermenting vat lined with lead, and capable of holding 250 gallons. The water is heated by means of steam to 176°. In another vessel, also lined with lead, 3 cwt. of potato starch, 6 cwt. of water, and 6 lbs. of oil of vitriol are mixed, and the whole poured into the first vessel, the heat being carefully maintained. In about six hours the starch will be converted into sugar. To get rid of the acid, 20 lbs. of whiting are added to neutralize it; the saccharine liquor is then drawn off, fermented with yeast, and the spirit distilled from it.

3753. For the second method, the potatoes are steamed, bruised into the state of pulp, and thrown into a tub with water of the temperature of 63°, in the proportion of 416 lbs. of water to every 100 lbs. of potatoes; the whole must then be suffered to ferment. While this is going on, 31 lbs. of malt in a state of fermentation are added, and the whole fermented together.

As potato juice contains a small quantity of tartaric acid, a little potash made caustic must be added to neutralize the acid; and it also serves to dissolve the albuminous matter that had been coagulated by the heat, and thus give complete fluidity to the mass. About half a pound of potash is sufficient for every 100 lbs. of potatoes. The fermentation finishes in about from 48 to 60 hours, when a spirituous odour will be perceived.

This fermented mass is now passed through a sieve to separate the pulp of the potatoes, and the liquor is put into the still. The spirit afforded by distillation will be in the proportion of 8 French pints of spirit for every 100 lbs. of potatoes: and the strength of the spirit will be such that it will contain 30 per cent. of pure alcohol. It is found that 3½ bushels of potatoes afford as much spirit as one bushel of malt; or 38 cwt. of potatoes and 200 gallons of malt will yield about 225 gallons of spirit.

The peculiar taste of potato spirit is removed by rectifying it with chloride of lime, about an ounce to each ten gallons of spirit; but roots and carrots mixed with the potatoes improve the flavour of the spirit. Some add aniseed or other flavouring ingredients. As potatoes pass readily into the acetous fermentation, the process requires to be conducted with great care.

3754. A brewery and distillery are common accompaniments of farming establishments in Germany and Norway; the farmers there produce spirit from potatoes as well as from barley, for their own use and that of their servants and labourers. We confess, we do not wish to see this example followed in this country, conceiving spirits less wholesome than beer. In France there are large manufactories for making sugar from potatoes, and for making spirit from the sugar. It must be observed that our laws do not permit the distillation of spirit from potatoes.

3755. *Birch Spirit.*—The sap of several trees contains sufficient saccharine matter to yield a spirit. The Swedes make a kind of strong spirit from the juice of the birch, by fermentation and distillation; and the ash is employed for the same purpose in northern countries.

3756. *Peach Brandy.*—A great deal of this *so-called* spirit is made in America, both South and North; and likewise in Persia, where this fruit grows in abundance. The process is the same as that employed in making spirit from cherries.

3757. *Cider Spirit.*—This is occasionally distilled in Devonshire from the lees of cider; but the flavour of the spirit is not to be commended. It may, however, be much improved by careful rectification, and has been made to imitate brandy by means of some additions.

3758. *Spirit from beet root* has been made in the following manner: Procure a quantity of the same beet roots that is employed for the manufacture of sugar; wash them well, and boil them in steam; mash them in two thirds of their weight of boiling water, and add a thirtieth of their weight of ground malt. Mix this well together, and leave the whole in a covered vessel for three hours; strain it through a wire sieve having the meshes one third of an inch square. When the temperature has fallen to 77°, add the proper quantity of yeast, and ferment in a covered tun. The fermentation will be finished in five or six days, and the wash is then to be put into a still and the spirit drawn off. A hundred lbs. of beet root will afford ten or twelve lbs. of proof spirits.

3759. *Spirits can be made from various other vegetable substances*, as carrots, gooseberries, the service berry, horse-chestnuts, even some kinds of sweet grass, any vegetables, in fact, which contain sugar; but they are not important enough to deserve particular description.

SUBSECT. 5.—*Arrack.*

3760. *Arrack is the East Indian name for all ardent spirits*, and it is made there from various materials. One kind of arrack is distilled from rice; another is made from the juice of various species of palm; a third from both these mixed; and another from molasses and mowah, a kind of sweet berry.

3761. *In making arrack from rice*, the grain called *ketan*, or glutinous rice, is used by the natives; it is boiled, and having a ferment added, called *rasi*, it is exposed in open tubs till fermentation takes place, when the liquor is put into earthen vessels, and kept buried in the earth for some months to check the fermentation. Large quantities of arrack are made in Batavia, where molasses and toddy are mixed with the rice before it is fermented; after fermentation the liquor is distilled, and the spirit thus produced is the best arrack.

3762. *Arrack from the juice of the palm* is made in the following manner: The species of palm from which the juice is obtained are the *Borassus flabelliformis*, *Cocos nucifera*, or cocoanut-tree, or the date-tree. The juice, when fresh drawn from an incision made in the stem, is a sweet, cooling, and wholesome beverage, called *toddy*, and by the natives *tari*. It contains much sugar, which, when separated by boiling, is called *jaggery*. The sap in its natural state is brought to market in large quantities, but it becomes sour in three or four days. When fermented into an intoxicating liquor, it affords one of the best kinds of Indian arrack by distillation. The trees from which the toddy is obtained are not suffered to bear any fruit. There are two ways of obtaining the toddy. One method is this: The person provides himself with a sufficient number of small earthen pots, resembling in form our glass bottles; he fastens several of these to his girdle, or to a belt across his shoulders, and climbs up the tall trunk of the cocoa-tree, or other palm. Having reached the top of the tree, where the large leaves form a great bunch, he cuts off with a knife the small buds or monthly shoots from which the fruit would be produced, and applies immediately to the wound one of his bottles, which he fastens on with a string. In this manner he proceeds till he has fixed the whole number of bottles in his girdle, which serve to receive the juice that flows out. This operation is generally performed in the evening, a greater quantity of juice flowing from the tree in the night than during the day. Another method is to make a perforation in the trunk of the tree, which is kept plugged up, unless when the gatherers are about to collect the sap. When put into vessels and kept out of the sun, the toddy undergoes the vinous fermentation, and is fit for distilling into arrack; but if it be exposed to the sun, it passes into the acetous fermentation, and is changed into vinegar.

3763. *The best arrack is the Batavian*, called *knap*; next is the Madras: the Goa and Columbo are inferior. The common Pariah arrack is often made from jaggery, rendered more intoxicating by hemp leaves, the juice of stramonium, and poppy heads, and is dangerous to Europeans. The consumption of arrack in India is very considerable, although the Hindoos, as well as the Mohammedans, are forbidden by their religions to use ardent spirits. Besides arrack, the natives of India distil intoxicating liquors from various plants; one made from the date-palm is of great antiquity: Herodotus mentions it as one of the principal articles of commerce in Babylonia.

A very bad imitation of arrack, made out of rum, is recommended by Dr. Kitchener, in his "Cook's Oracle" (p. 497), under the name of "*mock arrack*." "Dissolve two scruples of flowers of benjamin (benzoic acid) in a quart of good rum, and it will immediately impart to it the inviting fragrance of '*Vauxhall nectar*.'" Whether "Vauxhall nectar" was so composed, we have no means of determining.

SUBSECT. 6.—*Proof Spirit.*

The mode of judging of the strength of spirituous liquors by the taste is not always to be depended upon, as a false appearance of strength is sometimes given to a weak liquor by the infusion of acrid and pungent substances.

3764. *By the excise laws at present existing in the British islands, a duty is paid on spirituous liquors*, such as brandy, rum, arrack, gin, whiskey, &c., in proportion to their strength; *and the strength of these liquors depends upon the quantity of alcohol which they contain.*

Pure spirit, or alcohol, is considerably lighter than water; a mixture of alcohol and water will, of course, be lighter than water alone; from which it is evident that the more alcohol any liquor contains the lighter it must be. Hence, the quantity of alcohol in a mixture of it with water, or, in other words, its strength, may be determined by its comparative weight or specific gravity. See Alcohol in "Fermentation," Book VIII., Chap. II.

3765. *In order to compare the degrees of strength of various kinds of spirit*, the excise has established one degree of strength as a legal standard, and this they call *proof*, or *proof spirit*. "This liquor (not being spirit sweetened, or having any ingredient dissolved in it to defeat the strength thereof), at the temperature of 51° Fahrenheit, weighs exactly 12-13ths of an equal measure of distilled water." Its specific gravity is ·930.

3766. *The strength of spirituous liquors, when greater or less than this*, is said to be *above* or *below proof*; and, in the latter case, is estimated by the quantity of water which would be necessary to bring the spirit up to the weight of proof.

3767. *As it is necessary to have an accurate mode of ascertaining the strength of spirits*, particularly in case of purchasing a large quantity, various means have been resorted to to determine this. The most accurate mode, and the only one to be depended upon, is by the instrument called the *hydrometer*, which ascertains the specific gravity of the liquid.

3768. *The hydrometer* is a hollow ball with weights fixed to a stem, which sinks deepest in the lightest fluid; therefore the strength of the liquor may be determined by the depth to which the stem sinks. A mark is fixed on the stem for the depth to which it will sink in proof spirits; all spirits in which it sinks deeper are *over* proof, and those in which it sinks less are *below* proof; by the divisions in the stem, together with the weights employed, the exact degree of strength may be ascertained. This is the method prescribed by the excise laws for trying the strength of liquors.

There are several hydrometers, varying somewhat in form; but *Sykes's hydrometer* is that used by the excise. This method of ascertaining the strength of liquors requires some precautions in using the instrument. The difference of temperature materially affects the specific gravity of the fluids; therefore a thermometer is also employed to discover this at the time the hydrometer is used. But, to avoid the complicated calculations that would be necessary for this and other allowances to be made, tables are constructed, which renders the business very simple to the excise officer. He has only to put his hydrometer into the liquor, observe certain marks, and also try the temperature with his thermometer; then from these observations, by means of rules laid down for him, and his printed tables, he readily finds the strength of the spirit. The convenience and utility of this mode are incalculable; and to illustrate it, Dr. Arnott relates an interesting anecdote. "A shopkeeper in China sold to the purser of a ship a quantity of distilled spirit according to a sample shown; but not standing in awe of conscience, he afterward, in the privity of his storehouse, added a certain quantity of water to each cask. The spirit having been delivered on board, and tried by the hydrometer, was discovered to be wanting in strength. When the vender was charged with the intended fraud, he at first denied it, for he knew of no human means which could have made the discovery; but on the exact quantity of water which had been mixed being specified, a superstitious dread seized him, and having confessed his roguery, he made ample amends. On the instrument of his detection being afterward shown to him, he offered any price for what he foresaw might be turned to great account in his trade."

3769. *In purchasing large quantities of spirits of any kind*, the hydrometer should always be employed; but other methods less scientific have been, and still are resorted to on common occasions for trying the strength, when no hydrometer is at hand. The most usual is what is called the *Bead proof*, the mode of examination by which is as follows: Take a long vial, fill it half way with the common malt spirit, and give it a smart stroke by its bottom against the palm of the hand; there will then appear on the surface a chaplet or crown of bubbles, which will go off again in a peculiar manner; that is, first remaining a while, and then going off by degrees, without breaking into smaller bubbles, or swelling into larger. If the bubbles raised in any spirits are larger than those on proof spirits, and go off more suddenly, then the liquid is concluded to be *above* proof; if the bubbles are smaller than those on proof spirit, and go off quicker or fainter, the liquid is thought to be *below* proof. This test is very liable to be fallacious, though experienced dealers depend much upon it; but some of those who sell spirits know how to add certain substances to what is below proof, so as to show the same bead as that which is full proof; and as an instance how daringly such impositions are practised, we find, in a well-known work on distilling, distinct and express instructions how to deceive the purchaser.

3770. *The original mode of determining the strength of spirits*, whence the term "proof" was derived, was by pouring some of the spirit upon gunpowder, and setting fire to it. If, at the end of the combustion, the flame of the spirit fired the gunpowder, it was said to be proof; on the contrary, if the gunpowder did not take fire through the spirit having too much water, the spirit was considered as below proof. This method is very inaccurate.

3771. *For ordinary purposes, the relative strength of spirits may be known* by weighing the sample to be tried in a vial capable of holding exactly 500 grains of water. An equal bulk of rectified spirits weighs 418 grains, and of proof spirit, 465; hence the number of grains above or below these sums will indicate the relative strength of the spirit. Rectified spirits have a specific gravity of ·835, and proof spirit of ·930; so that in strength, nine of the former are nearly equal to ten of the latter. French brandy is about the same strength as proof spirit; Scotch whiskey has 54·32 of water; Irish whiskey about 53·4; rum, 53·68; gin, 51·6.

3772. *The most exact of all methods of determining the strength of spirits* is by distillation; rectifying it up to alcohol, and ascertaining how much alcohol there is in a given quantity; but though liable to no error, this is too tedious to come into common use.

Proof spirit contains about equal parts water and rectified spirit; rectified spirit of moderate strength has generally about 25 per cent. of water; and *alcohol* is all spirit.

Proof spirit cannot, like rectified spirit or spirits of wine, be used for burning in lamps, nor for dissolving resins, nor for making varnish, and many tinctures, not being strong enough.

3773. *When spirit is said to be one to three over proof*, it is meant that one gallon of water added to three gallons of spirits will reduce it to proof; on the contrary, one in three under proof signifies that in three gallons of that spirit there is contained one gallon of water, and the remaining two gallons are proof spirits.

Subsect. 7.—*Rectification of Spirits.*

3774. We have shown that the object of the distiller is to procure from fermented liquors all the pure spirit which they contain; and we have stated that all spirits are the produce of fermentation only, and that when rendered perfectly pure they are of the same nature, from whatever source they have been derived, whether from wine, malt, sugar, potatoes, &c. But they are never obtained in a pure state in the first distillation; independently of the water with which they are diluted, they contain other impurities. Brandy made from wine has a peculiar essential oil, derived from the grape, with some acid, &c.; rum is impregnated with another essential oil from the sugar-cane, together with other impurities; malt liquor has the essential oil of barley; in short, every spirit when first procured will have some impregnation of an essential oil, and some other substances in small quantity, but sufficient to communicate a peculiar flavour; and this, independently of the strength, constitutes the difference between one spirituous liquor and another.

3775. *The business of the rectifier* is to deprive the spirit of the water, essential oil, and other impurities, which process is called *rectification.* It is extremely desirable to have a pure flavourless spirit, for various purposes; as, for instance, in the case of making perfumed essences; for if the spirit in which the odoriferous oil is dissolved has in itself any peculiar odour, the perfume will be less perfect. It is also necessary to have a spirit as free as possible from peculiar flavour, when, as in the case of compound spirits, such as gin and cordials, certain flavours are to be imparted: hence rectifiers have had recourse to various expedients, and a great deal of their knowledge is kept secret.

It is very important that in the first distillation, particularly from malt or barley, the spirit should be drawn with a gentle fire, by which means great part of the essential oil will be prevented from rising and mixing with the spirit; and experience proves that it is much easier to keep asunder substances than to separate them when once they are mixed. But as it is almost impossible, with the greatest care, to draw over a spirit without its being at first impregnated more or less with essential oil, it is necessary to have some method of separating these: the best methods for effecting this are re-distillation and filtration.

3776. *Spirits drawn from wine*, such as French brandy, may in a great measure be purified or rectified by simple distillation in tall vessels or alembics, and gently distilled in a *balneum mariæ*, or water bath; the pure spirituous part rising first, a large proportion both of the oil and phlegm remains behind in the still. If French brandy be thus distilled to one half, the spirit obtained proves tolerably pure; and it was in this manner pure spirit was first procured, called from thence spirit of wine; this method is still employed in France. But wine and brandy being articles too dear in this country, recourse is usually had to the common spirit from malt or molasses, termed in its first state *raw spirit*, which is rectified for spirit of wine.

3777. *To separate the essential oil with which the raw spirit abounds*, it is mixed with an equal quantity of spring water, and is put into a still, and distilled with a very gentle heat. The first product of the distillation is the strongest and purest, and when it has come over, to the amount of one fourth of the whole contents of the still, it forms the rectified spirit. If the distillation be continued, the spirit continues to come over, but weaker and weaker, till at length it is so watery as not to be inflammable. What remains in the still is water, the colouring ingredients, with any accidental impurities; the water is generally turbid, and very nauseous in smell. When the ardent spirits which have been employed contain much essential oil, the distillation requires to be repeated before it can be purified from all ill flavour; and as this process is tedious, to expedite it, the distillers frequently mix with the impure spirit some potash, lime, or other alkaline substance. When potash is used, the spirit has a urinous taste; to free it from which, it is again distilled with the addition of a little alum and charcoal, the acid of the former attracting the small portion of potash which the spirit held in solution. Malt spirit, when properly rectified, yields as pure and as strong a rectified spirit as brandy.

3778. *The raw spirit is sold to the rectifier in the state of proof spirit*, and when it is converted into rectified spirit, it is sold as spirit of wine, or it is made into compounds commonly called *liqueurs* or *cordials*, by being distilled with certain herbs and other ingredients.

3779. *Rectified spirit, or common spirit of wine*, being spirit freed from the essential oils above mentioned, is in the highest state of concentration in which it can be easily prepared in the large way for the purpose of trade.

3780. *Properties of Spirit of Wine.*—It has a fragrant odour, a hot, highly pungent taste. It is colourless; always fluid; cannot be congealed at any known degree of cold; evaporates speedily at the ordinary temperature of the atmosphere; boils at 163°, and is extremely inflammable, burning with a blue lambent flame, without any sensible smoke. Like alcohol, it combines with water in every proportion; it is capable of dissolving many saline bodies, and is the proper solvent of the great number of the proximate principles of vegetables, particularly resins. Expressed oils, which swim on water, will sink in rectified spirit. It is composed of 85 parts of pure alcohol and 15 of water in 100 parts, when its specific gravity is ·835 at a temperature of 60°. It is a powerful stimulant, but is never taken into the stomach in its undiluted state. Diluted to the degree of proof spirit, it is still too strong for internal use.

Subsect. 8.—*Compound Spirituous Liquors.*

3781. In treating of the business of the rectifier, we have hitherto confined ourselves to the art of depriving distilled spirits of the essential oils and other matters with which they are contaminated, in order to produce a pure spirit approaching nearly to the nature of alcohol.

3782. *We have now to treat of those compounds which are produced by adding to pure spirit certain ingredients for the purpose of giving to it agreeable flavours*, or for other uses. Most of these are now generally manufactured in the large way by the rectifier; but their nature and composition are subjects of no small importance to the health of the public, as well as their gratification; and it is on this account chiefly that we consider it deserving attention, since we believe many of those most interested in them are not well-informed of many facts that should be known.

3783. *Impregnating spirits with flavouring substances is a practice of old times*, and was frequently done through the idea of giving them a medicinal quality, real or supposed; hence the name of *cordials*, yet so frequent in the shops, are insidious terms that serve too often as an excuse for dram-drinking, although it cannot be denied that some of them, judiciously employed on certain occasions, have beneficial effects. One of the most ancient of these appears to be *usquebach*, or *aqua vitæ;* and *Geneva*, both Dutch and English, belongs to this class, as well as the vast number of the more elegant foreign compounds designated *liqueurs.*

3784. *Of compound spirits some are made by our rectifiers, and others are imported from the Continent;* but as it has been always considered a branch of domestic economy to prepare a few of them at home, we shall describe their composition, and the manner of producing them, either to lessen their expense, or for the sake of showing what ingredients they contain.

3785. *In all these operations, it is an object with the rectifier*, or whoever attempts to form these compounds, first to obtain as pure a spirit as possible, that the natural flavour of the raw spirit may not interfere with the flavours to be communicated. It is not our object to enter into the details of the various processes of the manufacturer who works on the great scale, any farther than to give a general idea of the subject; but our directions for those processes which may be carried on at home will be more minute, referring the reader, at the same time, to Book XX., "On the Still Room," for a variety of information applicable to this, as well as to some other subjects of domestic economy.

3786. Some compound spirits are prepared by putting the spirit, together with the flavouring ingredients, into the still, applying heat, and drawing off the spirit impregnated. Another class is produced by simply infusing the flavouring materials in the spirit without distillation. The latter are sometimes termed *ratafias*, a name derived from France.

Subsect. 9.—*Geneva and Gin.*

3787. The term *Geneva* and *gin*, the name of a well-known spirit, is derived from *genèvre*, the French for juniper-berry. Shaw, in his "Essay on Distilling," informs us that originally it was a custom to add to the fermenting worts for distilling spirits some aromatic ingredients to take off the bad flavour, and give a pungent taste to the liquor. Among other things, juniper berries were tried by Sylvius, a professor of Leyden, who lived in the seventeenth century; and it was found not only that they gave a very agreeable flavour, but likewise communicated valuable medicinal qualities. This liquor was, accordingly, first sold as a diuretic in the apothecaries' shops; but as it was drunk with avidity, it soon became an article of trade, and received the name of the plant which gave the peculiar flavour.

3788. The original Geneva was made in Holland by grinding berries with the malt before fermentation, and fermenting the whole together, by which the spirit was flavoured with the juniper from the beginning, a method preferable to any other.

3789. *The English Geneva was an imitation of that made in Holland*, and, like it, was rectified from juniper; but it having been found out that the oil of juniper and the oil of turpentine were very like each other in flavour, the last being by much the cheapest, our distillers omitted the greatest part of the juniper, using chiefly turpentine. English gin is, therefore, only raw corn spirit and oil of turpentine distilled together by the rectifiers; occasionally some juniper is added, together with various other ingredients.

3790. *Hollands*, or *Dutch Geneva of the best quality*, is made at Schiedam, but it is likewise made very good at Delft, Rotterdam, Dordrecht, and Weesoppe.

3791 The usual manner of manufacturing it is thus described: "A quantity of flour of rye, coarsely ground, is mixed with a third or fourth part of barley malt, proportioned to the size of the tub in which the vinous fermentation is to be effected. This they mix with cold water, and then stir it with the hand, to prevent the flour from gathering into lumps, and to facilitate its dissolution. When this point is attained, water is added of the heat of the human blood. The whole is well stirred, after which the ferment or yeast is mixed with the wort, being previously diluted with a little of the liquor. The fermentation generally begins six hours afterward: if it commence earlier, there is reason to apprehend it will be too strong, and means are employed to check it If the fermentation be well conducted, it generally terminates on the third day, when the liquor grows transparent, acquires an acrid taste, hot and biting on the tongue. The wash is then well stirred, and the mash with all the corn is put into the still, and then commences the first distillation, which is conducted very slowly, that being a matter of the utmost importance. This liquor is then rectified over juniper berries once or twice, according to the sort of spirit which it is intended to produce. For common use, one rectification is deemed sufficient, though the spirit is not considered so agreeable as that which has undergone several rectifications, and which is called double Geneva. Some distillers mix the juniper berries with the wort, and ferment them together; but in that case they only draw a spirit from it for the use of the interior, or for exportation to England.

An inferior kind of Geneva is made at Weesoppe, with a less proportion of berries, some fennel seeds, and Strasburg turpentine.

3792. *The plant which produces the juniper berries* (*Juniperis communis*) belongs to the Coniferæ, and grows abundantly in most parts of Europe. It flourishes in almost any soil; granite rocks, sandy heaths, and fertile plains appear to suit equally this plant. The fruit or berries brought from Italy are preferred to those from Germany. They are abundant and cheap in Holland, being procured from Cologne and Coblentz, and are likewise indigenous in Britain. The whole of the plant yields the oil, the extremities of the shoots as well as the fruit, but that produced by the former is more nauseous, and therefore little employed.

The fruit or berries are round, of a blackish purple colour, and contain an essential oil in their minute vesicles, requiring to be bruised that the oil may be freed in distillation. This oil, when obtained separately, is of a greenish-yellow colour, and has an odour moderately strong, not disagreeable, and resembling that of turpentine. The taste of the berries when chewed is warm, sweetish, and pungent, followed by bitterness. The oil is soluble in alcohol, and may be obtained on distillation with water. The flavour is superior to that of turpentine, but their greater price, increased by a duty of 11*s*. 1*d*. per cwt., is no doubt the principal reason why they are so much less used here than turpentine for gin. Notwithstanding this, it is said that from 600 to 800 tons are annually imported.

3793. *Although in Holland the quantity of grain that is grown is inadequate to the consumption of its inhabitants*, yet there are few countries better supplied with that necessary of life. From Russia, Poland, Elbing, Koningsburg, and Flanders are drawn those immense resources which enable the Dutch to distil to so great an extent; but Dr. Render, in his "Tour through Germany," informs us that a great deal of the spirituous liquor imported as Hollands is actually manufactured in Germany. In most of the wine districts on the Rhine, the Germans make a liquor, called *troster*, by fermenting the skins of grapes that have been pressed with ground barley or rye; this liquor is considered very wholesome, and immense quantities of it are sold to the Dutch, who use it in distilling their Geneva. All over Germany there are not only many large distilleries, but many of the farmers distil spirits for themselves, as they are only obliged to pay two florins, about 4*s*. 6*d*., for a license. In producing spirits, they use not only grain, but plums and fruits of various kinds, and likewise potatoes. The principal part of this is sold at the fairs in casks.

3794. *The best English gin* is said to be made thus: Into the still are put ten gallons of proof spirits, together with three pounds of juniper berries, and water four gallons; the spirit is drawn off by a gentle fire till the faints begin to rise, and it is lowered with water as much as is necessary. Distillers call the gin *royal* when it is the strength of proof.

3795. *The following is said to be the mode in which the common gin is usually prepared in England:* Ordinary malt spirits are put into a still with the other ingredients in the following proportion: five gallons of spirit, one ounce oil of turpentine, half a pound of juniper berries, two ounces of sweet fennel and caraway seeds, and a good handful of bay salt. This is distilled off till the faints begin to rise. As much water is added to the product as is found necessary. They reckon that ten gallons of spirit will make thus fifteen gallons of common gin; and some say that turpentine alone, and not juniper, is used. The turpentine, however, is not a deleterious ingredient. Dr. A. T. Thomson observes, in his "Materia Medica," "if the spirit were good, the English gin is a better diuretic than Hollands, inasmuch as the oil of turpentine is a superior diuretic to the juniper."

3796. *That British gin is often adulterated is notorious;* the late examinations before a committee of the House of Commons have opened the eyes of the public to the dreadful extent to which the consumption of this pernicious article has reached, and some of the fraudulent practices employed in adulterating it; but it is not to be expected that the whole of the deleterious substances used should ever be completely discovered. *Lowering* the gin usually retailed with water, and sweetening with sugar, though an adulteration and fraud almost universally practised, is the least to be regretted. The latter substance may be easily detected by evaporating a quantity of the liquor in a silver spoon over a candle to dryness; the sugar will be rendered obvious, in the form of a gum-like substance, when the spirit is volatilized.

Subsect. 10.—*Usquebach.*

3797. *Irish usquebach was originally a liqueur*, a compound spirit made with spices. It was called *aqua vitæ*, and was supposed to have the power of arresting many diseases, and prolonging health and life. Among other receipts for making it, the following is one:

"Take of nutmegs, cloves, and cinnamon, of each, two ounces; of the seeds of anise, caraway, and coriander, each four ounces; liquorice sliced, half a pound; bruise the seeds and spices, and put them, together with the liquorice, into a still with eleven gallons of proof spirits, and two gallons of water. Distil with a pretty fresh fire till the *faints* begin to rise. As soon as the liquor comes over, fix some saffron to the end of the worm, that the liquor may pass through it and extract its tincture. Soften the whole with sugar"

The term aqua vitæ has been often applied to whiskey, and also to English gin. Spirituous liquors appear to have been much drunk in Ireland at a very early period; and in the reign of Henry VIII. it was decreed that "there be but one maker of aqua vitæ in every borough upon pain of 6*s*. 8*d*."

3798. *Another receipt for usquebach* directs that the following ingredients should be digested in five gallons of French brandy for a fortnight, viz.: nutmegs, cassia-cinnamon, angelica root, hay saffron, rhubarb, of each one ounce; mace, cloves, lesser cardamom seeds, of each two drachms; liquorice root, three ounces; coriander seeds, aniseeds, tumeric root, caraway seeds, of each one ounce.

3799. *Meg Dod's Usquebach.*—To two quarts of the best brandy or whiskey without a smoky or peculiar taste, put a pound of stoned raisins, half an ounce of nutmeg, quarter of an ounce of cloves, the same quantity of cardamoms, all bruised in a mortar; the rind of a Seville orange rubbed off on lumps of sugar, a little tincture of saffron, and half a pound of brown candy-sugar. Shake the infusion every day for a fortnight, and filter it for use. *Obs.*, not a drop of water must be put to this cordial. It is sometimes tinged of a fine green with the juice of spinach, instead of the saffron tint, from which it probably takes the name of usquebach, or yellow water.

SUBSECT. 11.—*Ratafias.*

3800. *Ratafias are liqueurs prepared by infusing the juices and kernels of fruits in strong spirit with sugar*, and are, therefore, to be considered as *tinctures sweetened.* Though the liqueurs, by distillation, would be difficult to prepare in a private family, ratafias are easily made. For this purpose, it is very important that the spirit should be of sufficient strength, since a strong spirit is enabled to extract certain vegetable substances more effectually than a weaker one. Genuine French brandy is usually recommended; but as this is expensive, rectified spirit may be advantageously employed. The chief use of ratafia is for imparting an agreeable flavour to puddings, pies, and other dishes.

3801. *Ratafia of Cherries, or Red Ratafia.*—Take two quarts of rectified spirits of wine; add to it two drachms of beaten cinnamon, one drachm of bruised cloves, and an ounce of coriander seeds, also bruised. Let them stand together well covered for a week; then press, from equal quantities of morello and black-heart cherries, twelve pints of juice, to which add three pounds of powdered loaf-sugar, and stir it till it is dissolved. Mix these with the spirit and spices. Take half the cherry-stones, mash them in a mortar, and add them to the other ingredients. Let the stone bottle, or jar, in which these materials are contained be closely covered. Stir it up, or shake it frequently. When it has remained two months pour it off, press the residuum, and filter it. It may then be put into bottles and corked. Some add the leaves of peach and black currant.

3802. *Cherry Brandy of the ordinary kind.*—Procure morello cherries, or small black cherries, but the former are the best; pick them from the stalks, and pierce each cherry with a needle; fill bottles with them nearly up to the necks, and pour in as much of the best brandy as the bottles will hold. In three weeks or a month strain off the spirit; add to it clarified sugar in the proportion of a pound to each quart; flavour to your taste with cinnamon or cloves. The flavour will be extracted from the kernels, although they have not been broken. Some use whiskey instead of brandy.

SUBSECT. 12.—*Cordials.*

3803. The following compounds are intended to be used rather in a medicinal way than any other. They may be prepared either by distillation or by infusion. We shall give directions for both.

3804. *Anise-seed Cordial.*—Put into a still one pound of bruised anise-seeds; proof spirit, six gallons; water, half a gallon; draw off five gallons with a moderate fire. By infusion: add three quarters of an ounce of oil of anise-seed, and four pounds of refined sugar to eight gallons of rectified spirit; fine with an ounce of alum.

3805. *Caraway Cordial*, by distillation, is made as the last: some add orange peel. Or, mix together three quarters of an ounce of oil of caraway, and four pounds of sugar; add ten drops of oil of cinnamon, two drops of the essential oil of orange, and as much of that of lemons; fine with alum.

3806. *Cinnamon Cordial.*—Dissolve one pennyweight of oil of cinnamon with sugar as above; add to it three quarters of a pound of rectified spirits, half an ounce of orange peel, and as much lemon peel, with the same quantity of cardamom seeds; put one gallon of water to this. Fine with alum, and if you wish it coloured, add some burned sugar.

3807. *Citron Cordial.*—Beat up half an ounce of essence of lemon, and as much of that of oranges, with three or four pounds of refined sugar; add to this a quarter of a pound each of dried lemon and orange peel; infuse this in six gallons of rectified spirits that has stood upon seven pounds of figs for a week; if required, add some water.

3808. *Geneva without Distillation.*—Take one ounce of the oil of juniper, and half an ounce of the oil of sweet fennel, three quarters of an ounce of oil of turpentine; and first beat up these with refined sugar, and then add to them one pint of strong spirit of wine. Put this to twenty gallons of proof spirit, and sugar to taste; fine with an ounce and a half of alum.

3809. *Gin Bitters.*—Mix with refined sugar half an ounce each of the essence of lemon and orange peel, a drachm of oil of wormwood, half a pound of dried orange peel; add this to five gallons of the best gin, and let the whole remain together for a fortnight, when it will be ready for use. Dilute it with water to the taste.

SUBSECT. 13.—*Legal Enactments respecting Spirits.*

3810. *The Manufacture of Spirits is under the surveillance of the Excise.*—The regulations are very complicated, and therefore every one carrying on any part of the trade should have a copy of the act of Parliament describing them in his possession. The duty on British spirits at present is 7*s*. 6*d*. per gallon.

3811. All persons not being licensed distillers, rectifiers, or compounders, having more than eighty gallons of spirits in their possession, shall be deemed dealers in spirits, and subject to the survey of the officers of the excise, and to all the regulations, penalties, &c., to which such persons are liable. Dealers in British spirits are prohibited selling or having in their possession any plain British spirits, except spirits of wine, of any strength exceeding the strength of twenty-five per cent. above hydrometer, or of any strength below seventeen per cent. under hydrometer proof; or any compound spirits, except shrub, of any greater strength than seventeen per cent. under hydrometer proof. No retailer of spirits, or any other person licensed or unlicensed, shall sell or send out of his stock or custody any quantity of spirits exceeding one gallon, unless the same be accompanied with a true and lawful permit, under pain of forfeiting £200. Brandy and rum, or any other foreign spirits, are seizable if sold by the dealer, or found in his possession under a certain strength, which is seventeen below proof by the hydrometer. But notwithstanding this, sugar is often added, which prevents the hydrometer showing its want of strength.

Subsect. 14.—*Various Spirituous Liquors prepared in different Countries.*

3812. Although it may not appear necessarily to belong to the subject of domestic economy to describe the spirituous liquors made in distant countries, yet some account of the most remarkable of them may be useful, as they are frequently mentioned.

3813. *In Europe*, besides those which we have described, there are some other spirituous liquors less known. In Dalmatia, a spirit is distilled from the marc of grapes and aromatic herbs called *Rakia*. In Zara, the famous *Maraschino* is made from cherries. In Dantzic, and many parts of Germany, an agreeable compound spirit called *Rosolio* is made from the juice of the plant called Ros salis, brandy, sugar, or honey, cinnamon and cloves, nutmegs, and other ingredients distilled. In Germany, they make also a liquor named *Troster*, from the marc of grapes fermented with ground rye or barley. *Gold wasser* is a spirituous liquor made from grain rectified upon anise seeds, cinnamon, and other spices; it derives its name from their keeping bits of gold leaf floating in it. In Brunswick, *Mum* is made from fermented wheaten malt and oatmeal, with fir rind, tops of fir and beech, and a variety of herbs. In Russia, they make *Braga* from oatmeal and hops fermented, and also *Mead* from honey and beer lees; their *Quass* is from barley malt, rye malt, and oatmeal, fermented and made acidulous. In Norway, the climate is too cold for the production of grain in sufficient quantity to answer the purposes of distillation; but there the inhabitants make a beverage from the fermented juice of the birch-tree, which grows in immense forests: among the better class, wine and lemons are used in the making of this liquor. Potatoes are likewise used in Norway for distillation. The *Snaps* of Denmark and Holstein is distilled from rye and barley. In Turkey, wine and spirits being forbidden by the laws of Mohammed, *sherbet* is made from sugar, lemon juice, apricots, or plums, and flavoured with some sweet flowers.

3814. *America.*—Besides the usual beverages of Europe, a liquor called *Pulque* is made in Mexico and Peru from the juice of the Agave or American aloe. By distilling the Pulque a very strong spirit is obtained called *Aquardiente de Magny*. They likewise ferment a liquor from maize; and this is said to have been done prior to the discovery of America by the Europeans. In Brazil they prepare an intoxicating spirit called *Grape* from sugar, water, and the leaves of the Akaya-tree. A beer called *Chica* is made by the Indians, and also one from the roots of the Manioc or Yucca. The Batata root affords the *Vintro da Batatas*. In North America they make a great deal of what they call brandy from peaches. In the West Indies the negroes prepare a kind of beer from the Cassava, which furnishes the tapioca.

3815. *Asia.*—The arrack of India has been already described. In Nepaul, *Phaur* is distilled from wheat or rice, and *Sihee* from the grape. In Afghanistan a spirit is obtained by fermenting sheep's milk. In Persia a strong spirituous liquor is distilled from peaches fermented; and although the Mohammedan religion forbids the use of wine, and that sherbet is the general beverage, yet several kinds of wine are made by Jews, and drank privately. In Japan, Birmah, Siam, and some of the Eastern islands, arrack is made in abundance. In Kamtschatka a spirit is made from a species of sweet grass, which grows six feet high, with a jointed hollow stalk containing a great deal of sugar.

3816. The Chinese make beer from barley and wheat, called *Tar-a-sun*, and also use hops to preserve it. Beer is also made there from rice, in which they sometimes infuse the seeds of thorn apple (*Datura Stramonium*) to add to its narcotic power. They also make vast quantities of arrack from rice, but use it, in general, with great moderation. The cultivation of the vine has been practised in China from time immemorial; but, in 1373, the Emperor Tay-tsu ordered most of the vines to be rooted out; and they were beginning again to be cultivated when Lord Macartney visited the country. They likewise ferment palm juice into a kind of wine called *Cha*. Although they manufacture much sugar, they have not yet learned the art of making rum from the refuse.

3817. The Tartars prepare a beverage called *Koumiss* from mare's milk: since milk contains a small quantity of sugar, it is not surprising that it should be capable of the vinous fermentation, although this fact is not generally known.

CHAPTER IX.

VARIOUS ORDINARY BEVERAGES.

3818. Besides wines and malt liquors, there are various beverages in common use, of which it will be useful to give some description.

3819. *We shall divide these into three classes:* 1. Beverages of the simplest kind, not fermented; 2. Beverages, consisting of water, containing a considerable quantity of carbonic acid; 3. Beverages composed partly of fermented liquors.

SECT. I.—BEVERAGES OF THE SIMPLEST KIND, NOT FERMENTED.

3820. *Water.*—We refer the reader to medical writers for the particular value of water as a beverage; by these it is described as the best and most wholesome beverage that exists. In Book VIII., Chap. I., we gave a description of the various kinds, such as rain water, spring water, &c. It may be proper here again to observe that no water whatever is absolutely pure; the freer, however, from extraneous matter, the better, except that it should not be deprived of the common air, of which it usually contains a portion; consequently, newly-distilled water is not desirable, nor water that is just produced from thawed ice or snow; such water should be exposed for a day or two to the atmosphere, that it may absorb air, which appears to be essential to it as an agreeable beverage. Spring water is the most agreeable, from its general purity and coolness; but all spring water is not fit for drink, as it often contains various salts. The water of rivers is, in general, good, particularly when filtered; so also is rain water; stagnant is the worst; it is necessary to boil water only when it contains salts which require to be precipitated.

3821. There are certain cases in which an infusion or decoction of some substances in water for drinking are proper, either to remove the vapid taste of water alone, which is sometimes not agreeable to those who are not used to it, or to give it some other property. Preparations of this kind are extremely numerous, and most of them are well known; nevertheless, we consider it proper, in a work of this kind, to collect them, or at least to speak of such as are most useful.

3822. *Toast and Water.*—Bread, highly roasted before the fire, so as to become deep brown, but not burned black, is in a slight degree soluble in water, and will communicate to it a faint tinge. The toast should be put into the water; if the water be poured on the toast, it breaks it, and makes the water thick; this may be drunk as soon as it has cooled sufficiently: it will not keep, acquiring a disagreeable taste after a day. Hard biscuit, browned by the fire to a coffee colour, has been recommended by Sir Anthony Carlisle for this purpose. A small piece of lemon peel is sometimes added.

3823. *Barley Water.*—This is a very ancient beverage, and formed the principal "ptisan" of the old physicians. Hippocrates recommended it as preferable to every other aliment in acute disease, and it still retains its character. The husk of barley contains an acrid resin, and to get quit of this, and render the starch of the grain accessible to water, the external cuticle is taken off, and the kernel, when rounded in a mill, is called *pearl barley*. Pearl barley, therefore, consists only of the starch of the grain, with a minute portion of mucilage and sugar. By slow boiling, a considerable part of it is dissolved, and according to the quantity used, the water is thickened in a small degree with the viscid paste. To prepare barley water, wash a handful of barley, either the common or the pearl barley, and simmer it gently in three pints of water till it is reduced to a quart, which may take an hour. It may be flavoured with a little lemon juice and sugar, or with lemon peel, or cinnamon. It must be used fresh, as it will not keep above a day. To make the barley water of a better colour, it may first be boiled for a few minutes in water that may be thrown away. Some prefer, instead of simmering the barley, to make merely an infusion, by pouring boiling water upon it as in making tea, and then letting it stand till it is cold. Figs, liquorice, or raisins make an addition that may be agreeable to some; or currant jelly may be added as a cooling drink.

3824. *Eau Sucré.*—Water with sufficient sugar dissolved in it to make it sweet is a beverage much used by French ladies, and is considered as very wholesome and refreshing. It is usual for men and women in France to take some of this just before bedtime.

3825. *Lait Sucré.*—Milk well boiled with sugar, and flavoured with lemon: taken cold.

3826. *Cheese or Milk Whey* is an excellent drink in the summer season; so is *butter-milk*, especially in the spring time when the cows have good fresh herbage. In Northern countries, butter-milk is kept till it becomes sour and separates into a curd and whey; this whey has a considerable quantity of acidity, but is nevertheless exceedingly wholesome, and forms a refreshing beverage. It is a common drink of labourers in the north.

A pleasant acidulous whey may be readily procured, by adding to a glassful of milk a little solution of citric acid, or lemon juice, which will curdle the milk. Care must be taken not to add too much acid; an experiment or two will readily show the quantity necessary to effect the purpose.

3827. *Milk*, and *Milk and Water*, are invaluable drinks.

3828. *Lemonade.*—This favourite beverage is easily made, and extremely refreshing. To make a quart, take two lemons, or more, according to taste; pare off thinly a little of the rind, or rub lumps of sugar upon them. Squeeze out the juice of the fruit, and mix it with two ounces of white sugar, including what has been rubbed upon the lemons, add the water boiling hot, and when sufficiently cool, strain the liquor. This may be diluted with water to the strength required. If lemons are not in season, sirup of lemons may be used, or the crystallized citric acid and sugar, adding a few drops of the essence of lemon. Like all drinks of this kind, it is rendered more refreshing by being iced; it may be kept bottled.

3829. *Orangeat*, or *Orange Sherbet*, is made nearly as above, only using oranges instead of lemons; some prefer it to lemonade.

3830. *Sherbet* is a favourite Eastern beverage, universally used among wealthy Mohammedans, to whom the Koran forbids the use of wine. It consists of water, the juice of lemon, orange, or other fruits, with sugar, flavoured farther with honey, spices, and even perfumes. Its agreeable acidity, blended with sweetness, renders it well calculated for assuaging thirst in a warm climate. The poorer classes, who cannot afford to have it so rich, drink water prepared by a little sugar and fruit juice. In India this is carried about in goats' skins for sale.

3831. *The juice of the apple and pear*, it has been suggested by Mr. Knight, might be used with great advantage for preparing a beverage. He has frequently, he says, reduced it by boiling to the consistence of a weak jelly; and that in this state it has remained several years without the slightest apparent change, though it has been intentionally exposed to much variation of temperature. A large quantity of the inspissated juice would, he observes, occupy but a very small space; and the addition of a few pounds of it to a hogshead of water would probably, at any time, form a liquor a good deal similar to cider or perry. It might also, he thinks, be used to supply the place of *rob of lemons* and *oranges*; and might be obtained at a much lower price. It would be useful in long voyages, and this hint might be advantageously used in domestic economy for obtaining an agreeable beverage.

3832. *Summer Cooling Beverage.*—Bruise any fruit you like, as cherries, currants, strawberries, raspberries, &c., add water and sugar to your taste, and strain it; it should be kept in a cool place: or dissolve fruit jelly or rob in boiling water, and let it cool.

3833. *Capillaire* is so called from being prepared from a species of fern called *Capillus Veneris*, or *maiden hair*, a native of Britain; but almost any other fern may be substituted for it. The decoction is considered as pectoral and slightly astringent; it is thought to be useful in allaying the tickling of a cough. The true capillaire made of a sirup of this, flavoured with orange-flower water, has generally been brought from France; and a sirup of the Canada sort, made with maple sugar, is sometimes received from America. A pleasant summer beverage is made by adding a spoonful of capillaire to a tumbler of water.

3834. *A liquid called Capillaire* is also made thus. Beat up sixteen pounds of white sugar and six eggs in three quarts of water; boil it to a sirup, and skim it well; add the eighth part of a pint of orange-flower water, or rose water. This is useful to sweeten liqueurs, or to make a pleasant summer draught with water and lemon juice.

3835. *Orgeat.*—This is made of sirup of almonds, mixed with water that has boiled and become cold, in the quantity most agreeable to the palate; a table-spoonful of it in a tumbler of water makes an excellent drink. The sirup of almonds may be made thus: Blanch and pound in a marble mortar one pound of Jordan almonds and one ounce of bitter almonds; add a spoonful or two of orange-flower water. Mix a pint of rose water with another of spring water, add this to the almonds, and pass the whole through a lawn sieve. Then boil three pints of clarified sirup, and, when it boils, put in the almonds, and let them boil one minute: when cold, put it into bottles, and cork it for use. To make it expeditiously for immediate use, pound the almonds as above; mix them with a quart of water, one of milk, and one of clarified sirup or capillaire; pass through a sieve.

3836. *Vinegar and Water.*—It is commonly known that cold water is dangerous when used by persons heated with labour or by any severe exercise; and yet it is necessary to supply the waste and exhaustion of perspiration in some way or other. When spirits or wine are added in small quantities to water, it may be used, even if cold, with little danger; but severe labour or exercise excites a degree of fever, and that fever is increased by spirits or fermented liquor of any kind. On this account, Dr. Rush, in a publication, recommended that labourers in the fields, particularly at harvest time, should allay their thirst by water containing a small quantity of vinegar, about a tea-spoonful to half a pint of water, which would have the desired effect without stimulating or increasing the heat of the body; and he states that those labourers who have used this beverage have found themselves more refreshed, and less exhausted at night, than when they drank water with spirits. This is not a modern practice merely; for the Romans used vinegar to mix with water for the drink of their soldiers. M. Denon informs us that he experienced great benefit from a drink made of vinegar, water, and sugar when in the burning climate of Upper Egypt. In some districts of England and Scotland, the labourers during harvest use no other beverage than milk and water, butter-milk, or whey, often sour; and, though they are glad to get beer or ale, confess that they are sooner thirsty again after drinking either than after milk and water or whey.

3837. *Raspberry Vinegar and Water.*—Raspberry vinegar is made by squeezing the juice of three quarts of raspberries into a quart of vinegar, and then simmering the vinegar for about a quarter of an hour, with two pounds of sugar, in an earthen pipkin not glazed with lead. When cold, it is to be corked; and a small spoonful of this in a glass of water makes a very cooling and refreshing drink.

3838. *Cream of Tartar* is much used for a cooling drink in warm weather: sugar and the rind of lemon may be added. Half an ounce of cream of tartar will do for a quart of water, which should be boiling; strain when cold.

3839. *Table Beer*, when fresh, is perhaps, upon the whole, the very best, or at least the most wholesome common beverage we have; and it was so considered by the late Dr. Babington.

SECT. II.—BEVERAGES CONSISTING OF WATER IMPREGNATED WITH CARBONIC ACID GAS, TOGETHER WITH CERTAIN SALINE INGREDIENTS.

3840. *General Remarks.*—A class of beverages has of late years come into use, consisting chiefly of water impregnated with carbonic acid gas. It has been long known that many mineral waters, such as the Seltzer and Pyrmont, owe their brisk, sparkling appearance and agreeable acidulous taste to carbonic acid; and to this, likewise, many of their medical virtues are attributed. Experiment has shown that water, under the usual pressure of the atmosphere, absorbs about double its own bulk of this gas when brought into contact with it, and that this absorption is increased considerably by agitation and pressure. It became a practice, therefore, to imitate, by artificial means, these mineral waters, and to use them occasionally as a beverage. The carbonic acid was easily produced, and, by proper apparatus, water was made to absorb it; also, sometimes, those saline ingredients were added which chemical analysis had demonstrated to exist in the natural mineral waters.

3841. *For the purpose of impregnating water with carbonic acid gas, nothing more is necessary* than to put some pieces of pounded marble or chalk into a bottle, *a*, *fig.* 569, and to add some diluted sulphuric or muriatic acid: a glass tube, *b*, bent to a proper shape, must be inserted into the cork of the bottle, through which the gas generated by the action of the acid upon the carbonate of lime can pass into another vessel, *c*, previously filled with water, and inverted, with its mouth *below the surface of water*, in a basin or trough, *d*, *fig.* 569. The gas will expel the water in the vessel *c*, and occupy its place. When the vessel is half empty, cork it under water, and, taking it out, shake the water, which causes it to absorb the air and become acidulous.

Fig. 569.

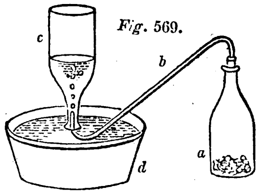
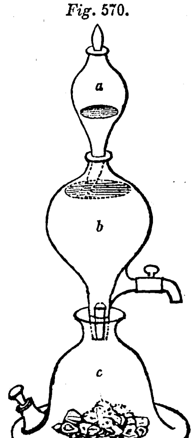


Fig. 570.



3842. *Nooth's apparatus* was one of the earliest contrivances for causing water to absorb carbonic acid, or making aërated water; and, about forty years ago, this was employed to a considerable extent, and might frequently be seen standing upon the sideboard, preparing a cooling beverage of the same kind as our present soda water, though much less powerful. This apparatus, which may still be useful in imitating mineral waters, and which has an elegant appearance, consists of three glass vessels, *a*, *b*, *c*, *fig.* 570, fitting into each other, yet capable of being easily detached. Into the middle vessel, *b*, is put the water to be impregnated; and into the lower one, *c*, is put some white marble or chalk coarsely pounded, together with dilute muriatic or other acid, which, by its action upon the chalk, sets free the carbonic acid gas which has been fixed in it, and hence had been named "fixed air." The gas thus disengaged ascends through a glass valve in the neck of the vessel *b*, the valves permitting the air to ascend, but preventing the water from coming down: the greater part of the gas is absorbed by the water in *b*, but a part is not absorbed, and this rises through the tube into the upper vessel, *a*, which also contains some water; and, lastly, what still remains unabsorbed escapes through its neck at the top, in which a heavy glass stopper, fitting in loosely, acts as a valve to confine it until its force becomes too great; and thus there is no danger of the glass vessel bursting by the extrication of the gas, which would be the case was there no valve. As the weight of the water in *a* prevents the air from rising into it until it has acquired so much force as to overcome that weight, the gas is subjected to a degree of pressure much greater than that merely of the atmosphere; and hence the absorption is proportionally increased, although this pressure falls far short of the means at present resorted to. By adding iron to the water, a small quantity was dissolved, and thus an artificial chalybeate may be produced; and, by the addition of salts, Seltzer and other mineral waters may be imitated. The prepared water in the vessel *b* is drawn off by a glass stop-cock, and the materials for making the gas are introduced through a glass stopper in the lower vessel. Though this apparatus has been long out of fashion, yet it is within the recollection of many persons still living.

3843. *A great number of simple contrivances* have been invented for the purpose of impregnating water with carbonic acid, one of which consists of a small cask fixed upon a horizontal axis like a barrel churn, which is half filled with pure water; carbonic acid gas is let into this cask through a tube that conducts it from the vessel in which it is generated in the same way as in Nooth's apparatus from chalk or marble and diluted acid. The bung of the cask must be kept open till all the common air has been driven out by the carbonic gas, which may be known by bringing a lighted taper to the bung; if the light is extinguished at once, it is certain that the space above the water is occupied by the gas generated. The bung being now securely fastened down, the cask is whirled round occasionally to agitate the water and increase the absorption. The vessel for generating the gas may be of glass or earthen-ware, as a large bottle; and a safety valve should be contrived some where upon the tube that conducts it to the barrel, to prevent accidents from the elasticity of the gas.

3844. *Impregnating water with carbonic acid, and making what is called soda-water*, is now managed on an extensive scale by manufacturers, who have very perfect apparatus for this purpose, in which considerable pressure and agitation are employed; but, as soda-water is now sold in almost every corner of the kingdom, we do not consider it necessary to detail the mode of operation in making it, as it demands more attention and care, and more expensive machinery than is likely to be resorted to in private families.

[The impregnation of water with atmospheric air has lately been practised in this country, and has been found to furnish a beverage little less attractive, when cooled with ice, than if carbonic acid gas were employed. The same apparatus for introducing the air, and for retaining it by compression, will answer; and either simple water, or that containing a solution of soda, may be used. When drawn from the fountain and mixed with sirups in the usual way, it is not easy to distinguish it from the carbonated water when it is kept sufficiently cold.]

3845. *Single Soda-water* is an acidulous water simply impregnated with carbonic acid.

3846. *Double Soda-water*, which is that now manufactured and sold in tightly-corked bottles, is water having a little carbonate of soda dissolved in it, in the proportion of two ounces to the gallon, and containing carbonic acid gas that has been forced into it by a particular apparatus, with agitation to cause greater absorption. These bottles are corked in a peculiar manner; and, when the pressure of the cork is removed, the gas, by its elasticity, forces out in the manner well known.

3847. *Effervescing draughts* are agreeable imitations of the natural acidulous waters. The best is made by adding a solution of carbonate of soda to some fresh lemon juice. The acid of the lemon attracts the soda from the carbonic acid, the escape of which in a gaseous state occasions the bubbling appearance called *effervescence*. When lemons are in season this is easily made, and forms a very refreshing and cooling beverage much employed in cases of fever, and very cooling in sultry weather.

Lemon juice, containing a great deal of mucilage, cannot be kept long by itself; but as it cannot always be had fresh, means have been found to preserve it in a solid and crystallized state, and a portion of this dissolved, added to the carbonate of soda, is as effectual as the lemon juice itself. The acid of the lemon being the same as that in the citron and lime, it is often named *citric acid*, from the first of these fruits, in which it exists very abundantly, and from which it is prepared in a concrete state. The concrete acid being extremely portable, is very useful to travellers, particularly in long sea voyages; and lime juice is much used in the navy as a preservative from scurvy.

The best modes of making this agreeable and useful beverage is the following: Into a half-pint tumbler of water stir thirty grains of *carbonate of soda* powdered, and into another similar glass squeeze the juice of half a good lemon, or twenty-five grains of crystallized acid of lemon (citric acid) powdered. When the powders are quite dissolved, pour the contents of one glass into the other; a brisk effervescence will take place; drink immediately. It must be observed that the first tumbler must be large enough to hold also the contents of the second. If it be required stronger, increase the quantity of each material. The proportions of each should be so managed that neither an alkaline nor an acid should predominate, except, for some reason, an alkaline or an acid draught is required. This beverage may be agreeably flavoured by dissolving a little raspberry or red currant jelly in the water before the salts are put in; and if these be preferred, a little tincture of ginger, or sirup of ginger, a bit of sugar rubbed on a lemon, or a little white wine. Ten drops of *tinct. ferri muriati* added will form a chalybeate. It is to be observed that the crystallized citric acid contains none of the agreeable aroma of the fruit, as that resides solely in the skin.

3848. *A cheaper mode of making effervescing draughts*, now become very general, is by using the *tartaric acid* with the *carbonate of soda* instead of the citric, and papers of each, containing the proper quantity for taking at one time, are commonly made up in packets of different colours, and sold at all the chemists and druggists' shops under the name of *soda powders*.

3849. *The tartaric acid exists in the juice of several acidulous fruits*, particularly in the grape. It is chiefly procured from the crude tartar which is deposited in the making of wine. (See Wine, Book VIII., Chap. IV.) This tartar is the tartaric acid in combination with potash, that existed in the grapes from which the wine was made. To procure the acid pure, the tartar is dissolved in boiling water, and chalk or lime is added; this decomposes the tartar, and tartrate of lime is obtained, which is afterward decomposed by sulphuric acid, which takes away the lime, leaving the tartaric acid free.

3850. *Ginger Beer for keeping.*—Take five gallons of good water, six pounds of loaf-sugar, three ounces of sliced or powdered ginger, boil them together for half an hour. Peel six lemons, add the peel, and boil for another quarter of an hour. A few minutes before taking it off the fire put in the lemon juice; and when the whole has cooled down to the temperature of new milk, pour it into a cask, and add to it half a pint of good yeast; stir it well together, and let it work for two or three days, according to the weather. Then strain it off from the lees into another cask, and add to it a pint of brandy. Hang in the cask a little isinglass in a muslin bag, and stop the cask down for three weeks; then bottle in stone bottles, cork, and wire it. It will be fit for use in forty-eight hours. This is, in fact, a weak sugar beer, flavoured strongly with ginger and lemon peel.

3851. *Common Ginger Beer.*—Take one ounce of powdered ginger, half an ounce of cream of tartar, one pound of white sugar; mix these in a gallon of water, and simmer it over the fire for an hour; when cooled to milk-warm, add a table-spoonful of yeast, and ferment it for twelve hours. Then put it into stone bottles, cork, and tie it well down. It will be fit for use in forty-eight hours.

An imitation of Ginger Beer is made by means of what are called *ginger beer powders*, which are likewise sold. Take eight grains of finely-powdered ginger, twenty-six grains of carbonate of soda, and one drachm of white sugar; powder these in a mortar, mix them intimately, and dissolve them in a tumbler half filled with water. Then add the tartaric acid, as above described in the soda powders.

3852. *An agreeable beverage may be made*, which will be useful in hot weather as a light summer drink, by mixing a bottle of ale or porter with ten quarts of water, adding a pound of coarse brown sugar and two ounces of ginger. This is not exactly ginger beer; but if well mixed, then bottled and corked, it will be found to be brisk, and fit for drinking in a few days.

SECT. III.—BEVERAGES COMPOSED PARTLY OF FERMENTED LIQUORS.

3853. *Hot spiced wines* were much in use till the beginning of the sixteenth century; and some of these favourite compounds were known by the names of *ypocras*, *sack*, and *clary*. The first of these, which took its name from the bag through which it was strained, called by apothecaries "Hippocrates's sleeve," was made either of white or red wine with aromatics, such as ginger, cinnamon, aromatic seeds, and sugar. Clary was made from claret, with honey and aromatics; and sack from the wine of that name, a kind of sherry. These were drunk as a "night cap," and at the conclusion of a banquet. Le Grand, in his "Vie privée des François," observes that the poets of the thirteenth century speak with rapture of these delicious beverages; and it is said that they were highly esteemed in convents and universities. A scale of perfection was even observed: when the compound was made of Bordeaux wine, it was simply called *Bishop*; but received the name of *Cardinal* when old Rhine wine was used; and rose to the dignity of *Pope* when imperial Tokay was employed. The vestiges of these ancient mixtures may still be seen in our mulled wine and bishop.

3854. *To mull Wine.*—Boil the spices (cinnamon, nutmeg grated, cloves, and mace) in any quantity approved, in a quarter of a pint or better of water; put to this a full pint of port, with sugar to taste. Mix it well, and serve hot with thin slips of toast or rusks. Lemon or orange juice may be added, and the water may be strained off from the spices. *Ale or porter may be mulled* as above, and have toasts or biscuits put to them.—(*Meg Dods.*) Formerly the yolks of eggs were mixed with mulled wine, as in making custard or egg-caudle, and many flavouring ingredients were employed which are now disused.

3855. *Bishop.*—The day before it is wanted, grill on a wire-grill, over a clear, slow fire, of a pale brown, three smooth-skinned, large, bitter oranges. Place them in a small punch-bowl that will about hold them, and pour over them a full half pint from a bottle of old Bordeaux wine, in which a pound and a quarter of loaf sugar is dissolved. Cover with a plate. When it is to be served next day (though it may lie over two or three days), cut and squeeze the oranges into a small sieve placed above a jug, containing the remainder of the bottle of wine, previously made very hot; add more sirup if it is wanted. Serve hot in large glasses, or in summer it may be iced. Bishop is often made of Madeira in England, and is perfumed with nutmegs, bruised cloves, and mace. It ought, however, to be made of old generous Bordeaux wine, or it fails of its purpose as a tonic liqueur. It is reckoned highly stomachic, and is served at French dinners, *savans* and *récherchés*, either as the *coup d'après* or after the dessert.—*Meg Dods.*

3856. *The wassail bowl* of ancient times was made of mild ale, well spiced and sweetened; and sometimes with eggs beat up in it.

3857. *The ancient Ypocras* was made of a quart of red wine, an ounce of cinnamon, half an ounce of ginger, a quarter of an ounce of pepper, and half a pound of sugar, all put into a bag and infused in the wine.

3858. *Cool Tankard.*—The composition of this ancient beverage is of great variety. The basis is home-brewed ale, spices, and seasoning herbs. To a quart of good ale, add a glass of white wine, and another of brandy, some lemon juice, and the rind pared very thin; a little well-toasted bread; a sprig or two of burrage or balm, and a little nutmeg grated. Some use cider instead of ale.

3859. *Egg Flip.*—Heat a quart of good home-brewed or other ale, and pour it into a jug with a spout; in a similar jug beat up three or four eggs with a quarter of a pound of moist sugar, and one or two glasses of rum or brandy, flavouring it with nutmeg, ginger, and grated lemon peel. When the ale is quite hot, but not boiling, pour it quickly into the jug with the eggs, return this back again into the other jug, and thus keep pouring the mixture backward and forward from one jug to another, till the whole is thoroughly incorporated, and as smooth as cream.

3860. *Egg Hot.*—This is made in the same manner as the last, only there is no spirits nor spices; simply the egg, and ale or beer, with sugar.

3861. *Ale Posset.*—Boil a pint of new milk with a slice of toasted bread; pour a bottle of mild ale into a punch-bowl, sweeten, and add spices, and then pour the boiling milk over it. A fine head should rise.

3862. *Sack Posset.*—Boil some cream and grated sweet biscuits; add sugar, cinnamon, and nutmeg. Warm some sherry, and stir it into the cream; then pour the whole quickly from one vessel to another until it be perfectly smooth; or it may be made with eggs beat up in milk instead of the cream.

3863. *Punch is a beverage made of* various spirituous liquors or wine, hot water, the acid juices of fruits, and sugar. It is considered to be very intoxicating; but this is probably because the spirit being partly sheathed by the mucilaginous juice and the sugar, its strength does not appear to the taste so great as it really is. Punch, which was almost universally drunk among the middle classes about fifty or sixty years ago, has almost disappeared from our domestic tables, being superseded by wine.

3864. *English Punch.*—Rub the yellow rind of a lemon with lump sugar; put this sugar into the punch-bowl, and squeeze the lemon juice to it, add the spirits, rum and brandy, in such proportions as are preferred, incorporate the spirits thoroughly with the sugar and lemon before pouring in the boiling water, and keep stirring the whole while this is pouring: some add Madeira or sherry. Punch is kept also cold in bottles, and in summer is very agreeable. In Scotland it is frequently made with whiskey. Where fresh lemons cannot be had for punch, or similar beverages, crystallized citric acid, and a few drops of the essence of lemon, will be very nearly the same thing.

3865. *Regent's Punch.*—A bottle of Champagne, a quarter of a pint of brandy, a glassful of *veritable Martinique*: with this mix a pint or more of a strong infusion of the best green tea strained, and capillaire or simple sirup to taste.—*Meg Dods.*

3866. *Norfolk Punch.*—Pare thirty-two Seville oranges, and the same number of lemons; infuse the peel for two days in a large bottle or jar with a gallon of brandy (or flavourless whiskey), a little reduced in strength; clarify in a gallon of water four pounds of sugar; when cold, strain the brandy (which will now be a tincture) to this; add the juices of the oranges and lemons, previously strained and bottled, when the peel is taken off; cask the liquor, or put it in a jar, and stop it well; in six weeks it may be gently poured, or drawn off, and bottled. A tincture of bruised nutmegs and cloves may be added to this compound; this will keep any length of time, and in any climate.—*Meg Dods.*

3867. *Milk Punch.*—Rub off on lumps of sugar the zest of a dozen lemons; pare off what you do take off on the sugar, but take none of the white stuff; infuse in two quarts of brandy; strain off in two days, and add of clarified sirup two pounds, and of water two quarts, with half a pint of hot new milk; strain through a jelly bag, and keep in a close jar or small cask till it fines, which will be in six weeks or less. Milk punch may be made extempore by adding a little hot milk to lemonade, and straining through a jelly bag; it is generally drunk cold.

3868. *Wine Punch.*—Port wine, two pints; arrack, two pints; the juice of twelve lemons; sugar, one pound; hot water, six pints.

3869. *Tea Punch.*—Hot tea, two pints; arrack, thirteen ounces; sugar, four ounces; flavoured by rubbing off the yellow peel of the lemons; or green tea, juniper, and Champagne.

3870. *French Punch.*—Cut a lemon into thin slices, taking out the seeds; boil them in water, and add a pinch of green tea, and let it infuse five minutes; strain the whole, and add brandy and sugar sufficient.

3871. *Auld Man's Milk of Scotland, or Egg-nog of America.*—Beat the yolks and whites of six eggs separately; put to the beat yolks sugar and a quart of new milk, or thin sweet cream; add to this rum, whiskey, or brandy, about half a pint; put in the whites of the eggs whipped up, and stir the whole gently. It may be flavoured with nutmeg or rind of lemon.

3872. *Sangaree* is a kind of punch frequently drunk in the West Indies, and is composed of half Madeira and half water, acidulated with lime juice and sweetened with sugar.

3873. *Mint Julep of North America*, from Capt. Marryatt.—Put into a tumbler about a dozen sprigs of the tender shoots of mint; upon them put a spoonful of white sugar, and equal proportions of peach and common brandy, so as to fill up one third, or perhaps a little less. Then take rasped or pounded ice, and fill up the tumbler. Epicures rub the lips of the tumbler with a piece of fresh pineapple, and the tumbler itself is very often incrusted outside with stalactites of ice. As the ice melts, you drink. The Virginians, says Capt. Marryatt, claim the merit of having invented this superb compound; but from a passage in the Comus of Milton, he claims it for his own country.

3874. *Rum Shrub and Water.*—Rum shrub is made from the juice of lemons, with rum and sugar, but oftener of the juice of the lime, rum, and sugar. Great quantities of lime juice with rum are imported from the West Indies, for the purpose of making shrub and other liquors. A small quantity added to water makes an agreeable beverage. *Brandy Shrub* and *Currant Shrub* are made in a similar manner.

3875. *Spirits and water* warm, or cold as *grog*, are well known.

CHAPTER X.

ON TEA.

Sect. I.—History of the Introduction of Tea into Britain.

3876. *The beverage so named, and now become almost a necessary of life* in a great part of the British Isles, was wholly unknown to the Greeks and Romans, as likewise to our ancestors previously to the middle of the seventeenth century.

3877. *The date of its beginning to be used in this country* is well ascertained by the fact that a duty of eightpence per gallon was, in 1660, laid on the infusion of tea made and sold in coffee-houses in London; and that its use had not at that time become very general, is shown by an entry in the published diary of Mr. Pepys, secretary to the Admiralty: "September 25th, 1661.—I sent for a cup of tea (a China drink), of which I had never drunk before."

3878. *It does not appear clear by whom tea was first imported into Europe.* We learn from Mickle, in his "Introduction to the Lûziad," that the Portuguese, who had intercourse with China in 1517, were allowed to purchase silks, porcelain, and tea; but we have no evidence how far they availed themselves of this privilege with respect to the latter. That they were acquainted with the use of an article in such general consumption among the Chinese is rendered very probable from the circumstance that they are the only European nation who designate the plant by its national name of *tscha*, all others applying to it the provincial name of *te*, derived from the dialect of Tokien, the province with which the English and Dutch maintained their earliest intercourse. The Dutch arrived for the first time in China in 1601; but there is no authentic evidence that either they or the English, who appeared about the same time in the Eastern seas, imported tea during the first half century of their intercourse with the East. No doubt, however, from the facts we have noticed, it was brought to Europe about that time, and that the taste for it was beginning to spread in 1660.

3879. It was, however, so rare a commodity in England in 1664, that the English East India Company at that time brought two pounds two ounces of it as a present for his majesty; and it was not imported direct from China, but from Holland. In 1666, Lord Arlington and Lord Ossery brought over from the latter country a quantity, at which time it was sold in England for sixty shillings a pound. The Dutch procured it from Bantam, then one of the principal emporia of India, and much frequented by the junks or ships of Canton. But it was scarcely then considered as an article of commerce: for in 1667 we find that the East India Company gave the first order to their agent at Bantam to send home 100 pounds of tea for the purpose of making "presents to their friends at court."

From that time the consumption increased; and in 1678, nearly 5000 lbs. were imported: a quantity, however, which is now easily sold annually by a single shop in London. As a proof of the rapidly-increased demand for what had become a favourite article of luxury, about the end of the century nearly 20,000 lbs. of tea were brought every year to England; and in twenty years more the annual importation exceeded 1,000,000 lbs. The present enormous consumption in England of upward of 49,000,000 lbs. annually is perhaps greater than the quantity consumed in all the countries of the world besides, except China. The amount of the duty on tea in the year is about 4,603,000*l.*

Sect. II.—Tea Plant, and its Cultivation.

3880. *With respect to the tea plant* (*Thea*, Linn.) we have, until lately, been deficient in accurate information, as it was only cultivated in China and Japan, countries to which strangers are not permitted free access.

Linnæus was induced to think that there were two species, one of which produced the black, and the other the green teas; but later observations do not confirm this, and from various information received concerning the tea plant, some botanists are of opinion that the various qualities of teas depend upon varieties produced by soil, climate, and the age at which the leaves are plucked, as well as upon the management of them afterward; in short, that a single species has, like most other useful plants long cultivated, spread into several permanent varieties, two of which, the black and the green, distinguished by broad and narrow leaves, are chiefly known to us: these grow in different districts. When the leaves of black and green tea are expanded by hot water and examined by the botanist, though a difference of character is perceived, yet this is not sufficient to authorize considering them as distinct species.

3881. *The tea-tree or shrub belongs to the class and order* of Monadelphia Polyandria in the Linnæan system, and to the natural order of Aurantiaceæ in the system of Jussieu. Lately it has been made into a new order, the Theasia, which includes the Camellia and some other plants. It commonly grows to the height of from three to six feet; but it is said that in its wild or native state it reaches to twenty feet or more. In China it is cultivated in numerous small plantations. In its general appearance, and the form of its leaf, *fig.* 571, it resembles the myrtle; the blossoms are white and fragrant, not unlike those of the wild rose, but smaller, and they are succeeded by soft green capsules, containing each from one to three white seeds. These capsules are crushed for oil, which is in general use in China.

Fig. 571.

3882. *The tea-tree does not require a tropical climate,* but flourishes best in temperate regions. In China, where it is indigenous, the greatest part of the tea grows between the twenty-seventh and thirty-first degrees of north latitude, though the plant thrives to the north and south of these parallels. It also grows in Japan, Cochin China, Tonquin, and Ava, and it is raised without difficulty in our own green-houses. The part of China where the best tea is cultivated is called by us the "tea country," and consists of portions of five provinces; viz., for black tea, Tokien and Canton, but more particularly the first, where formerly European traders were permitted to resort, until the evils supposed to arise from the intercourse with foreigners induced the Chinese government to restrict all communication to a single port; and for green tea, Kiang-nan, Kiang-si, and Chi-kiang, but chiefly the first of these, that beautiful province of which Nanking is the capital. The worst teas, the bohea, come from Woping, a district in Canton.

In other parts of China, tea, though grown, is of inferior quality compared with that of the above-mentioned provinces, and is raised for local consumption only; or when of a superior kind, it loses its flavour when exported, like some of the fine wines of France.

The more northern part of China, as Pecheli, the metropolitan province in lat. 40°, is too cold for the successful culture of the tea plant; and in the extreme southern parts of China the heat is too great. It is not cultivated farther south than about Canton, where a few small plantations are to be seen. The producton of good tea depends upon soil and locality fully as much as that of good wine; like it, too, the produce varies according to the care with which the crop is collected and prepared for use. The quality of the crop varies also, like the vintage, with the nature of each season.

The best green tea is grown in the district of Hoey-chow-foo, the most southerly city of the province of Reang-nan, and about 700 miles from Canton. The soil in which it is reared is a decomposition of granite abounding in feldspar; and it is remarkable that it is from the same mineral the finest porcelain cups for drinking tea are manufactured. The black tea district is about 200 miles from Canton.

3883. *The cultivation of the tea plant requires great care.* It is raised chiefly on the sides of hills; and in order to increase the quantity and improve the quality of the leaves, the shrub is pruned, so as not to exceed the height of from two to three feet; much in the same manner as the vine is treated in France. They pluck the leaves one by one, selecting them according to the kinds of tea required; and notwithstanding the tediousness of the operation, each labourer is able to gather from four to ten or fifteen pounds a day. When the trees attain to six or seven years of age, the produce becomes so inferior that they are removed to make room for a fresh succession, or they are cut down to allow of numerous young shoots.

In China landed property is very much subdivided; and tea is, for the most part, grown in gardens or plantations of no great extent by proprietors little above the rank of peasants. The leaves, being gathered by the cultivator's family, are immediately carried to market, where they are purchased by a particular class of dealers, who dry them and otherwise prepare them to be sold to the "tea merchants." The latter complete the manufacture, sorting the teas according to their qualities, give them a final drying, and pack them up in chests, which are stamped with the name of the grower or manufacturer, and the merchant who makes them up.

3884. *Teas of the finest flavour* consist of the youngest leaves; and as these are gathered at four different periods of the year, the younger the leaves, the higher flavoured the tea, and the scarcer, and, consequently, the dearer the article.

3885. Perhaps one of the most authentic accounts which we have of the preparation of tea in China is that which was given in evidence before the House of Commons, September, 1834, by Mr. Reeves, who was for many years the East India Company's tea inspector.

"The tea plant in China has two distinct varieties, if not species, which respectively yield the *black* and the *green* teas. The tree is an evergreen. The pickings of the leaves begin in about May, when the plant is in full leaf, but ready to shoot out other leaves. In the black tea plant, the first shoot, or the bud coming out, then covered with hair, forms the fine *flowery pekoe*. A few days' more growth makes the hair begin to fall off; the leaf then expands and becomes the *black-leafed pekoe*. Some young shoots have fleshier and finer leaves, which makes the *Souchong;* the next best leaves make the *Campoi;* the next *Congou*, and the refuse and inferior leaves the *Bohea*. These are the states in which the black teas are collected by the tea farmers; and some very coarse teas used by the Chinese themselves are cheaper than the sloe leaves could be brought to market in this country. The tea of Woping in Canton is of this character. There is a greater difference in the qualities of black teas than of green.

"The varieties of green tea appear to originate, not from the stages of picking, like the black, but partly from difference of treatment and manipulation, partly from difference of soil. A large proportion of *Twankay* is the growth of a different district from that which produces the *Hysons*. When a tea merchant buys green tea from the farmer, he subjects it to the following process: he sifts it through one sieve, which takes out the dust, the *young hyson*, and the *gunpowder*, then through another sieve, which passes the *small leaf hyson* of commerce; two other sieves successively take out the second and largest degree of size, and what does not pass the third forms *hyson-skin*. The teas then undergo the process of firing, in an iron pan, at a great degree of heat, which gives the leaves a lighter twist, and brings them up to their colour. The tea which passes the first sieve is then put into a winnowing machine, and the fan blows the light leaf at the farther end, and the larger broken leaf at a shorter distance. The heavier teas, as the gunpowder and hyson, fall nearer or farther from the hopper, according to their gravity, and are separated by the winnowing machine. When fairly made, the difference between the gunpowder and the young hyson will be this: the young leaf which takes the long twist will form the young hyson, and that which takes the round twist will form the gunpowder. The same mode of manufacture is pursued with respect to twankay tea, the fine leaves of which make hyson."

3886. *Another account states* that the drying of the leaves is begun in the sunshine, after which they are carried into houses erected for the purpose, with charcoal stoves, each being covered with a large flat iron pan, on which, after it is heated to a certain degree, a half or three quarters of a pound of the leaves are put, and stirred about briskly with a kind of brush, to cause them to dry and curl up. They are then swept into baskets and rubbed or rolled between the hands to curl them still more, and again subjected to the heat of the stove. By repeating this process they are made to assume the appearance which we see. There is some difference between the modes of preparing the green and the black teas; but no authentic account of this difference has yet been received in Britain. There is no truth, however, in the report that green tea owes its colour to being dried upon plates of copper, for it is in fact dried upon iron plates. This tea has been carefully analyzed, and chemical tests do not detect any copper, which would thus appear if any existed. It has been stated that some vegetable dyes are sometimes used by the Chinese for the green; and it is asserted that they can make either black or green tea from the same leaves; but however this may be, these two kinds of tea are mostly produced from different plants and in different districts.

3887. *The poorer people of China*, who grow a little tea in their own gardens, it is said, content themselves with drying the leaves in an iron kettle over a slow fire, shaking the kettle as the leaves dry and curl up, and stirring them with their hands; when they judge the tea to be well done, they pack it in baskets, and hang it in the roofs of their cottages. It is not used until it has been kept a twelvemonth.

SECT. III.—VARIOUS KINDS OF TEA IMPORTED.

3888. *The following is a list of the various kinds of tea usually imported* into this country from China, with a statement of the prices paid for them at Canton, beginning with the lowest qualities:

Black Teas.

		s.	d.		s.	d.
Bohea of Woping or Canton	from	0	6	to	0	7
Bohea of Tokein	——	0	9	to	0	10
Congou	——	0	11	to	1	0
Campoi congou	——	0	11	to	1	2
Souchong	——	0	10	to	1	10
Ankoi souchong	——	0	9	to	1	0
Orange pekoe	——	1	0	to	1	4
Caper	——	0	10	to	1	0
Fine flowery pekoe	——	1	10	to	3	2

Green Teas.

		s.	d.		s.	d.
Twankay	from	0	9	to	1	1
Hyson skin	——	0	9	to	1	0
Young hyson	——	1	2	to	1	8
Hyson	——	1	8	to	2	3
Imperial gunpowder	——	1	9	to	2	3
Pearl gunpowder	——	1	9	to	2	5

These names are corruptions of Chinese words; but though they are not the terms employed by the Chinese themselves in their transactions with each other, they are well understood by them in their dealings with Europeans. Sir George Staunton informs us that the names Bohea, Congou, and Souchong are not given by the Chinese, who merely describe these teas as inferior, middling, and superior. These varieties necessarily graduate into each other; and some have supposed that it must be impossible to distinguish them always by the taste; but experience has shown that those whose business it is to taste and discriminate teas at the sales acquire the power of distinguishing pretty correctly the various sorts; sometimes by the smell alone, or, when that is not sufficient, by the infusion.

It is said that in the catalogues of the Chinese merchants there are at least one hundred and fifty names of teas; but many of these express the same sort, and others are invented to impose upon foreigners. Some of these teas are of so delicate a kind, such as the true imperial tea, that their flavour would be destroyed by a sea voyage, and hence they are never brought to us.

The following brief description of the various sorts of tea usually known in Britain may interest the reader.

3889. *Bohea.*—This is so called from the district (the Wo-ee-hills in Fokien, the great country for black tea) where it is principally grown. It is of two kinds, that of Fokien, which is nearly as good as congou, and that of Woping or Canton, which is the lowest quality of tea in the European markets. The last consists of the coarsest and oldest of the leaves, often the refuse, and on this account is the most liable to be adulterated both in China and in this country; it is said to be but little used in London, being mostly sent into the country; it is of a blackish cast, and yields a deep yellow infusion.

3890. *Congou* (*cong-fou*, "made with care").—The consumption of this black tea in England very much exceeds that of any other variety. Its infusion is lighter than that of bohea; the best kind, the Campoi congou, has a very agreeable flavour; but the cheaper kinds somewhat resemble bohea, and are probably often mixed with it.

3891. *Souchong* (*se-ou-chong*, "a very little sort").—This was formerly much imported, and is still so to a certain extent; but it is said that some of the finer kinds have of late almost disappeared from the English market, without any cause being assigned, and that the finer congou is often sold for it. Its infusion is of a greenish colour, and it has an agreeable flavour.

3892. *Pekoe.*—The class of teas which bears the name of Pekoe (*pe-kow*, "white leaf-bud") is the finest of black teas. The flowery pekoe consists of the early buds of the best tea plants, and are sometimes, in parcels intended for presents, intermixed with flowers, supposed to be those of the fragrant olive, which is discoverable in the form of small white particles; its infusion is light, inclining to green, has a violet scent, and very agreeable flavour. This tea is more common in Russia than in England, being chiefly the produce of the north of China: with us it is little used except for flavouring other teas.

3893. *Twankay.*—This is the coarsest of the green teas, and is little used in this country, except by the lower classes. It is said to be the growth of a different district from the hyson. *Singlo* is very similar to twankay.

3894. *Hyson.*—The hysons are the sorts of green tea most usually employed. When good, the infusion is a fine green, with a decided flavour. *Hyson skin* consists of the inferior leaves of the hyson separated in the manufacturing.

3895. *Gunpowder Tea.*—This is the best of the hyson, or green teas, and is so named from the smallness and roundness of the grain. It consists of the first leaves of the vernal crop of the green tea plant. What is brought to England is not mixed with the flowers of any other plant, like the pekoe; but some of the finest green teas imported by the Russians possess this admixture. What is sold for gunpowder tea by many grocers is only hyson of a small grain; and the latter is often employed to adulterate gunpowder tea. Real gunpowder tea should have a small, bright, well-curled leaf, and a very fine flavour.

Several other kinds of tea than those just mentioned are to be met with in lists of teas kept in shops; but these consist chiefly of mixtures of teas of various sorts, and are scarcely to be considered as actual varieties; the dealers, there is reason to believe, producing most of them for their customers, according to the demand, or their skill and ideas of profit. It is probable, likewise, that in future considerable alterations may take place in the varieties and classification of teas; and that the late endeavours to grow tea in other parts of the world, and the discoveries of wild tea in our lately-acquired province of Assam, may tend to this effect.

3896. *Besides the above teas in common use in Britain*, some other less known varieties are occasionally imported. Among these are, *Padre tea*, a very highly-flavoured souchong, made up in pound packets; *Caper Souchong*, scented, made up in the form of balls, and imported chiefly in small boxes; *Cowslip Hyson*, tea scented by the admixture of scented berries, that give it a cowslip flavour, &c.; *Ankoy teas*, grown in *An-khe:* these, though they resemble the teas of Canton, are inferior and cheaper. They are supposed to be gathered from wild tea plants, with which whole districts in China are covered.

3897. *Several plants, it is said, are employed by the Chinese in giving a perfume and flavour to teas;* as the leaves of Olea fragrans, Camellia sesanqua, Polygala thurans, Rhamnus thurans, &c. It appears that different tea farms in China produce teas of various qualities, in the same manner as wine is prepared of different degrees of perfection, according to the vines and skill of the manufacturer. These are often mixed by the Hong merchants, or their agents, to make up the marketable quality.

SECT. IV.—CHEMICAL ANALYSIS OF TEA, AND ITS MEDICAL EFFECTS.

3898. Few things have been more exclaimed against than the drinking of tea, the constant practice of which has been proclaimed to be injurious to the nerves, and debilitating to the constitution; yet the use of this beverage continues. It has been attempted, also, to be shown that it is a useless article of diet to the poor, as being devoid of nutriment, except it may be contained in the milk and sugar used with it; yet some explanation is necessary to account for the great partiality of all, particularly of the poor, for tea. Liebig observes, "We shall certainly never be able to discover how men were led to the use of the hot infusion of the leaves of a certain shrub (tea), or of a decoction of certain roasted seeds (coffee). Some cause there must be, which would explain how the practice has become a necessary of life to whole nations." General experience has proved that it is a valuable diluent, and particularly useful at the commencement of febrile complaints, and, being of a slightly sedative and astringent quality, it is allowed to be peculiarly refreshing after great fatigue. Upon the whole, it is not shown by facts that its effects upon the human constitution, when used in moderation, are of that injurious tendency that has been so frequently alluded to; on the contrary, there is no doubt that, among the lower classes in particular, its substitution for stronger stimulants has been extremely beneficial, and that its character has risen of late in the medical profession. It is, perhaps, less proper for breakfast than for an evening refreshment; and it is not advisable to allow it as a constant morning meal for young people, who require something more nutritive. Strong green tea, however, has remarkable and injurious effects on certain constitutions, producing tremour, distressing feelings, and sleeplessness when taken at night; hence it has been employed by ardent students to resist the desire for sleep.

3899. *Tea, when chemically analyzed, is found to contain* woody fibre, mucilage, a considerable quantity of the astringent principle, or tannin, a narcotic principle, which is, perhaps, connected with a peculiar aroma. The tannin is shown by its striking a black colour with sulphate of iron, and is the cause of the dark stain which is always formed when tea is spilled upon buff-coloured cottons dyed with iron. Lately, a crystallizable and salefiable constituent has been found in tea, which has been called *Theine*, and is supposed to be identical with *Caffeine*, one of the constituents of coffee. Theine exists in tea in combination with tannin, or tannic acid, forming tannate of theine, and is extracted by hot water, but precipitates on the water cooling. Liebig has conjectured that theine, from its containing nitrogen in its composition, and by its combination with oxygen and the elements of water yielding *taurine*, the nitrogenized compound peculiar to bile, may contribute to the formation of that secretion, and hence may perform an important part in the function of nutrition. If this conjecture should prove well founded, it may account for this liquid appearing to possess more nutritive property than has been supposed; why tea so often satisfies the poor as a substitute for animal food; and why females and literary persons who take little exercise manifest such partiality for it; and it would likewise show why none of the substitutes for tea which have been tried have been found equal to it, being deficient in the theine. It does not appear quite certain whether green or black teas contain the greatest quantity of the astringent principle, or tannin; for the analysis of Sir H. Davy gave most to black tea, whereas that of Mr. Brande ascribes the most to the green; the latter opinion is most generally received, though it is probable that the composition of both kinds of tea varies considerably in this respect.

Sect. V.—Adulteration of Tea.

3900. *Chinese tea has frequently been adulterated in this country* by the admixture of the dried leaves of certain plants. The leaves of the sloe, white thorn, ash, elder, and some others, have been employed for this purpose. Other plants have likewise been mentioned, as the leaves of speedwell, wild germander, black currants, syringa, purple-spiked willow herb, sweet briar, and cherry-tree. Some of these are harmless; others are, to a certain degree, poisonous; and the latter are the leaves of all the varieties of the plum and cherry tribe, to which the sloe belongs.

Adulteration by means of these leaves is by no means a new species of fraud; and several acts of Parliament, from the time of George II., have been passed specifying severe penalties against those guilty of the offence, which, notwithstanding numerous convictions, continues to the present time.

To such an extent had this illicit practice been carried, that it has been officially stated in a parliamentary report that upward of four millions of pounds weight of dried leaves were used annually to mix with tea. A patent was even taken out for the preparation of British leaves as a substitute for tea, and extensive works were erected for the manufacture; but it was soon discovered that the leaves so prepared found their way to the grocers, who employed them in adulterating foreign tea, upon which the manufacture was suppressed.

It is by no means easy to detect adulterations of this kind. The best mode is to employ the knowledge of the botanist, by moistening and spreading out carefully, and drying flat the suspected leaves, and then comparing their form with that of genuine tea leaves. The leaves of the sloe are not quite so long, a little rounder in their form, and not so deeply serrated or notched; but their general resemblance is so nearly that of tea leaves, that few, except botanists, could distinguish them; their astringency is greater than that of tea; and though the leaves are poisonous, that is not the case with the fruit, which has been used to adulterate port wine.

These leaves are not the only poisonous substances used; from the evidence given, it appears that in the attempt to imitate green tea, verdigris, and, what is worse, carbonate of copper, a strong poison, had been employed to give them the colour of genuine green tea. The carbonate of copper may be detected by making an infusion, and putting some into water impregnated with sulphuretted hydrogen; the water will acquire a black colour if this salt be present; but no change will happen if genuine green tea is used; we have already stated that it contains no copper.

Although frauds of this kind will probably always be attempted, and therefore it is proper to study the means of detection, yet, as they are always attended with a great deal of risk, another species of fraud, involving no legal penalty, is more commonly practised; this is, deteriorating certain teas, by mixing them with others of inferior quality. It is said that a great deal of twankay and bohea, the cheapest kinds of green and black teas, are disposed of in this way. It is well known that vast quantities of bohea are imported; and as very little of this tea is met with in the shops of London, it is concluded, and we believe not without good reason, that it is extensively mixed with congou. At present there appears to be no method of guarding against these frauds but by purchasing teas of the most reputable dealers.

3901. *The Chinese manufacturers themselves sometimes employ means of adulterating their teas;* and it is said that they dry vast quantities of the leaves of various trees for this purpose. Some tea was brought to this country from Sincapore, which was found to be mixed with other leaves; and this tea had been carried to Sincapore in Chinese junks. Similar frauds had been practised previously; but when discovered by the East India Company, who kept skilful inspectors for the purpose, such teas, when discovered, were never offered for sale, but were destroyed.

Sect. VI.—Consumption of Tea.

3902. The following statement of the consumption of tea in Europe, America, and the colonies is believed to come near to the truth:

	lbs.		lbs.
Great Britain	43,000,000	United States	10,000,000
Russia	6,500,000	British America and West Indies	1,500,000
Holland	3,000,000		
Germany	2,000,000	British India	1,000,000
France	250,000	Australia	250,000

This vast quantity of the leaves of a foreign plant, imported in most instances from a distance of fifteen thousand miles, may cost in China, in round numbers, about four millions sterling; and the total cost to the consumers, including duty, may be about sixteen millions. The Chinese, and the other Oriental nations, use scarcely any but black teas. In Britain, the black tea consumed is to the green as five to one. The Americans, on the contrary, use, in general, two parts of green to one of black. The English in Bengal and Australia use little else than green; and at Bombay and Madras they drink chiefly black tea. In Holland more black tea is used than green; and in Russia the consumption is almost all of black.

Sect. VII.—Purchase of, and keeping Tea.

3903. *Tea should be chosen* by the agreeableness of its odour, and as whole as possible, in order that it may be easily examined as to its leaf; and the greatest care should be taken that it has not been exposed to the air, which destroys its flavour.

The method employed by the Chinese to prevent this is extremely ingenious and effectual. It is well known that it is brought from China in boxes termed tea-chests, made of thin, hard wood, and lined with extremely thin lead, the method of making which is as follows: A man sits on the floor with a large stone slab before him, and a moveable flat stone on its edge. His fellow-workman, who stands by his side, pours a small quantity of melted lead on the slab, and the first workman instantly dashes down the moveable stone on the melted lead, which presses it out into a flat and thin plate, which he immediately removes from the slab; the rough edges of these plates are then cut off, and they are soldered together for use. Considerable dexterity is probably necessary in this operation, which does not appear yet to be imitated in this country. The tea-chests are remarkably strong, from the great toughness of the wood, the manner in which their corners are joined, and their being pasted over with paper. When emptied, they are sold by the grocers, and form remarkably cheap and convenient packing cases for various purposes.

Sect. VIII.—Cultivation of Tea in other Countries than China.

3904. *It had long since occurred to intelligent persons that it would be desirable we should not be wholly dependant upon so singular a nation as the Chinese for tea*, which has now really become an article of necessity. Trials made in several other countries proved that the tea plant might be easily cultivated, the climate required not being tropical.

From the variety of climate in that extensive portion of China where it grows, the tea plant would not appear to be a very delicate shrub, and there does not seem to be any reason why it might not be raised in some of our colonies, among which may be found every variety of climate.

3905. *In 1793 Lord Macartney procured some tea plants from China, and sent them to Bengal*; and, at various times, experiments have been made with respect to the cultivation of the tea plant in India, for which, in many parts, particularly in the Nepaul country, the climate and soil appear favourable.

Mr. Royle, in his "Illustrations of the Natural History of the Himala and Cashmere," has published much collected information respecting the tea plant, and upon the conditions which relate to the vegetation and the cultivation of these plants in China; and, from the whole, the author concluded that, in the Himala country, where so great an analogy exists in latitude, elevation, soil, climate, and the course of the seasons, as well as considerable identity of vegetation, there cannot be a doubt of success in introducing the cultivation of tea, with the strongest probability of all its properties remaining unimpaired.

Under Lord William Bentinck a committee was formed, in 1834, for the purpose of studying the subject, and attempts, partly successful, were made to visit the tea districts of China, in order to collect information, from which sanguine hopes were entertained that in many parts of India tea might be raised in considerable quantity.

3906. *But attention was turned more particularly to this object by the discovery, in 1834, that the tea plant was indigenous in Upper Assam*, a district that had lately been conquered from the Burmese, and which adjoins the Chinese province of Yunnan, where tea is cultivated. Mr. Bruce, Mr. Wallich, and Mr. Griffiths, eminent botanists, were commissioned by the government of India to explore this country, and their report confirmed the accounts that had been given. The tea plant was found growing wild through an extent of thirty or forty miles in Assam, and was used by some of the native tribes. Accordingly, active steps were taken for forming experiments on a considerable scale to cultivate tea in this district; and the result appears to promise ultimate success. The wild tea shrubs flourish in Assam in woods or jungles, where they are protected by the larger trees, and appear to prefer a moist situation. Some of these jungles have been converted into tea plantations, by clearing away much of the trees, and planting branches of the tea shrubs. Some native Chinese have likewise been procured, who are conversant with the manner of gathering and preparing the leaves for use.

Samples of Assam tea have been sent to this country; and having been placed in the hands of several public bodies and private individuals, they have been reported favourably upon; there is, therefore, every prospect that, in the course of time, a considerable supply may be obtained from this source. It does not appear easy at present to compare this tea with that of China, on account of the novelty of the discovery, which will require much experience to render very available. The tea, although evidently the genuine plant, does not appear to correspond exactly with any of the Chinese teas, whether from some slight difference in the cultivation of the shrub, or in the curing of the leaves, but it is said to be most analogous to souchong; of course, the quality must vary, like the teas of China. The specimens yet imported having been considered chiefly as objects of experiment and curiosity, and, consequently, sold at a high price, it is impossible as yet to form an idea of how far this acquisition may render us independent of China; time and much experience will be necessary to solve this problem. In the mean time, the circumstance is highly interesting, particularly since Assam is a hilly country, where the climate is excellent and temperate, and possesses a great variety of beautiful and picturesque situations. Several varieties of the silkworm are likewise found indigenous in it.

3907. *Many attempts have been made by other European nations to cultivate the tea plant* in their colonies with the assistance of Chinese labourers, but hitherto without much profitable result. The difficulty probably does not consist so much in finding a suitable soil and climate as from the high price of human labour, and the great trouble and expense of collecting and preparing the leaves. Tea has been cultivated in Brazil, Carolina, Louisiana, and Rio Janeiro; and the Dutch have grown a good deal in Java.

3908. *The cultivation of the tea plant in England* is perhaps not likely to be attended with any advantage farther than as a matter of curiosity. Both the green and black tea plants have been grown in England. The green tea plants are more hardy than the black in this climate, being kept out in the open air with little protection during the winter, as at Kew, and Messrs. Loddiges, and even as far north as Forfar. The black tea plant is more tender, and is unable to stand unprotected the cold of an English climate. The leaves of the green tea plant grown in England are larger than those of the black tea.

Sect. IX.—Plants employed as substitutes for tea.

3909. *Various plants are employed in different countries as a substitute for the tea-tree of China.* In New Grenada, they use *Alstonia theaformis*, said to be equal to the Chinese tea; in North America, *Gaultheria procumbens* and *Ilex Gongonha*; in Mexico, *Psoralea glandulosa*; in New Holland, *Correa alba*; in Kamtschatka, *Pedicularis lanata*. The leaves of *Lantana macrophylla* are said by Martius to afford an infusion that has exhilarating properties, and which is drunk as an exciting beverage in Brazil.

3910. *Of these, perhaps the most remarkable is the Ilex Paraguensis*, or *tea-tree* of Paraguay, nearly peculiar to that country, and called there *Yerva maté*, the latter term being the name of a particular kind of tea-pot, from the spout of which with a strainer the hot infusion is imbibed. This tree grows wild, and in great abundance in the dense forests in the northern and eastern parts of Paraguay, and is an evergreen about the size of the common orange-tree, the leaf not unlike that of Chinese tea. There is also a better sort, called *caamine*, produced by the Jesuit mission from cultivating the wild sort. When the leaves are gathered, they are dried at the fire, and packed into hide bags containing 200 lbs. each. The use of this beverage appears to have been known to the aboriginal inhabitants, and to have been communicated to the Spaniards. It is not only employed in Paraguay, where it is in universal use, but it is transported to La Plata, Peru, Quito, and Chili; in short, all over the countries in America formerly belonging to Spain, where the inhabitants are passionately fond of it, and drink it at all hours of the day. Some mix sugar with it; others lemon juice; and it is said that five millions of pounds are annually produced in Paraguay. It appears to have a sedative effect, and, like substances of this kind, produces baneful effects, if too much indulged in. Kotzebue states that it is used in Chili alone to the amount of 1,000,000 dollars annually.

3911. Several British plants have been recommended as substitutes for tea, particularly in cases where the Chinese did not agree with the constitution; sage, balm, and mint have been employed. Dr. Withering recommends the leaves of the different species of rose-trees, and of black thorn, which, when dried, he esteems one of the best substitutes for tea that has yet been tried; he observes that the first tender leaves of the whortleberries (*Vaccinium myrtillus*) can scarcely be distinguished from real tea, when properly gathered and dried in the shade. None of these, however, can be said to have all the properties of tea; and they are too imperfectly known to be depended upon.

Sect. X.—Use of tea in different nations.

3912. *This beverage has been used by the Chinese* from time immemorial. In the reign of the Emperor Fitzong, who ascended the throne in the year of Christ 724, or above eleven centuries ago, tea was subjected to a tax, which the Chinese historians inform us was loudly complained of by the people as a grievous oppression, because it fell on a "*necessary of life.*" We have a distinct notice of the use of tea in China by the Arabian travellers Wahat and Abuzaid, who visited that country A.D. 851.

3913. The Chinese drink their tea without milk (which is entirely a European addition), and, in general, without sugar. They throw some tea into a cup, and pour boiling water over it; they cover the cup with a shallow saucer, and let it rest some time. After it has stood sufficiently, they pour the clear liquid into the saucer, and drink it as hot as possible, which is, indeed, their practice with every kind of beverage. The tea used by the Chinese grandees consists of entire leaves, and therefore the extract is perfectly limpid.—*Dr. Mayer's Voyage.*

The Chinese also sometimes beat up the yolk of new-laid eggs with sugar, and mix this with their tea, which is an excellent addition for travellers. They say we suffer the water to remain too long upon the tea, which causes it to extract a bitter portion.

Its use extends to all classes: the mandarin in his palace and the labourer in the field are equally accompanied by the kettle and the tea-pot; and to handle the cups with elegance, and the service of the beverage, forms, as with us, an essential part of female education. The Chinese take it at all times throughout the day as a common beverage, and they likewise introduce it as a refreshment to regale their friends. The tea-pot forms even an important part of the equipage of the traveller, and, for those who have not time nor convenience to prepare their own tea, booths are erected for its preparation and sale on every great road. The higher classes use only the finest teas, and are particularly careful in its preparation; but the lower ranks employ tea often of execrable quality, and even substitute for it the leaves of other plants.

The Japanese, it is said, prepare and drink their tea in the same manner as is done in China; but we have had no accurate information respecting them of late.

3914. *Tea is also used among several other nations of Asia.* The Tonquinese and Cochin-Chinese grow tea, but import the best qualities from China. In Camboja and Siam there is also a considerable consumption of tea imported in Chinese junks, and it has been lately imported into England from the last-named country. The Burmese are also tea consumers; they import it from the neighbouring Chinese province of Yunnan, in parcels of a globular form; but, exclusive of this, the Burmese have a genuine native tea. Tea is also grown in Java, and a good deal of this is imported into Holland.

The natives of Hindostan, Persia, Arabia, and Turkey are not unacquainted with the use of tea, but have recourse to it, for the most part, only for its supposed medicinal virtues. According to the account given by Sir A. Burnes, the Turcomans of Transoxiana and the neighbouring countries are among the greatest consumers of tea. It is conveyed by Chinese caravans through the routes of Yarkand and Badakhshair, and there purchased by Moslem merchants, who forward it to Bokhara.

A singular preparation of tea is in use among the Tartar tribes from the borders of Russia to the Eastern Ocean. Partly for the purpose of rendering tea-leaves more portable and to preserve them, they are moistened with some slightly-glutinous fluid, and then pressed into moulds, from which they take the form of small bricks. To use it, they scrape off a portion of this brick and boil it with butter, flour, milk, and salt; and though we would scarcely anticipate that this preparation would be relished by European palates, some travellers who have tasted it describe it as far from unpleasant. The same tribes use also the infusion in the ordinary way.

3915. *The mode of preparing the infusion of tea in Europe*, or, as it is termed among us, "making tea," is nearly uniform. To make the infusion properly, it is essential that the water, when applied to the tea, should be boiling hot, and, that it should be so, some water is always poured into the tea-pot first, to warm it, and thus prevent it from abstracting heat from the water which is poured upon the tea, and lessening its effect. It is for the same reason that the water should be cooled as little as possible, that a small quantity is first poured upon the tea, and more added afterward for the first infusion. It is well known that the first infusion is the best, containing the chief part of the aroma, and that the second infusion, by adding more water, is less agreeable.

Dr. Kitchener recommends that all the water necessary should be poured in at once, as the second drawing is bad. When much tea is wanted it is best to have two tea-pots instead of two drawings.

Dr. Trusler's method was to make a very strong infusion by pouring boiling water upon the tea, and let it stand twenty minutes, putting into each cup no more than is necessary to fill it about one third full; then each cup was filled with hot water, from an urn or kettle; thus the tea will be always hot and equally strong to the end; and one tea-spoonful will be found enough for three cups for each person; whereas, according to the present mode of making it, a much greater quantity is used. This will be convenient in parties.

Dabuisson's Method.—Put the tea into a kettle with cold water; cover it close; set it on the fire, and make it very nearly, but not quite boil; then take it from the fire; when the leaves sink it is ready.

SECT. XI.—TEA-POTS AND TEA-KETTLES.

3916. *With respect to tea-pots*, the form is of less importance than the material of which they are made. About thirty years ago there was a warm and learned contest respecting the best substance for tea-pots, that is, what they should be made of, to "draw the tea" best. It is obvious that the nature of the material itself will have no particular action upon the tea, and that the question would be decided by determining what substance kept the water hot the longest. It had been supposed, from observation, that metal tea-pots performed the best; and yet the doctrine of the conducting powers of bodies, as understood at that time, appeared to be in favour of earthen-ware, which, being a worse conducter than metal, was supposed to prevent in a greater degree the escape of heat. Each substance, therefore, had its advocates: theory appeared to decide for one, while experience declared for the other. In the mean time, a discovery made by Professor Leslie of Edinburgh threw a new light upon this subject. He found that, although all heated substances throw off invisible rays of radiant heat, yet that the quantity projected depended much more upon the smoothness and roughness of the surface than upon the conducting power of the body; and that *polished* metal, although one of the best conductors of heat, was one of the worst radiators, metal not polished being a good radiator as well as conductor. Although earthen-ware, particularly the black unglazed sort, then so much in use (Wedgwood's), is a bad conductor, yet it is a better radiator than the polished metal, and, consequently, throws off more heat. Water, of course, cools sooner in an earthen-ware tea-pot, particularly if not glazed, than in one of polished metal. Since the date of this discovery, bright metal tea-pots have been considered to be most effectual in preserving the heat of the water; and hence both theory and practice now agree as to the substance best adapted for making a strong infusion of tea.

But for this purpose it is essential that the metal tea-pot shall be *kept bright*; for, if not, it is worse than the earthen-ware, as it is the polish of the surface that particularly acts in preventing the radiant heat from escaping. This principle, though here applied to a tea-pot, has many other important applications, since a bright metal tube of any kind will confine the heat of a fluid better than one covered with cloth, and, therefore, is fittest for conveying steam where it is required not to be given out.

3917. As a set-off against what has just been said, it is to be observed that, if a second quantity of water be poured into the tea-pot, the metal one will give worse tea than the earthen-ware one, because the greater heat of the metal will exhaust the tea at first, so as to leave very little for the second infusion; whereas the inferior temperature of the earthen-ware tea-pot, by extracting only a small proportion at first, leaves some soluble matter for the action of a subsequent infusion.

When the tea-pot is of metal, the handle should be of wood, ivory, or some other bad conductor, to keep it cool for the hand.

3918. *That a tea-pot should pour well*, it is absolutely necessary that either the lid should not fit quite tight, or that a small hole should be made in it. If the lid be quite tight, and there is no perforation, it is obvious that no water can be poured out, since no air can enter to supply its place. This hole is easily concealed by some ornament.

3919. *Tea-kettles* for supplying boiling water for tea have been employed since the first introduction of this beverage, according to the practice of the Chinese. They are made of a variety of forms, sizes, and materials, according to the particular places they are intended for. The largest and strongest for the kitchen are of copper or cast iron (*figs*. 572 and 573); smaller tea-kettles for the same place are made of tin, that is, of tinned sheet iron.

Fig. 572.

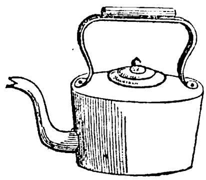
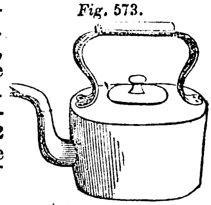


Fig. 573.



3920. The shoots of tinned plate used for tin tea-kettles are cut out to the proper shape, and are fastened together with a solder that easily melts with the heat of the fire. If such a kettle, *fig*. 574, be put on the fire with a sufficient quantity of water, the solder of the joints would not melt, because this, being a moveable body, carries off the greater part of the heat from the metal, and does not become hot enough for the solder to melt. If, however, the kettle should remain on the fire with very little water, it is evident that the solder which fixes the spout, made also of tin plate, will not be protected; and should the flame be permitted to reach this part, the spout becomes unsoldered, wholly or in part, and the kettle leaks, an accident well known to happen too frequently.

Fig. 574.

The best tin tea-kettles, *fig*. 575, have the spout formed, not of tin plate, but of stout iron tinned, without any seam, and fixed on to the kettle by being passed through a circular hole in the body, to which it is soldered inside, and therefore is safe from the flame: the handles of these are likewise made of stout iron tinned, and fixed on by rivets.

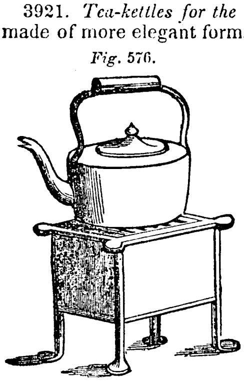
Fig. 575.

The joints of copper tea-kettles are all done with hard solder, which does not melt with the common heat of a fire; this is termed *brazing*.

A small tea-kettle, wholly of tin plate, costs only from 1*s*. to 1*s*. 3*d*., whereas one of the same size with strong spout and handle costs from 3*s*. to 4*s*. With care, the first will last a year or two, but are not fit for the common wear and tear of a kitchen. The *furring* of tea-kettles is a stony deposition from calcareous earth held in solution in the water; though it somewhat impedes the boiling, yet it serves to protect the kettle from rust. In countries where the water contains no dissolved earth, tea-kettles rust and wear out much faster.

3921. *Tea-kettles for the breakfast and tea table* are generally made of more elegant forms, and various contrivances are used to keep the water boiling while it is off the fire.

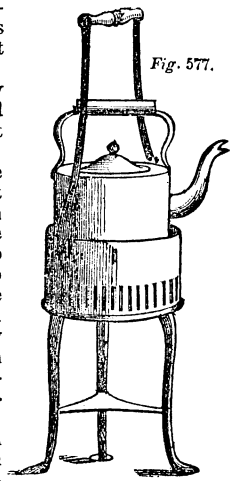
Fig. 576.



An old method of keeping the tea-kettle boiling was, to bring it in upon a chafing-dish filled with lighted charcoal, *fig*. 576. A little grating on it, which was made to raise up to put in the fuel, served to place the tea-kettle upon; but the fumes of the charcoal were found very pernicious, and this gave way to the invention of the tea-urn with an iron heater. The charcoal chafing-dish ought not to be used except in the open air.

Fig. 577 is a tea-kettle placed on a stand that contains a flat iron eater that keeps it boiling. These are usually made of tin-

Fig. 577.



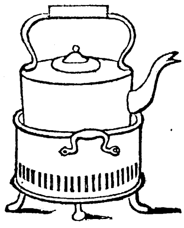


Fig. 578.

plate, and are very economical and convenient. By means of the long handle, the tea-kettle and stand may be carried in together.

3922. *Fig.* 578 is on the same principle, but with short handles.

3923. *Fig.* 579 is a tea-kettle of brass, placed on a stand with a lamp.

3924. In *fig.* 580 the water is kept boiling by iron heaters; *a a* are tubes of copper attached to the tea-kettle, and reaching to the bottom; *b* is one of the tubes detached. Within these are put irons red hot, of which *c* is one separate. The knob on the top of this iron forms the finish to the tube *b*. It is important that the lid of a tea-kettle should not fit so tight as to prevent entirely the escape of steam. When the lid fits perfectly tight, there is

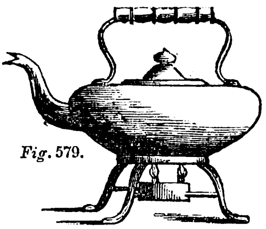
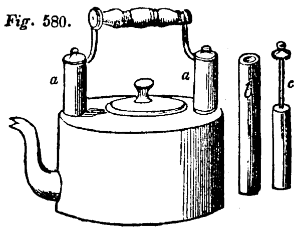


Fig. 579.

Fig. 580.



danger of the steam forcing the boiling water out suddenly through the spout, by pressing upon the surface of the fluid within, a circumstance which sometimes does occur, and which is very dangerous, particularly where there are children.

3925. *A tea-kettle, fig.* 581, *invented by Count Rumford,* and exhibited at the Royal Institution, has since been lately introduced as a novelty, perhaps without the second inventor knowing that it was not new, although the principle is described in the count's essays. If a common tea-kettle be placed upon an open fire, the heat and flame that rises round the sides has little effect, and it is only that which strikes the bottom that acts considerably in heating the water. By surrounding the body of the tea-kettle with a cylinder, or cone, of sheet iron, *a b*, extending deeper than the bottom of the kettle, and soldered tight round the top, there will, of course, be a cavity between this casing and the kettle. The heat, whether that of a fire or lamp, will not only strike the bottom, but will accumulate to a considerable degree round the sides, and occasion the water to boil much sooner than in the ordinary way. One of the objections to this is the weight of the whole.

Fig. 581.

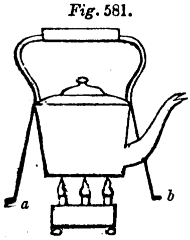
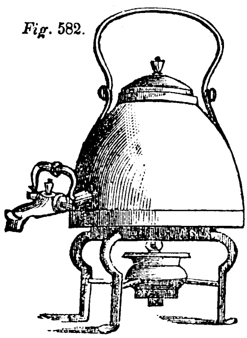


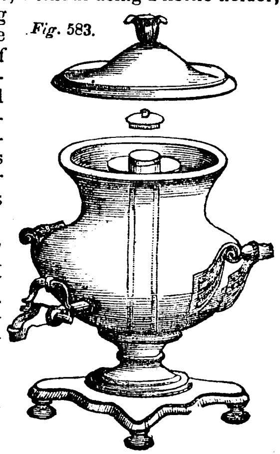
Fig. 582.



3926. *Fig.* 582, *is a tea-kettle fitted up on the same principle* with a lamp for the table, with a cock like a tea-urn.

3927. The best tea-kettles have handles turned of wood or ivory. One with a metallic handle cannot be touched, when filled with boiling water, without using a kettle-holder, made of some non-conducting substance, as cloth of some kind, or by wrapping a piece of paper round it; while a wooden handle, being itself a bad conductor, may be used without inconvenience. Glass, being a very bad conductor, is now sometimes employed for the thick part of the handles of tea-kettles.

Fig. 583.



3928. *It is said that tea-kettles have lately been made,* which appear to be all of copper, but which are only iron covered by a thin coating of copper by means of the new electrotype process. We mention this particularly, because, if such kettles have been manufactured, they may be offered for sale, and the copper will of course very soon wear off by cleaning.

3929. *The tea-urn* is certainly the most elegant mode of supplying water for tea. It is made in the form of a vase, but in a great varity of patterns. *Fig.* 583 represents one of the usual kind. In the centre there is a vertical tube, into which a cylinder of iron, heated red hot, is slipped down, and covered by a little lid, and that by the cover of the urn. This keeps the water in the urn at a boiling heat. Some tea-urns have lamps below them instead of iron heaters, which have the advantage of keeping the water hot any length of time.

CHAPTER XI.

ON COFFEE.

SECT. I.—HISTORY OF COFFEE.

3930. The introduction of coffee into this country is comparatively of recent date. We are assured by Bruce that the coffee-tree is a native of Abyssinia, and it is said to have been cultivated in that country from time immemorial.

As a general and esteemed beverage, we read of its having been first used in Arabia and Persia, but there are various accounts of its early history. Some say that, having been found useful by some Arabian dervises to keep themselves awake, it was introduced into Persia by a mufti of Aden, from whence it found its way to the principal cities of that kingdom. It was afterward carried into Turkey by Selim on his conquest of Egypt, but it was not until 1554 that it was publicly sold in Constantinople. As the Turks are forbidden the use of wine, it came into great request among them on account of its exhilarating qualities; in consequence of which, numerous coffee-houses were established that were much resorted to, causing great neglect of the mosques. This produced a solemn complaint from the ministers of the Mohammedan religion, and the drinking of coffee was at length prohibited by the mufti. The use of it was, however, again permitted by Solyman the Great, and it was then subjected to a tax, since which time it has been universally employed by the Turks. The Venetians brought it from the Levant in 1615; and, thirty years afterward, some gentlemen, returning from Constantinople to Marseilles, carried home with them this luxury.

3931. *It appears that coffee was first introduced in England by Daniel Edwards, a Turkey merchant,* whose servant, Pasqua, a Greek, understood the manner of roasting it. The servant, under the patronage of Edwards, established the first coffee-house in London, in George Yard, Lombard-street. Coffee was then sold at four or five guineas a pound; and a duty was soon afterward laid upon it of four-pence a gallon, when made into a beverage. Until that time its culture was confined to the East; and it was owing to the Dutch and French that it has been naturalized in South America and the West Indies. Coffee-trees were carried from Mocha to Holland, and so lately as 1714 a coffee-plant was presented to Louis XIV. by the magistrates of Amsterdam, and was placed at Marly under the care of the celebrated Jussieu: a few years afterward, some of the progeny of this plant was conveyed to Cayenne and Martinique, the Dutch having previously introduced it into Surinam. In these tropical regions its cultivation spread rapidly, and all the varieties of it, as the Mocha, the Bourbon, Jamaica, &c., have been the result of various soils, climates, and modes of cultivation. Thus, in the course of two centuries, has a berry, unknown originally as an article of food, except to some savage tribes on the confines of Abyssinia, made its way through the whole of the civilized world. On the Continent, especially in France, coffee is in universal request, and it is now very generally used in Britain. In Mohammedan nations it is drunk twice a day by all ranks, from the sultan to the peasant.

SECT. II.—THE COFFEE-PLANT, AND ITS CULTIVATION.

3932. *The plant that produces coffee* (*Coffea Arabica*) belongs to the natural order of the *Rubiaceæ*, and cannot be grown to advantage in countries where the thermometer descends at any time below 55°. The tree grows to the height of twelve or fifteen feet, with leaves not unlike those of the common laurel, although more pointed, and not so dry and thick, *fig.* 584. The blossoms are white, much like those of jasmine, and issue from the angles of the leaf-stalks. When the flowers fade, they are succeeded by the coffee-bean, or seed, which is enclosed in a berry of a red colour when ripe, resembling a cherry. Each berry contains two oval seeds, or beans, which are surrounded by a yellowish glutinous pulp. These seeds, constituting the coffee of commerce, have one side convex, and the other flat, with a little straight furrow, as we see in the common coffee-bean; they are placed with the flat sides together, and are covered by a tough membrane, called the *parchment.* The trees are raised from seed, and are afterward planted out at regular distances. They flourish best, and produce berries smaller and of a finer flavour, in light, dry soils than in those which are rich and moist, although in the latter they grow to a large size, and give a greater quantity of

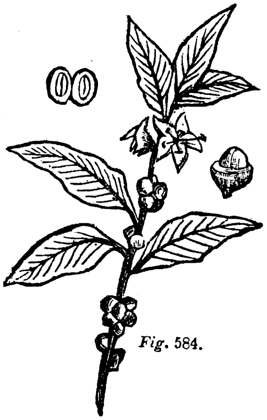


Fig. 584.

coffee. They begin bearing when they are two years old; and the aspect of a coffee plantation is very interesting during the time of flowering. In a single night the blossoms expand in such profusion as to resemble the effects of a snow-storm, but do not last longer than a very few days. The berries are known to be ripe when they assume a dark-red colour, and will drop from the trees if not gathered immediately. The Arabians suffer them to fall upon cloths placed for their reception; but in the West Indies the negroes are set to gather them.

3933. *To prepare the coffee-beans*, the berries are exposed to the sun for a few days, that the pulp may ferment and throw off a strong acidulous moisture. They are then gradually dried for about three weeks, and put into a mill to separate the husks from the seed. Some omit the fermentation, and separate the husks as soon as the seeds are gathered, by passing them under heavy rollers. The parchment is taken off by another mill, and after being winnowed to separate the chaff, the seeds, when quite dry, are ready. It is thought by some that the flavour of the coffee would be better preserved if it were sent home not divested of its coverings; in the West Indies they keep it in this manner, and beat it out only as it is wanted.

3934. *The best coffee is the Arabian;* this is most extensively cultivated in the province of Yemen, and chiefly in the districts of Aden and Mocha, whence the name of our Mocha coffee. This superiority is attributed partly to the difference of soil and climate, and partly to culture. Although Arabia is very hot in the plains, it possesses mountains where the air is mild, and the coffee is raised upon their slopes in a soil that is rocky and dry, but so situated as to admit of irrigation; though the berries are small, they have seeds of a very delicate flavour. In our colonies, coffee is planted in a richer soil, by which the berries are of larger size, but are comparatively insipid. In a deep, rich soil each tree will yield from twelve to sixteen ounces of coffee; but upon a soil the most favourable for the best kind, it will not yield above half that weight. In Arabia, where the climate is drier, they also cure the berry in a different mode.

Mocha coffee may be known by its having a smaller and rounder bean than any other, and likewise a more agreeable smell and taste.

3935. *Next in reputation and quality is the Java and Ceylon coffee*, and then the coffees of Bourbon and Martinique; also that of Berbice, a district of the colony of British Guiana. The Jamaica and St. Domingo coffees are less esteemed; the two extremities of the beans from these are pointed.

SECT. III.—ANALYSIS OF COFFEE.

3936. *Coffee has been analyzed by various chemists*, but the results of their analyses are far from being uniform. Raw coffee contains a yellowish-brown transparent extract, to which the name of *Caffeine* has been given, and which constitutes the characteristic portion of coffee; coffee contains also a resinous matter, an oil or fatty substance, an aromatic principle, and some tannin and gallic acid. Six pounds of coffee give ninety grains of caffeine, a proximate principle remarkable for containing 21·54 per cent. of nitrogen, which is a larger quantity than is found in most other vegetables; it is a crystallizable salt of a bitter taste, producing an exhilarating effect when taken in four or five grains, such as is felt when good coffee is drunk. It was first discovered by Runge in 1820, and it is considered by Liebig as nearly identical, if not quite so, with *Theine*, a principle existing in tea. See "Tea."

SECT. IV.—ROASTING AND GRINDING COFFEE.

3937. It appears that a considerable change takes place in the arrangement of the constituents of coffee by the application of heat in roasting it. Independently of one of the objects of roasting, namely, that of destroying its toughness, and rendering it easily ground, its tannin and other principles are rendered partly soluble in water; and it is to the tannin that the brown colour of the decoction of coffee is owing. An aromatic flavour is likewise developed during torrefaction, which is not perceived in the raw berry, and which is not produced in the greatest perfection until the heat has arrived at a certain degree of temperature; but if the heat be increased beyond this, the flavour is again dissipated, and little remains but a bitter and astringent matter with carbon.

3938. *The roasting of coffee in the best manner requires great nicety*, and much of the qualities of the beverage depends upon the operation. It is essential that the process should be performed in a close vessel, otherwise much of the fine aroma will be dissipated in the air. It is usually roasted in a hollow cylinder made of sheet-iron, which is kept turning over a brisk fire, to prevent any part from being more heated than another; and when the coffee has acquired a deep cinnamon colour, and an oily appearance, and the peculiar fragrance of roasted coffee is perceived to be sufficiently strong, it should be taken from the fire, well shaken, and suffered to cool. Not more than half a pound of coffee should be roasted at once for domestic use; for if the quantity is greater, it becomes impossible to regulate the heat in such a manner as to secure a good result. If the heat be so violent as to burn any part, the whole will be materially injured

Fig. 585 represents a very simple coffee-roaster, being merely a cylinder with a sliding door, turned over a charcoal fire made in the receptacle beneath, with a cover to shut close, and a tube to carry off the fumes of the charcoal. *Fig.* 586 is another, of a form a little different.

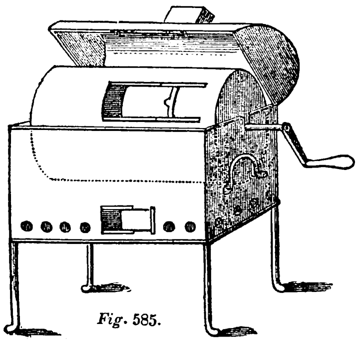


Fig. 585.

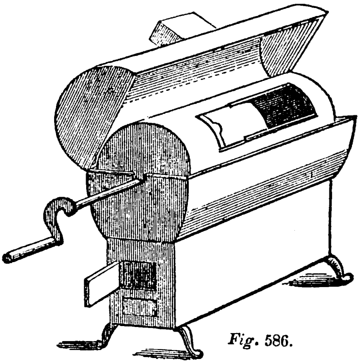


Fig. 586.

The coffee-roaster should never be filled above one third; for, by roasting, the bulk of coffee is nearly doubled, and sufficient space ought to remain to allow of turning the coffee readily, that every part may be equally exposed to the heat. Sometimes a similar cylinder of sheet-iron is used, but fastened to a spit that is turned by a jack.

3939. In Italy they roast coffee in small quantities very frequently in one of the thin flasks of glass used for oil, which answer extremely well if the roasting is performed over a charcoal fire, and the coffee shaken and turned often The non-conducting power of the glass is thought to give this material an advantage over metal, as being less liable to burn; added to which the progress of the roasting can be better watched. One of these flasks will roast somewhat less than a quarter of a pound at a time; and it is, perhaps, worth while mentioning that this mode is often found useful to the traveller.

It is desirable, in the commencement of the roasting, that the steam should escape as quickly as possible; and Mr. Donovan recommends that, instead of roasting the coffee in an atmosphere of its own steam, as is usually done, it should first be dried on an iron pan over a very gentle fire, keeping it constantly stirring so as to present new surfaces, until the colour becomes yellow. In this way the chief part of the water will be dissipated without exerting any detrimental influence on the substance which is afterward to form the aromatic bitter. After being thus dried, the coffee should be pounded into coarse fragments, by no means too fine; each kernel, as it occurs, being divided, perhaps, into four or five parts. In this state it is to be transferred into the roasting apparatus, and scorched to the proper degree. It is observed that when coffee is roasted in the usual way, without being broken, a portion often remains in the centre of the beans not sufficiently done.

3940. *The roasting of coffee for the dealers in London and Paris* is now become a separate branch of business, and some of the roasters perform the operation on a great scale with considerable skill; they are guided in the process by the tint of brown produced, and the proper aroma, which is prevented by means of their apparatus from escaping. When coffee can be had ready roasted from dealers who roast and grind every day, much trouble may be saved in a family that is not anxious to have the very best; but the retailers, says Mr. Donovan, almost invariably roast their coffee too little; the more it is roasted, the greater is the loss of weight on it, and the less their profit is at a given price; and the more of it, within certain restrictions, will be consumed to produce a given flavour. Coffee loses from twenty to thirty per cent. by sufficient roasting; but if the deficiency exceed that, it is injured. Mr. Donovan is inclined to attribute much of the vapid, raw, and poor taste of our coffee, so much complained of by foreigners, to insufficient roasting. It should be observed, however, that if coffee be roasted too much it becomes too bitter, with little flavour. It is found by experience that the qualities of the beverage depend as much upon judicious roasting as upon the variety of the raw coffee purchased.

3941. *The grinding of coffee* is performed by iron mills. A very small portable mill is common, which is useful on occasion, but too tedious for a large family, as it holds so small a quantity. The portable coffee-mill consists of a square box, either of mahogany or iron, japanned, containing in the interior a hollow cone of steel, with sharp grooves on the inside; into this fits a conical piece of hardened iron or steel, having spiral grooves cut upon its surface, and capable of being turned round by a handle. The coffee is put into a hopper, which conducts it into the hollow cone, where it is crushed by the motion of the solid cone as it revolves. The powder ground in this manner falls into a drawer below.

3942. When large quantities are wanted in a family, a coffee-mill of a larger kind, requiring less labour, is fixed against the wall; but the construction of the mill is gen erally the same. This is a necessary machine in every family, as the goodness of the coffee depends much upon its being fresh ground, which can only be ensured by grinding it at home. Coffee ought to be ground fine, in order that the water may be enabled to penetrate to the centre of the particles, and extract those parts upon which the valuable qualities of the beverage depend. It is not, in general, ground fine enough. When coffee is very highly roasted, so as to develop the greatest quantity of bitter aroma without burning, it is rendered more difficult to grind, for it then acquires an oily surface, which causes the kernels to slip over each other, and hence they are not caught so readily by the teeth of the mill; but the powder, when obtained, is finer than if the coffee had been less roasted, because it is rendered more friable.

Sect. V.—Preserving Coffee.

3943. *Roasted coffee loses much of its flavour by exposure to the air;* on the other hand, it is said, that while raw it not only does not lose its flavour for a year or two, but improves by keeping. That the fine aromatic flavour of good coffee, and which is one of its chief recommendations, depends upon some principle that is extremely volatile, a little observation will render evident. If a cup of the best coffee be placed upon a table boiling hot, it will fill the room with its fragrance; but the coffee, when warmed again after being cold, will be found to have lost most of its flavour. The fragrance diffused through the air is a sure indication in what manner it was dissipated; and therefore it is evident that in preparing coffee every possible endeavour should be made to preserve this precious part of the beverage. To have coffee in perfection, it should be roasted and ground just before it is to be used, and more should not be ground at a time than is wanted for immediate use; or, if it be necessary to grind more, it should be kept close from the air.

3944. *Count Rumford's apparatus for preserving the aromatic fragrance of ground coffee* may sometimes be useful. It consisted of a cylindrical box made of strong tin, four and a half inches in diameter, and five inches in height, formed as accurately as possible within, to which a piston is so adapted as to close it very exactly, and when pressed down into it, to remain in the place where it is left, without being in danger of being pushed upward by the elasticity of the ground coffee which it is destined to confine. This piston was composed of a circular plate of very stout tin, which was soldered to the lower part of an elastic hoop of tin, about two inches wide, which was made to fit into the cylindrical box as exactly as possible, and so as not to be moved up and down without employing some considerable force. This hoop was rendered elastic by means of a number of vertical slits made in the sides of it; on the upper side of the circular plate of tin, which closed this hoop below, and in the centre of it, there was fixed a strong ring, of about one inch in diameter, which served instead of a piston rod, or handle for the piston. The cylindrical box was closed above by a cover, which was fitted to it with care, in order that the air which was shut up within the box, between the piston and the cover, might be well confined.

We may observe that a wide-mouthed glass bottle will answer tolerably well, if a good cork, having a piece of gold-beater's skin, or leaf India rubber, on the lower side, be well fitted into the neck; or the lower part of the cork may be covered with wax.

3945. *Coffee readily imbibes exhalations from other substances*, and thus often acquires a bad flavour; brown sugar placed near it will communicate a disagreeable flavour. It is stated that the coffee in the West Indies has often been injured by being laid in rooms near the sugar works, or where rum is distilled; and the same effect has been produced by bringing over coffee in the same ships with rum and sugar. Dr. Moseley mentions that a few bags of pepper on board a ship from India spoiled a whole cargo of coffee.

Sect. VI.—Preparing Beverages from Coffee.

3946. *The best method of preparing a beverage from coffee*, or, as it is termed, *making coffee*, is a subject that has received a good deal of attention, even from persons eminent for their scientific acquirements; among them we may mention particularly Count Rumford, and, lately, Mr. Donovan.

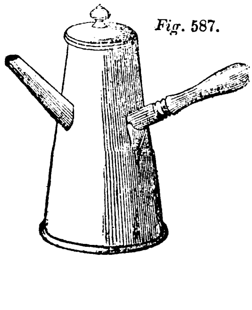


Fig. 587.

3947. *The most usual method of making coffee in England* is the following: Put fresh-ground coffee into a coffee-pot, *fig.* 587, with a sufficient quantity of water, and set this on the fire till it boils for a minute or two; then remove it from the fire, pour out a cupful, which is to be returned into the coffee-pot to throw down the grounds that may be floating: repeat this, and let the coffee-pot stand near the fire, but not on too hot a place, until the grounds have subsided to the bottom; in a few minutes the coffee will be clear without any other preparation, and may be poured into cups: in this manner, with good materials in sufficient quantity, and proper care, excellent coffee may be made. The most valuable part of the coffee is soon extracted, and it is certain that long boiling dissipates the fine aroma and flavour. Some make it a rule not to suffer the coffee to boil, but only to bring it just to the boiling point; but it is said by Mr. Donovan that it requires boiling for a little time to extract the whole of the bitter, in which, he conceives, much of the exhilarating qualities of the coffee reside. As an improvement on the common mode, he therefore recommends that the whole of the water should be divided into two parts; one half should be put on the fire with the coffee, and as soon as the liquor boils it should be taken off the fire, allowed to subside for a few seconds, and then poured off as clear as it will run. Immediately, the remaining half of the water, at a boiling heat, is to be poured on the grounds, the coffee-pot is to be placed on the fire, and kept boiling three minutes. This will extract all the bitterness left on the grounds; and after a few moments' subsidence, the clear part is to be poured off and mixed with the former liquor. This mixed liquor now contains all the qualities, both aroma and bitter, which originally existed in the roasted coffee, and is as hot as any taste could desire it. From what has been said, the error of some persons is evident, who suppose that long boiling is necessary to extract the strength of coffee.

3948. *The usual method of preparing coffee in France*, as described by the French naturalist Du Tour, is the following: Let the powder be poured into the coffee-pot filled with boiling water, in the proportion of two ounces and a half to two pounds, or two English pints of water. Let the mixture be stirred with a spoon, and the coffee-pot be soon taken off the fire, but suffered to remain closely shut, for about at least two hours, on the warm ashes of a wood fire. During the infusion the liquor should be several times agitated by a chocolate frother, or something of the same kind, and be finally left for about a quarter of an hour to settle. This long, very gentle simmering over hot ashes is probably favourable, but it would require some care to effect it where coal is the fuel.

3949. *The Café noir* of the French is coffee made strong with water only. *Café au lait* must not be made by boiling coffee and milk together, as milk is not proper to extract the coffee; the coffee must first be made as café noir, only stronger; as much of this coffee is poured in the cup as is required, and the cup is then filled up with *boiled* milk. *Café à la crême* is made by adding boiled cream to strong clear coffee, and heating them together.

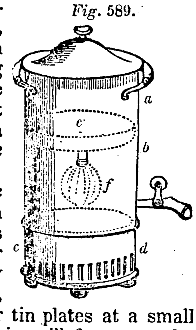
3950. *The clearing of coffee* is a circumstance demanding particular attention. After the heaviest parts of the grounds have settled, there are still fine particles suspended for some time, and if the coffee be poured off before these have subsided, the liquor is deficient in that transparency which is one test of its perfection; for coffee not well cleared has always an unpleasant bitter taste. In general, the coffee becomes clear by simply remaining quiet for a few minutes, as we have stated; but those who are anxious to have it as clear as possible employ some artificial means of assisting the clearing. The addition of a little isinglass, hartshorn shavings, skins of eels or soles, white of eggs, &c., has been recommended for clearing; but it is evident that these substances, to produce their effect, which is upon the same principle as the fining of beer or wine, should be dissolved previously, for if put in without, it would require so much time to dissolve, that the flavour of the coffee would vanish.

3951. *The white of egg clears well*, but often passes into the coffee-cups, when the coffee is poured out, in the form of little shreds, consisting of the coagulated egg; the coffee in that case should be strained. Mr. Donovan recommends drying white of egg by spreading it thin upon a plate before a brisk fire for twelve or fourteen hours. This dried egg will easily scale off the plate, and may be kept for any length of time in a bottle corked. A small bit of the size of a sixpence will be sufficient to clear three ounces of coffee. All that is necessary is to throw it into the half of the coffee made to boil as in the above directions, by which it will be dissolved, and when this half is added to the other that had been already poured off, the clearing will be effected on resting a few minutes; or this dried white of egg may be previously dissolved in a table-spoonful of boiling water, and added to the coffee before it is set down to settle.

3952. *The difficulty of clearing coffee has led to the invention of a variety of apparatus for coffee-making.* One of the simplest modes is putting the coffee into a bag of muslin suspended to the rim of the coffee-pot, *fig.* 588; and, by pouring boiling water through it, the soluble parts of the coffee are separated, and the grounds thoroughly retained, the bag serving as a filter. The objection to this method is, that the water, remaining but a very short time in contact with the coffee, cannot extract from it the whole that is required. Any coffee-pot with such a bag fitted into its mouth is termed a *coffee biggin*.

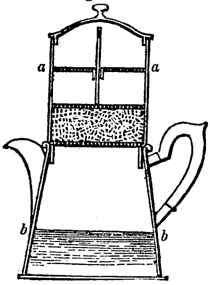
Fig. 588.

Fig. 589.



3953. *Evans's apparatus for making coffee* is intended to let the coffee soak longer in the water, and thus extract more of its principles. *a b*, *fig.* 589, is a tin cylinder with handles and a cover, which is nearly filled with water, and placed upon a stand, *c d*, containing a lamp. *e* is a low cylinder made of two circular tin plates at a small distance apart, and closed all round; this, being filled only with air, will float upon the water, and will bear to have the bag with the coffee, *f*, suspended to it beneath in the water; after the latter has boiled long enough, the decoction of the coffee will mix with

Fig. 590.



the water, but perfectly fine, and may be drawn fit for use by the stop-cock.

3954. *Count Rumford's percolator* is an improvement upon this, and is in very general use under the name of *coffee filterer. a a, fig.* 590, is a cylindrical vessel of metal of any kind, silver or tin japanned on the outside; this vessel fits into another, *b b*, in the form of a tea-pot or any other. The cylindrical vessel has a bottom that is perforated with numerous very small holes, and into this, the lid being taken off, the coffee is put, resting on the perforated bottom. To press the coffee as compactly as possible, that the water may not penetrate so quickly as in the bag, a cylindrical plate of metal, also perforated, is forced down, guided by a metal stem; and this stem passes through another perforated plate at top, to keep it steady. The coffee being packed close, by pressing the stem down hard several times, water is poured upon the uppermost perforated plate, and it passes through the perforations to the coffee, through which it makes its way slowly, dissolving the soluble part, which descends very slowly into the lower vessel, *b b*. This infusion of the coffee, which may now be pourèd out, is perfectly transparent, and the whole of the aroma is preserved. There are two objections to this apparatus in its original form. It does not entirely exhaust the coffee of its virtues; and, consequently, as it requires a greater quantity of coffee than the common method, it is not the most economical, although a very convenient and elegant mode. But the greatest objection is that, if there be much thickness of coffee, or if it be pressed very hard, the liquid requires so much time to percolate, that it is too much cooled before it can be poured out. This last objection is removed by placing the percolator over a spirit lamp, as in *fig.* 591, or it may be placed on a small vessel containing an iron heated; but care must be taken to have some method of fixing securely the percolator to this stand, after the heater is put into it, that the latter may not drop off in carrying. For this purpose, there should be handles to the percolator; and in this form, or with a lamp, it is at present much used, and is, perhaps, upon the whole, the best apparatus for the table, when a small quantity of coffee only is wanted.

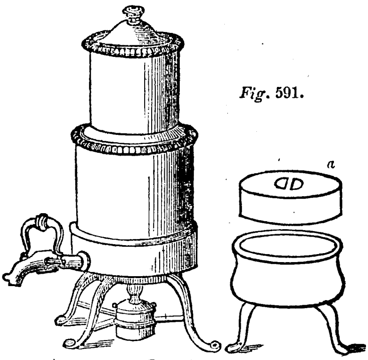


Fig. 591.

3955. *When much coffee is required* for parties, the way is to make and clear it in the kitchen, and send it up in a *coffee urn with a* lamp, *fig.* 592.

Fig. 592.

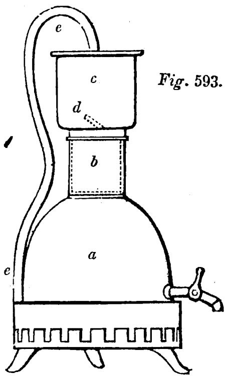


Fig. 593.

3956. *Mr. Jones, of the Strand, London, has an apparatus* for making coffee: *a, fig.* 593, is a vessel placed over a lamp, into which the proper quantity of water is put; *b* is a double vessel, the internal one consisting of a perforated metal cup, to hold the ground coffee; *c* is another vessel fitting on *b*, and having a valve at *d*. When the water in *a* boils, the steam ascends among the coffee in *b*; and when it accumulates in sufficient force, its pressure upon the surface of the water in *a* causes the boiling fluid to rise in the pipe *e e*, and to be discharged in the vessel *c*; the lamp may then be blown out, and the liquid will percolate through the coffee in *b*, and passing through the perforated strainer, will descend into a filtered infusion.

3957. *Parker's patent steam-fountain coffee-maker* is a machine by which the extract of coffee is prepared in a very easy and expeditious manner. When the extract is made, it may be diluted with boiling water to suit the palate; or hot milk may be used instead of water, making *café au lait.*

Fig. 594.

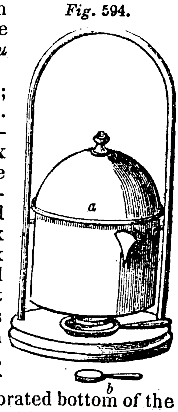
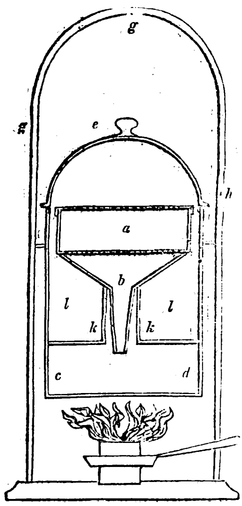


Fig. 594 represents the external appearance of the apparatus; and *fig.* 595 is a section to show its construction and mode of action. *a* is a box of metal to hold the coffee, having its bottom lid perforated with numerous small holes. From the lower part of this box proceeds a funnel, *b*, that reaches nearly to the bottom of an outside vessel or cylinder of metal, *c d*, which is divided into two parts interiorly by a partition, *k k*; and on the middle of this partition is fixed a tube, into which the neck of the funnel is put, and on which the box with the coffee rests. This exterior vessel is covered by a convex lid, *e*. The whole is placed over a spirit lamp, *f*, and is suspended by centres fixed to the upright arched rod, *g g h*. Having taken out the box with its funnel, it is filled with coffee, and boiling water is poured down the tube in the interior; this will pass into the division at the lower part, *c d*; then the box with the coffee is to be replaced, and the lamp lighted. The steam which is formed forces the water in *c d* to rise through the tube *b*, and passes upward through the perforated bottom of the box into the coffee, forming the extract, which is seen rising as a dark fluid through the perforated lid of *a*, and flowing over into the upper division, *l l*. The passage of the water should be permitted to continue till it becomes pale-coloured, and has consequently extracted all the goodness of the coffee, when the lamp should be extinguished, and the lid put on. To get out the extract, the finger is pressed upon the little wooden cup at *a*, *fig.* 594, by which the cylindrical vessel is brought into a horizontal position, and the extract is poured out through the spout. After making the extract, it is best not to drain off the liquid remaining within the rim of the cover, but to let it return into the boiler, which it will do as soon as the lamp is extinguished; thus any sediment will return with it.

Fig. 595.



The filling of the box is best done by piling up the ground coffee in the centre, and then striking it off with a knife, as is done with corn in a bushel measure. The time for making the extract of coffee, where hot water is used, should never exceed five minutes. If it takes longer, it can arise only from the coffee being ground too finely; and this not only increases the expenditure of spirits of wine and of time, but likewise injures the quality of the extract. The remedy is to grind the coffee coarser and coarser until the operation, after the water in the boiler boils, lasts only three minutes. Instead of the ordinary spirit-lamp with a wick, a little cup of tin with a handle is used; this is filled two thirds with just as much spirit of wine as is necessary for one operation, by which the waste very common in lamps with wicks is avoided. Care should be taken not to spill any of the spirit on the outside of the cup, or it will blaze, and occasion inconvenience. An ordinary spirit-lamp with a wick will answer sufficiently well. *b*, *fig.* 594, is an extinguisher with a handle, to put out the lamp with. A variety of this machine is likewise made to use by means of a fire instead of a lamp. The extract of coffee prepared by this apparatus contains all the aroma and other fine qualities of the coffee.

Fig. 596.

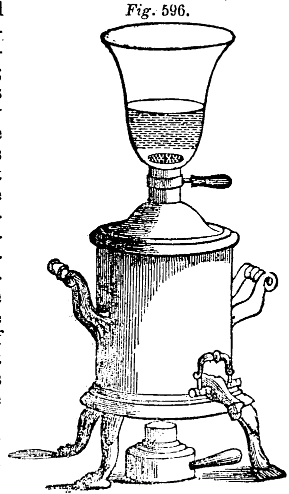
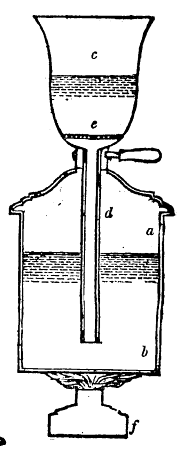


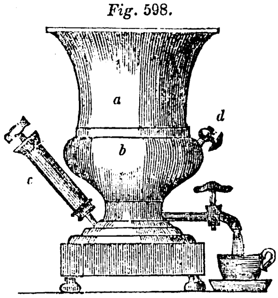
Fig. 597.



3958. *Fig.* 596 *is a view of Platow's patent filterer* for making coffee; and *fig.* 597 is a section of the same. The lowest vessel, *a b*, is often japanned, into which water is put, proportioned to the coffee to be used. *c* is a glass vase with a tin tube, *d*, attached, and having a little circular plate, *e*, fixed at the bottom of the glass, and pierced full of very fine holes. The glass vase and tube are fitted on the top of *a b*, the tube going into the water and near to the bottom. The coffee is put into the glass vase without water. The lamp, *f*, being applied to the bottom of the lower vessel, the water in it is caused to boil, and as soon as the steam forms it presses upon the surface of the water and forces it up through the tube into the coffee in the vase; and when enough has been so raised the lamp is withdrawn, which stops the formation of steam, otherwise the water would be forced over the top of the vase. As the water now cools a little, the stream will be condensed and no longer keep up the water, which will therefore descend by its own weight into the vessel *a b*, carrying with it the extract of the coffee. The made coffee is then drawn off into cups by the stop-cock, represented in *fig.* 596.

3959. *By Brain's vacuum, or pneumatic filter*, *fig.* 598, coffee may be made perfectly clear and bright in a few minutes: *a* is a receptacle made of tin, Britannia metal, or other material, fitting into another one, *b*, which has an exhausting piston, *c*, attached, by which it may be exhausted of air. The top of the vessel, *b*, is covered with a wire grating, and before the vessel *a* is placed on it, a piece of close muslin, linen, or shamoy leather is laid over the grating, and the vessel *a* is forced down, so that the joint is air-tight. The coffee is put into the vessel or chamber *a*, which is open at the top; then open the little plug, *d*, and press the piston down to the bottom, and add as much boiling water over the coffee as is necessary. Now shut the plug, *d*, work the exhausting pump, *c*, and draw the air out of the vessel *b*, so as to produce a vacuum in it; when that is effected, the pressure of the atmosphere, acting upon the liquid in *a*, will force it through the coffee and the filter down into *b*, from whence it may be drawn perfectly clear into cups. This machine not only produces coffee beautifully clear, but also with great expedition. The closer the muslin or linen, the more perfect will be the filtration. Previous to using the apparatus, it should be warmed by passing hot water through it. It is to be observed that this apparatus, from its mode of operation, is not proper to be put upon the table, but is intended for preparing the coffee in the kitchen, whence it must be transferred to a more sightly vessel.

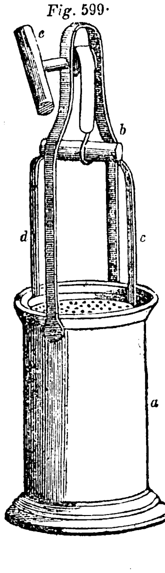
Fig. 598.



3960. *Palmer's pneumatic filtering* machine is nearly of the same construction. The *essence of coffee* may be also thus prepared by this apparatus. Put four ounces of the best ground coffee into a covered vessel, with twelve ounces of cold soft water. Let it stand for twenty-four hours, stirring it two or three times; after which, pour into the pneumatic filtering machine, and pass the liquid two or three times through it. The same apparatus will do also to filter wine, water, or other fluids.

3961. *Beart's coffee percolator* acts also by producing a vacuum below the coffee, in consequence of which the liquid is forced through by the pressure of the atmosphere. *a*, *fig.* 599, is a cylindrical vessel of strong tin or other metal, having a piston that fits the inside, and is made tight by a piece of soft leather; the bottom of this piston is pierced with fine holes, and on this the coffee is put. This piston is raised up by means of a handle fixed to two uprights, *c* and *d*. If now this piston be put down to the bottom of the vessel *a*, and the coffee and water be put into the vessel on the piston, in drawing the piston up by the handle, all the air in *a* will be brought with it, except what forces through the coffee and percolator to fill up the vacuum that would be formed. Hence a clear and transparent extract of the coffee will be produced, which will be strong in proportion to the water employed. As considerable force is necessary to raise the piston, an axis, *c*, is passed through another upright piece bent at top like an arch, and round this axis a band passes that is attached to the handle *b* by a hook; this axis being turned by a lever or cross handle, the raising of the piston is easily effected. The facility and quickness with which coffee can be made perfectly clear by this apparatus is a great recommendation; but it is evident that, though the principle is unobjectionable, the form does not render it suitable to the drawing-room.

Fig. 599.



3962. *An essence of coffee* may be purchased in the shops, which will supply a cup of coffee at any time by diluting it with water; but as the mode of preparing it is not generally known, and the taste is somewhat peculiar, we cannot recommend it as equal to the usual coffee, though it may be convenient, and even useful, on par ticular occasions, as in travelling. A tea-spoonful put into a cup of boiling water makes one of coffee.

3963. *Coffee may be prepared by simmering over a lamp* in the following manner, which may be useful for those who wish for an early cup of coffee without disturbing servants Procure for the purpose a simple cylindrical coffee-pot of tin, *a. fig.* 600, as wide at top as bottom, to hold the coffee and water; then another cylinder, *b c*, must surround it, open at bottom, *d e*, and joined to the inner one at top, so much larger as to leave an inch space, or half an inch between the two, and reaching an inch below the bottom of the inside one. To this outside cylinder three short feet, *f g*, of strong wire may be fixed. The cover of the pot should be double, the better to confine the heat; a handle is fixed to the outside cylinder, and also a spout from the inside one of sufficient length. Below this cylinder, which contains the coffee and the water, a small lamp with three wicks, or a chemical Argand lamp, is placed between the wire legs. The space between the two cylinders being always full of hot air, which is allowed to issue through holes at *h i*. The lamp should be so regulated that the coffee should not boil, but only simmer; and a very small lamp will be sufficient to keep up the simmering for any length of time. The oil should be of the best kind; but spirit of wine or naphtha will be better to prevent smoke or smell. Before the coffee is drunk, the lamp should be withdrawn, and the liquor should rest to be cleared.

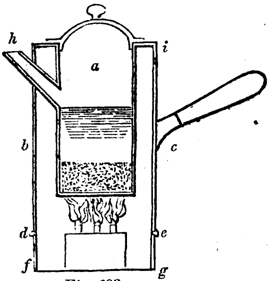


Fig. 600.

3964. *Fig.* 601 is an apparatus for making coffee *very useful for travellers.* It consists of a tin cylindrical vessel, with an opening for introducing a lamp with three wicks, which may burn spirits of wine. Three wires bent at both ends, as in the wood-cut, are hung upon the edge of the cylinder, and upon these the coffee-pot is made to rest. As the handle is made to take off, the coffee-pot can be packed inside the cylinder.

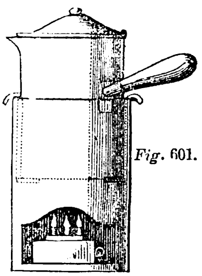


Fig. 601.

3965. *Coffee may likewise be made by infusing a proper quantity in cold water*, and letting it remain all night; in the morning the infusion may be filtered, and only heated, not boiled; some prefer this mode.

3966. *Professor Gregory has given a receipt for preparing a cold infusion of coffee.* He directs that a cylinder shall be provided about two feet long and two inches wide, terminating below in a funnel, which is to be placed in the neck of a bottle. A small portion of cotton wool being inserted in the neck of the funnel, half a pound of coffee is to be mixed with as much water as to form the consistence of thin porridge; and when this has stood an hour or two, it is to be introduced into the cylinder. Immediately a very strong infusion will begin to drop into the bottle; and when the dropping ceases, the coffee will still be impregnated with strong liquor. To obtain this, more water must be poured upon the coffee, till the infusion becomes pale, when the coffee is exhausted. Several bottles will be required, and this operation may last three or four days, some kinds of coffee being sooner exhausted than others. The contents of the several bottles are to be mixed together; and in this way six imperial pints of good coffee may be obtained from half a pound; but the strength, of course, is a matter of taste. The coffee exhausted in this manner will still yield some weak infusion. When heated, this coffee should not be suffered to boil. It is evident that the length of the tube assists the percolation by the hydrostatic pressure.

3967. *With respect to the quantity of coffee used in making the decoction*, much depends upon the taste of the consumer. The general use of tea among us, and the greater price of coffee while the high duty existed, occasioned the latter to be much less used in England, and the art of preparing it less understood than on the Continent. The greatest and most common fault in English coffee is the too small quantity of the ingredient; and coffee is usually made stronger on the other side of the Channel than it is here. The present cheapness of our coffee, however, renders the quantity less an object of economy than it was formerly. Count Rumford, who had a very favourable opinion of the valuable qualities of coffee, observes, that to make it good, such as is usually drunk after dinner, a pound of good Mocha coffee, which, when roasted and ground, weighs only thirteen ounces, serves to make fifty-six full cups, or a little less than a quarter of an ounce to a coffee-cup of moderate size. Mr. Donovan gives the proportion of two ounces and a half of well-roasted coffee to an imperial quart measure of water. Some may prefer it rather weaker. If coffee is too strong, the fine aromatic flavour is less perceived than the bitter.

3968. *The method of making coffee in some parts of Turkey* is thus described by Mr. Fellows in his "Excursions through Asia Minor:" "Each cup is made separately, the little sauce-pan, or ladle, in which it is prepared being about an inch wide and two deep; this is more than half filled with coffee, finely pounded with a pestle and mortar, and then filled up with water; after being placed for a few seconds on the fire, the contents are poured, or, rather, shaken out (being much thicker than chocolate), without the addition of cream or sugar, into a china cup of the size and shape of half an egg-shell, which is enclosed in one of ornamented metal for convenience of holding in the hand."

3969. *Coffee is always drunk without milk* in Turkey and the East, and also in France and England *after dinner*. When taken at breakfast with us, milk, or, what is much better, cream, is added to it. The milk should always be first boiled; and when the quantity of the boiled milk equals that of the strong-made coffee, the beverage is termed by the French *café au lait*.

3970. *From what has been stated, it appears that, to make good coffee, the following circumstances are to be attended to:* procure coffee of good quality; have it carefully roasted and ground, if possible, on the day it is wanted; use a sufficient quantity in making the decoction; boil it according to the directions given above; clarify it well; add to it cream or boiled milk; let it be served quite hot.

3971. *Coffee is sometimes adulterated* by mixing with roasted pease and beans, but, most of all, with *chiccory;* and many grocers have been prosecuted and convicted of this fraud.

But, as it is impossible to counterfeit the berry in the unground state, the best precaution is never to purchase ground coffee, but to see it ground; or, what is better, to roast and grind it at home. The poor are most liable to suffer by this species of dishonesty, as they generally purchase coffee ready ground in very small quantities. To detect the adulteration of coffee by pease and beans is beyond the reach of chemical science.

Sect. VII.—Substitutes for Coffee.

Various substitutes for coffee have been tried and recommended; but none of these are found to have much of the flavour of true coffee; and considering the trouble attending on such preparations, and the present low price of the real article, it is much to be doubted whether any of them be worth using; certain it is, that no substance is brought forward that can be at all compared, in point of flavour and other properties, to coffee.

3972. *Chiccory* is used in many places on the Continent as a substitute for coffee, and is also mixed with it, either from an idea of improving its flavour, or for economy. For a description of the plant, see Book VII., Chap. VII., Sect. VIII.

The roots, cut in pieces, kiln-dried, and ground, are used by the poorer classes in these countries. The powder has a strong resemblance to coffee; but, instead of the flavour of that berry, it has rather an odour of liquorice, and seems to have little in common with coffee except its colour. This preparation does not appear to be much used in England, except for adulterating coffee; and as large quantities have been imported, it is difficult to say to what other use it is applied. But it is easy to detect this fraud by a very simple experiment. Put the quantity of a pinch of snuff of the ground coffee you suspect to be adulterated on the surface of a glass of water; the coffee itself will swim, and not mix with the water, but the chiccory will sink in the water, and be seen falling down as a red powder.

3973. The substance called *Hunt's breakfast powder,* which used to be sold in the shops, consists of rye, boiled, dried, and roasted with a little butter, and then ground like coffee; it is not unlike the most ordinary description of coffee, but it has none of the fine aroma for which good coffee is distinguished; it is at least harmless. *Roasted rice* is used in India, and is considered as the best substitute; it is found to agree better with some constitutions than Turkey coffee. The seeds of the yellow water-flag, *Gladiolus luteus,* or *Iris pseudacoras,* often found growing near water, is another good substitute, known by the name of Iris coffee, or Sylvester's coffee. In North America they use, as a substitute for coffee, the seeds of the *bean-tree,* or *coffee-tree, Gymnocladus Canadensis;* but they form a poor one, as the liquor made from them is very rank and bitter.

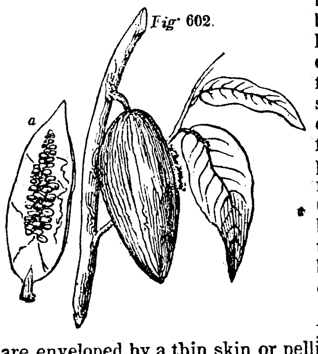
3974. *Acorns have been recommended as the best substitute* by the Academy of Sciences at Petersburgh. To communicate to them the oily properties of coffee, the following process has been used: When the acorns are roasted brown in the usual manner, add fresh butter to them in small pieces while hot in the ladle, and stir them with care, or cover the ladle, and shake it, that the whole may be well mixed.

CHAPTER XII.

Chocolate and Cocoa.

3975. *Both these preparations are made from the seeds or beans of the Cacao-tree,* which grows in the West Indies and South America. The Spanish, and the proper name, is *cacao,* not *cocoa,* as it is generally spelled; from this mistake, the tree from which the beverage is procured has been often confounded with the palm that produces the edible cocoa-nuts, which are the produce of the cocoa-tree (*Cocos nucifera*), whereas the tree from which chocolate is procured is very different (the *Theobroma Cacao*). The cocoa-tree was cultivated by the aboriginal inhabitants of South America, particularly in Mexico, where, according to Humboldt, it was reared by Montezuma. It was transplanted thence into other dependencies of the Spanish monarchy in 1520; and it was so highly esteemed by Linnæus as to receive from him the name now conferred upon it of Theobroma, a term derived from the Greek, and signifying "*food for Gods.*" The Mexican name was *chocolatl,* whence the term chocolate. The trees are raised from seed, and grow to the height of about twenty feet, resembling a young cherry-tree, and do not come into bearing until six or seven years old, but then they bear leaves, flowers, and fruit all the year round; the leaves are about four inches long, pointed, and of a dull green; the flowers saffron-coloured and beautiful. The trees grow in morassy situations, and are sheltered by larger trees. Their cultivation is very easy, requiring little attention beyond gathering the fruit when ripe. The cocoa beans are contained in pods something like a roundish cucumber deeply furrowed, about five inches long and three wide, *fig.* 602, each pod, *a,* containing from twenty to fifty beans, according to the particular variety and country where they grow, about the size of almonds, imbedded in a reddish-white pithy substance, like that of a watermelon.

Fig. 602.



The pod is smooth on the outside, green when young, but when ripe variously coloured. The beans are enveloped by a thin skin or pellicle, of a brown colour, which is taken off before they are converted into chocolate. The kernel is divided into several portions, which do not adhere together, and which easily come to pieces when the skin is removed.

In the West Indies, when the fruit is ripe, the beans are taken out of the pulp, spread out to dry, and put into bags for exportation; but in the Caraccas they are subjected to a species of slight fermentation, by which they lose a good deal of their acrimony and bitterness, and acquire more aromatic flavour. It appears that there are several species of the *cacao*, or cocoa bean, and that these differ much in their qualities. The Mexican is considered the best, but it seldom comes to Europe; that from Guatemala is much esteemed, and the beans are larger. The West Indian cocoa is among the least valuable kinds, being very oily.

Chocolate has always been a favourite beverage among the Spaniards and Creoles, and was considered here as a great luxury when first introduced, after the discovery of America; but the high duties laid upon it here confined it long almost entirely to the wealthier classes. Before it was subjected to that duty, Mr. Bryan Edwards stated that cocoa plantations were numerous in Jamaica, but that the duty caused their almost entire ruin. The removal of this duty has increased their cultivation.

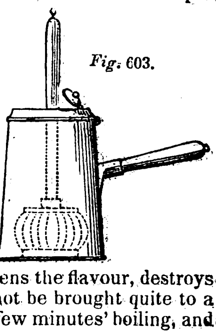
3976. *The cocoa bean has been analyzed* by Lampadius; the kernels of West Indian cocoa contain, in 100 parts, some water, 53·01 of a fat oil, 16·7 of a brown albuminous substance that contains the aroma, 10·91 of starch, 7·75 of gum, 0·9 of woody fibre, and 2·01 of a reddish matter that would serve as a dye stuff. The husks of the beans form 12 per cent. of their weight; they contain no fat, but consist of woody fibre and a brown mucilaginous extract. The fat or oil which the cocoa-nut contains, called *butter of cocoa*, may be extracted by steaming the nuts, or soaking them in boiling water, and subjecting them to strong pressure in canvass bags, or by skimming it off the water when cold. It is of the consistence of tallow, is of a mild agreeable taste, has a reddish tinge when first expressed, but it becomes white by boiling in water. From five to six ounces of the butter may be obtained from a pound of cocoa; it is not apt to become rancid like fats in general; it serves in some places to make candles, as it melts only at 122°, but it is not used here; in France it is employed for making soap. Recently a principle has been discovered in the cocoa bean very similar to caffeine.

3977. *The simplest method of preparing a beverage from the cocoa beans* is that which was employed originally by the Mexicans. They roasted them in earthen pots, and, after clearing them from the husks, which then easily separated by fanning, bruised them between two heated stones, working the oily paste into the form of cakes; and this is nearly the process employed here at present. The taste of the unroasted bean is bitterish, unctuous, rather rough and peculiar, but not ungrateful. By roasting it is considerably altered.

3978. *Chocolate*, made in the manner above described, was imitated by the Spaniards from the Mexican mode. It was extensively used in Spain, and was imported into this country as a great luxury under the name of *Spanish chocolate*. This, however, had the addition of other ingredients than the cocoa beans, to give it a more agreeable flavour; as sugar, cinnamon, vanilla, and other spices. Some have added maize, tapioca, salep, arrow-root, and substances which may be considered as adulterations. When the mixture was made into a liquid, it was poured into moulds, which gave it the form of cakes when become dry and hard. The spices added to chocolate are thought to render it less wholesome and more heating than the simple cocoa bean, and are generally omitted in our preparation of this article.

3979. *When Spanish chocolate is to be used*, a portion of one of the cakes must be scraped fine, added to a sufficient quantity of water, and simmered for a quarter of an hour; but *milling* is necessary to make it completely smooth. For this purpose, a tin vessel is made, *fig.* 603, that has a circular wheel of wood or metal within, fixed to a stem that passes through the lid, and which, being whirled about rapidly by the palms of the hand, bruises and mixes the chocolate with the water. The chocolate must be milled off the fire, then put on again to simmer some time, then milled again until it is quite smooth. From the fineness of the chocolate, there should be no sediment, and the whole should be drunk; cream is generally used with it. An ounce of the cake will make a pint quite rich. The sugar may be put in with the scraped chocolate, or added afterward. Chocolate should never be made before it is wanted, because heating it again lessens the flavour, destroys the froth, and injures the body of the chocolate. It should not be brought quite to a boil, for the oil of the nut is observed to rise to the top after a few minutes' boiling, and even on standing long on the fire.

Fig. 603.



3980. *Churchman* was a celebrated manufacturer of chocolate in this country, and he has been succeeded by *Fry*, of Bristol, who now prepares every variety of chocolate and cocoa in the greatest perfection.

3981. *Fry's Churchman's chocolate* in powder does not require milling. It is sold in small tin canisters, and is extremely convenient for travellers or persons in public offices, &c., as a cup of chocolate is made with little trouble. To prepare it, put a large tea-spoonful into a tea-cup, add a few tea-spoonfuls of boiling water, and mix it well; then fill up the cup with boiling water and stir it; add sugar, milk, or cream to suit the taste.

3982. *Chocolate paste* is another preparation by Fry, made with still greater facility than the last; it may be mixed at the breakfast-table.

3983. *Broma* is a preparation of chocolate adapted for those with whom the oily quality of chocolate does not agree. Part of the oil is extracted, and some sago, potato starch, or similar substance substituted, which renders it easier of digestion.

3984. *Milk chocolate* is made with milk instead of water. Put the milk and water on to boil, then scrape the chocolate fine, from one to two squares to a pint. When the milk and water boils, take it off the fire, throw in the chocolate, mill it well till it froths.

3985. *Chocolat à manger* is a preparation of chocolate, originally French, made up with sugar into small long cakes for eating. They are considered useful to travellers, from the great quantity of nutriment they contain in little compass. Humboldt states that, by means of this nutritive quality of cocoa, the inhabitants of some parts of South America are enabled to sustain very long journeys in crossing the deserts or uninhabited forests.

3986. *Since the cocoa beans themselves have been imported in abundance into this country,* real Spanish chocolate is nearly gone out of use, and both *chocolate* and what is termed *cocoa* are manufactured here; the difference between them being that in the former the beans, carefully selected and deprived of their skins, are perfectly levigated, so that the paste unites heartily with the water and milk boiled with it, scarcely depositing any sediment; whereas in *cocoa*, being less finely ground, there is more sediment; chocolate is so finely ground that the particles are kept suspended, and the whole is drunk, whereas in what is called simply cocoa the sediment must be allowed to subside, and only the liquid is used when poured off from the grounds.

3987. *Cocoa is prepared here for sale in several ways.* The beans are put into a heated iron cylinder similar to a coffee-roaster, having holes at the ends for suffering the vapours to escape. When the aroma is well developed, the roasting is finished; and the beans are turned out, cooled, and freed from their husks by slightly rubbing, sifting, and fanning. It is a peculiarity in the cocoa beans, that when first heated they are dry, and may then be ground to powder by a mill or by the pestle; but by continuing the process of bruising, the oil separates, and forms the whole into a soft paste One of the preparations, therefore, consists of *cocoa in powder*, which has been ground in a mill like coffee. Indeed, the best mode of having the cocoa pure is to purchase the beans or nuts, which are now commonly sold roasted, and to grind them in a large coffee-mill. Cocoa is deteriorated by keeping, and at the end of two years it has lost all its fine flavour.

3988. *To make cocoa ready for use,* an ounce is boiled in a pint and a half of water for about a quarter of an hour, and then it is to be kept near the fire to settle and become fine; after that it is to be poured off into another pot for immediate use. It is drunk with sugar and milk, or cream, like coffee. To save time, it may be boiled over night.

3989. *Cocoa paste* is prepared as follows: The cocoa beans are heated in iron cylinders, and deprived of their husks in the manner above described; the kernels are then put into an iron mortar heated by keeping lighted charcoal in it for some time, and pounded and rubbed with the pestle, also heated, till the whole is quite smooth like a paste. It is then placed upon a marble, or, what is better, a porphyry slab made hot thoroughly before the fire, and worked well with an iron roller, until it is as soft and smooth as butter; or this process is performed more expeditiously in a mill. A little sugar is added to make it dissolve readily when used. Sometimes it is put into tin moulds, and dried in square cakes. It is said, however, that much heat dissipates the flavour. To prepare a beverage from cocoa paste, nothing more is necessary than to stir it well in boiling water.

3990 *Soluble cocoa* is made in cheap little squares, and is mixed up with a little sugar, and probably sometimes with adulterating ingredients. By means of the sugar this readily dissolves, and is useful as being easily prepared.

3991. *Flake cocoa* is the cocoa simply crushed by a machine that delivers it in the form of flakes.

Since the duty has been so much reduced, cocoa has become an article of consumption among all classes.

3992. *Cocoa is extensively cultivated in the West Indies and in South America.* The consumption is immense. Humboldt estimated that in Europe, in 1806, at 23,000,000 lbs., of which from six to nine millions were supposed to be consumed in Spain. He observes that, "alike easy to employ and convey as an aliment, it contains a large quantity of nutritive and stimulating particles in a small compass. It has been said with truth that in Africa rice, gum, and shea-butter assist man in crossing the deserts In the New World, chocolate and the flour of maize have, by their portability, rendered accessible to him the table-lands of the Andes, and vast uninhabited forests." Cakes of chocolate may be considered as a kind of portable soup of the Tropics.

CHAPTER XIII.

ON SUGAR.

SECT. I.—INTRODUCTION AND HISTORY OF SUGAR.

3993. *We have stated before that sugar, or saccharine juice, is a constituent of many vegetables,* and it is accordingly extracted from several, but by far the most abundantly from a cane or reed called the *sugar-cane*, from which our sugar in common use is made. We shall first describe the manufacture and qualities of this kind, and afterward speak of some varieties of sugar which, though much less common, are yet occasionally produced from other vegetables.

3994. *History of Sugar from the Cane.*—Sugar, which has been used in Europe for several centuries as an agreeable condiment, was imperfectly known, and was not in common use among the Greeks and Romans. By our ancestors it was seldom obtained previously to the discovery of the West Indies; and at that time honey was usually employed for sweetening liquors and food. It is not a little curious that the Chinese, the most ancient nation now existing, were acquainted with the manufacture of sugar from the sugar-cane above two thousand years ago; the cane, indeed, is a native of China, and grows abundantly in that country. Chinese sugar in small quantities occasionally found its way into ancient Europe, and the Greek physicians, who procured it from the Arabian merchants, employed it as a medicine, describing it as a kind of concrete honey, which exuded like gum from canes or reeds. The Arabian navigators first brought it from India into Arabia and Greece; but it does not appear to have been transported to Rome, probably on account of its great bulk and little comparative value, which rendered it an unprofitable article of commerce. It is evident that the ancient notions of it were extremely erroneous, since solid sugar of every kind is the produce of manufacture only, and is never found adhering to the cane like gum; the juice must always be forcibly expressed, and afterward crystallized. Pliny speaks of a substance called *saccharon*, obtained from certain reeds in India: he observes that it was of a white colour, crackled like salt between the teeth, was sweet like honey, and was in lumps not exceeding the size of a hazelnut: a description which corresponds with that of the white sugar-candy made at present in Cochin-China. Our term sugar is probably derived from the Bengalee *shukkur*, the name by which it is still known in India.

3995. It was not until a considerable time afterward that the plant which produced it was brought from the eastern parts of Asia; and it does not appear to be certain at what particular period, nor by whom, this acquisition was first made. Early in the tenth century it was cultivated in the vicinity of Ormus, on the Persian Gulf, whence, no doubt, it was carried to Mesopotamia, a country celebrated for its sugar in the time of the Crusades; hence it spread into Syria, New Tyre being famous for excellent sugar in the twelfth century. By the Saracens it was introduced into Egypt, Rhodes, Cyprus, Sicily, and Spain.

3996. From a passage in an Arabian author, who wrote in 1073 (quoted by Blanquiere, Madrid, 1801), giving directions for the cultivation of the sugar-cane, and for boiling the juice, nearly in the same manner as at present, it would appear that sugar was made in Spain at least 700 years ago, the manufacture having been probably introduced by the Moors.

It is a circumstance not generally known that the sugar-cane is grown at this day in Andalusia, in the south of Spain, or, at least, was, only a few years ago, over a narrow tract between a chain of rugged mountains and the Mediterranean, about a hundred and thirty miles in length, with a medium breadth of four or five miles, the climate being sufficiently warm, with the exception of slight nocturnal frosts in some winters. The sugar is manufactured there nearly in the same manner as in the West Indies. This fact has been overlooked by almost all travellers, but has been stated in a late paper in the "Edinburgh Philosophical Journal" by Dr. Traill, who visited the country.

The Portuguese planted the sugar-cane in their newly-discovered islands of Madeira and the Canaries, whence it was afterward transferred to their colonies on the coast of Africa and in Brazil.

3997. It has been supposed that the sugar-cane was indigenous in America; this, however, is improbable, since it is not found growing wild in that part of the world. But the climate of the New World being found highly favourable to the growth of this plant, the Portuguese, who devoted themselves with much assiduity to its cultivation, and to the extraction of its sugar, for some time possessed almost the entire supply of Europe with this commodity.

From 1466 to 1580 sugar was rare in England, being procured from the Portuguese, Venetians, and Genoese, and was used only in the houses of the wealthy, or in medicine. With regard to its introduction into the West Indies, it appears that it was planted there some time before it was cultivated on a large scale for the manufacture of sugar. At first no other use was made of it than as an esculent garden vegetable, the stem being eaten, or, rather, sucked or chewed in a raw state, after being simply peeled, as is still the practice in China and in some of the East Indian islands. This will account for its having been noticed by travellers in the West Indies previously to the date of the establishment of the first sugar plantation. In 1643 the English began the manufacture in St. Christopher's and Barbadoes, and in Jamaica in 1656; the plant having flourished there in great luxuriance, it has ever since been extensively cultivated, and the produce distributed thence over the globe.

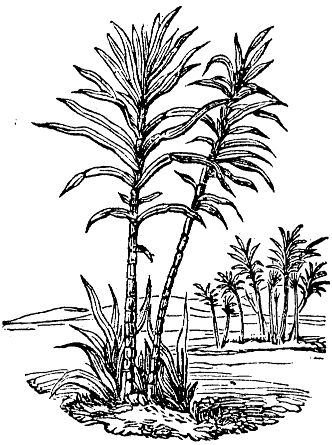
3998. *The art of refining sugar*, or making what is called *loaf-sugar*, was a discovery of some Venetians in the early part of the sixteenth century, and does not appear to have been known to the Chinese; but it was not until coffee and tea were introduced into England that sugar came into general demand here. Sugar-candy is of very early date: according to Dr. Moseley, there is an account of a shipment made at Venice for England, in 1319, of 100,000 lbs. of sugar and 10,000 lbs. of sugar-candy. Refined sugar is mentioned in a list of provisions in the reign of Henry VIII. Numerous improvements up to the present time have been made in the art of manufacturing sugar in a pure state.

SECT. II.—MANUFACTURE OF SUGAR FROM THE SUGAR-CANE, AND THE VARIOUS KINDS OF CANE SUGAR.

3999. *The sugar-cane* (*Saccharum officinale*) is a species of large, jointed reed, or grass, of which there are several varieties; but all of them appear to have been natives of the eastern parts of Asia only. In some districts of Bengal there are canes not much thicker than the finger, which give a juice that is sweet, but which does not afford a crystallizable sugar. Of the other sugar-canes, one has a pale yellow stem, agreeing with the common cane in the West Indies; another, frequent in Hindostan, has a stem of a reddish-brown colour, giving abundance of juice.

4000. *The yellow sugar-cane* of the West Indies (*fig.* 604) grows to the height of six, twelve, and even twenty feet, according to the nature of the soil, the most favourable being a deep loam: much moisture is essential to its growth. It is propagated by cuttings only, and possesses a power of tillering like wheat, though in a less degree. The canes are not planted annually; but, as they deteriorate in size every year they continue, they are renewed in ten or twelve years, or oftener. The cultivation of sugar-canes requires hoeing and weeding very frequently, a process which is extremely laborious, particularly when performed under a tropical sun. As they grow up the lower leaves are taken off, and the wind having considerable power upon them, they are then supported by props of bamboo, or sometimes tied together by their tops.

Fig. 604.



Twelve or thirteen months after they have been planted, the canes, though not quite ripe, abound in sweet juice, but mixed with much mucilage; and if they are cut at that time, which is sometimes done, though improperly, the sugar procured from them does not crystallize so well, on account of the mucilage. This is said to be one of the causes of the inferiority of East India sugar: if the canes, on the other hand, remain too long before they are cut, they throw out their flowers, and much of their sweetness is dissipated. The joints in one stalk are from forty to sixty in number, and from one to three inches apart. The young shoot ascends from the earth in an almost straight line, and is surrounded by a tuft of dark green leaves. A field of canes, when in full blossom, is extremely beautiful.

Of late years, another variety of the sugar-cane, a native of Otaheite, has, in many places in the West Indies, superseded the common sugar-cane, as it affords a somewhat larger proportion of sugar, is sooner fit to cut, and the juice is more easily clarified.

4001. *When the canes are ripe, they are cut down close to the stool;* the stems are divided into lengths of about three feet, which are made up into bundles, and carried without delay to the mill to have their juice extracted by crushing.

The crushing mill is usually a pair of fluted rollers, of wood or cast iron, and turned with levers by men who pass the canes one by one between them. The juice, as it is squeezed out, runs down into a reservoir. These mills are worked also by horses, oxen, wind, or steam. By the pressure of the rollers, the canes are not only squeezed quite dry, but sometimes reduced to fragments. The refuse, or macerated rind of the cane, which is called *cane-trash,* serves for fuel to boil the liquor in the subsequent operations. The juice which has been thus expressed is strained to separate it from pieces of the cane and other coarser impurities, and then is conveyed by a trough to the boiling-house.

4002. *In describing the manufacture of sugar* from the cane juice, we propose first to give the process which has been long followed in the West Indies, and afterward to mention those improvements which have been lately introduced.

4003. *In the boiling-house* the cane juice is received into one of the flat-bottomed copper pans, or caldrons, called *clarifiers,* of which there are generally three. The raw juice is so exceedingly fermentable, that, in the climate of the West Indies, it will scarcely remain longer than twenty minutes before this change commences; and as the least degree of fermentation materially affects both the quality and quantity of the sugar, it is necessary that the clarifier should be large enough to work off the liquor with great expedition. The clarifiers are capable of holding from 300 to 400 gallons, on plantations which make from fifteen to twenty hogsheads a week. Each clarifier is furnished with a siphon, or a cock, to draw off the liquor clear and free from the scum which is thrown up during the boiling.

When this clarifier is charged, in order to assist in the separation of the gum, oil, and other vegetable principles which are intermixed in the expressed juice, and for the purpose of neutralizing some acid contained in it, a quantity of quicklime (generally brought from Bristol) is stirred in, after having been mixed with a little cane juice to the consistence of cream. In this first part of the clarifying process, the liquor is not suffered to boil; but as it grows hot, a crust or thick scum begins to rise, and when it has reached within a few degrees of the boiling point, the damper of the fire-flue is closed, and the liquor remains undisturbed for about an hour, in order that all the impurities may have time to rise to the top. The liquor is now drawn off clear by a siphon, or cock, into the next pan, called the *evaporating copper;* in this it is made to boil, and the scum is removed by skimmers as it rises. The liquor ought now to be bright, and of the colour of Madeira wine. If it is not sufficiently bright, it is diluted with lime-water, which, by rendering the impurities insoluble, throws them up in the form of scum. From the great evaporating copper, the liquor, now considerably reduced in quantity, is transferred by ladling to a smaller copper; and when farther evaporated in this, it passes into the smallest, called the *teache;* here the boiling is continued till the liquor is sufficiently condensed for granulation. From the teache it is ladled into the coolers, which are shallow wooden vessels, about eleven inches deep, and capable of holding a hogshead of sugar. Here the liquor cools, and the sugar crystallizes, or concretes in small irregular crystals, or *grains,* which are kept from uniting together by the liquid, now in a viscid state, called *molasses,* the granulation being assisted by stirring the mass with wooden stirrers.

4004. *When all the sugar appears to have grained,* it is taken to the *curing-house,* which is an airy building, containing a large cistern below, and open joists without boarding above. Empty hogsheads without headings are ranged on these joists, and the bottom of each hogshead is pierced by holes, through each of which a plantain leaf is thrust, long enough to stand above the top of each hogshead, and to reach a few inches below the bottom. The sugar from the cooler being put into one of these casks, the molasses gradually drains from the granular part, percolating through the spongy plantain stalks, and dropping into the cistern below. In about three weeks the sugar is sufficiently cleared and dry, when it is packed into hogsheads ready for exportation. The sugar thus obtained is called *Muscovado,* and is the raw material whence the sugar-bakers in Britain make their loaf, or refined lump sugar.

4005. Part of the Muscovado sugar, on arriving in England, is purchased by the grocers, and constitutes the brown or moist sugar of the shops, and they select it according to its cleanness, its bright colour, and dryness.

The planters in our colonies have generally sent their sugar to Britain in the state of Muscovado; but in the French, Spanish, and Portuguese settlements it has been usual to convert it into what is called *clayed sugar,* which was formerly much used in Britain for domestic purposes under the name of *Lisbon sugar,* and is often mentioned in receipts.

4006. To prepare Lisbon sugar, a quantity of sugar from the coolers was put into conical pots with their points downward, and having a small hole at the bottom; the molasses which drained from the sugar dropped out through the hole into a jar intended to receive it. In about twelve hours a quantity of clay was laid upon the top, and kept moistened with water, which, oozing gently from the clay through the sugar, dilutes the molasses, and causes more of it to come away than in the hogshead, leaving it whiter than at first. This Lisbon or clayed sugar is afterward dried, and is purer than Muscovado; it is used in many places for the same purposes as loaf-sugar is with us.

4007. *Refined sugar is made from Muscovado sugar* in the following manner: The raw sugar is put into vessels charged with lime-water and the serum of bullock's blood, or white of eggs, well mixed. After standing a night to dissolve, fires are lighted under the bottom of the boiler, and as soon as the liquid begins to boil the albumen or serum of the blood coagulates and rises to the top, carrying with it all the impurities of the sugar, and these are removed by a skimmer. The other part of the blood, the clot, does no injury, as it is not soluble in the liquor, and therefore comes away entirely in the scum, none of it remaining, as some erroneously imagine, in the sugar which we use. The liquid is kept gently simmering for some time, being skimmed all the while; the heat is then increased, and the sugar made to boil rapidly until it is concentrated sufficiently; it is then transferred to the coolers, where it is violently agitated with wooden oars till it is granulated. In this granular state it is poured into conical earthen moulds, or pots, having a small hole at their pointed ends. When sufficiently cold, these moulds, containing the sugar loafs, are set, with their broad ends uppermost, over earthen pots; the hole at the small end is opened, and the treacle, or coloured sirup, runs out at the points of the moulds, in consequence of which the sugar is much whitened. After this, a paste of pipe-clay is poured upon the bottoms of the loaves to the thickness of an inch, and the water that percolates through the sugar washes down all remains of the treacle that adheres to the minute crystals, leaving the sugar white. The clay is of no other use than to prevent the water from running down too fast, which would dissolve the sugar. A sponge would answer the same purpose. This process of claying is repeated several times, when necessary, to make the sugar quite white, and the loaves are then set in a stove to dry.

4008. *Treacle, or molasses,* drained from the Muscovado, is the uncrystallizable part of the saccharine juice, either naturally so, or rendered uncrystallizable through defects in the process of boiling. It contains a large portion of sweet or saccharine principle, and is therefore, particularly on account of its cheapness, a useful article of domestic economy. It is considered as very wholesome, and children are generally fond of it. M. Cadet has shown that it may be deprived of its peculiar taste by boiling for half an hour with pulverized charcoal; the saccharine liquor is then strained from the charcoal, when its flavour is found equal to that of sugar. Treacle is found useful for making beer, rum, and the very dark sirups, as that of poppies, &c.

4009. *Several improvements have lately been made in the manufacture of sugar,* a short account of which may be interesting.

In the manner in which it has been usual to refine raw sugars, a large quantity of molasses is separated, so much sometimes as from twenty to thirty-five per cent., and it had been supposed that in the juice of the sugar-cane there were two distinct kinds of sugar, one crystallizable, and the other not capable of being crystallized, the latter being highly charged with colouring matter, constituting the molasses; and that the process of refining consisted merely in separating these two from each other. But it is now supposed that this is not the most correct view of the subject; and that the molasses is not an original and essential part of the cane juice, but is a portion of the sugar which has been charred, and thus rendered uncrystallizable in consequence of the very high degree of heat which they were obliged to use in boiling the sirup in open vessels. The formation of molasses is, consequently, so much loss of sugar. Various plans have accordingly been devised for diminishing this production of molasses, and, consequently, of increasing the quantity of sugar; and some of these have been very successful.

4010. *To avoid the action of the fire upon the bottom of the boiler,* a method was employed of boiling the sirup in coppers without fire-places, and merely by forcing heated whale oil through a coil of metallic pipes lying in the midst of the sirup within the boiler. This mode prevented, in a considerable degree, the burning of the sugar and formation of molasses. Oil was used because it is capable of receiving a very high degree of heat, but not sufficient to burn the sugar.

4011. Lately a process analogous to the mode of making Lisbon or clayed sugar, but superior in efficacy and expedition, is now coming into use in the British West India plantations, being the subject of a patent. The raw or Muscovado sugar, moistened with a little water to dilute the molasses, is put into a vessel having a perforated bottom, and placed over another which is exhausted of air by means of an air-pump. In consequence of this vacuum being formed, the pressure of the atmosphere drives the molasses down through the sugar, leaving the latter very white and pure.

4012. Heating the coppers in which the sugar is boiled by steam, at a certain degree of compression applied to the outside, instead of the direct action of fire, is another useful improvement that has been made upon the old method of boiling. This prevents the sugar from burning.

4013. *But the greatest improvement in the manufacture of sugar* was made about thirty years ago by the Hon. Mr. Howard, a gentleman eminently skilled in chemistry. From the well-known principle that boiling water, or the conversion of it into steam, takes place at a lower degree of temperature when the atmospheric pressure is taken off, Mr. Howard conceived the idea of constructing the evaporating pans in such a manner that the atmospheric air could be removed from the surface of the liquid in them by an air-pump; and thus the solution of sugar could be made to boil or evaporate in vacuo, and, consequently, with a much lower degree of heat. The advantage of this may be imagined from the fact that, whereas in the old process of boiling in the air, sixty-three pounds only of refined sugar were produced from a hundred weight of Muscovado, by this improved method they got seventy-eight pounds. The saving of sugar and improvement of quality were such as to make the patent right, which secured the emoluments of the process to the inventor and other parties, worth many thousand pounds a year; and scarcely any instance is known of so much money having been made in so short a time by any invention. The patent having expired some time, this process is now generally employed; and lately, West India planters, having applied the principle in boiling their sirups, obtain pure raw sugar direct from the cane juice, and much whiter than before.

4014. By the old process of boiling the sirup in making the raw sugar, the temperature advanced as the boiling went on, in consequence of the concentration of the liquid which prevented its ready evaporation, so that the heat, amounting to 218° or 220° and, consequently, exceeding the heat of boiling water, occasioned the charring of a good deal of the sugar. This concentration also prevented the full formation of the minute crystals of sugar; and in this manner much of the sirup that would otherwise have formed into sugar was carbonized and changed into molasses. In this state, also, the molasses was still so much united with the sugar itself, that it could not be completely separated without re-dissolving the whole, and crystallizing it afresh, which constituted the process of refining. In the new method, the temperature of the sugar in the vacuum pans does not exceed 150° or 155°, and they are heated externally by steam. When the granulation is completed in the pans, the sugar is put into the curing boxes, which have their bottoms formed of metallic gauze. The air is then drawn away from below these boxes by an air-pump, and the pressure of the superincumbent atmosphere forces down all the molasses, and leaves the crystallized sugar nearly pure. Of course, before the sirup is put into the vacuum pans for granulation, it has been clarified and skimmed as usual. Another advantage in this process is the great saving of time. Sugars cured in this manner require only a few hours' drying previous to shipment. So great is the expedition with which sugar has been made by these improvements, that at Plantation Richmond, in Demerara, the "sugar has been growing in the fields in the morning, and converted into sugar beautifully white in the evening."

The vacuum sugar, as it is called, is admitted at the same duty as ordinary raw sugar, and it bears transportation from the West Indies better than the old sugar. By the new process they get less molasses than formerly, and, of course, cannot make so much rum; but they say that the molasses is superior in quality; part of it appears to be owing to a combination of the sugar with mucilage in the cane juice, which prevents some of the juice from crystallizing.

4015. *This Demerara sugar*, made in the above manner, consists of pure, transparent, very small crystals, which are, in fact, sugar-candy of a rich taste, equal to that of refined sugar, less apt to become acescent than Muscovado, and therefore applicable to all the ordinary purposes of domestic economy. The time required for its solution being greater than that of other sugar, is in some cases a slight objection.

4016. *The East India sugar*, which has lately come into the market, is likewise made from the sugar-cane, and is whiter, though less strong than the West India Muscovado. It somewhat resembles the Lisbon, and is said to be clayed.

Sect. III.—sugar-candy, barley sugar, and sirup.

4017. *Sugar-candy consists of regular crystals of sugar.* In making refined sugar, the crystals are small, confused, and irregular; hence the whiteness and opacity of loaf-sugar; but if pure sirup, or dissolved sugar, be allowed to remain quite still and undisturbed, as the water evaporates the sugar will crystallize in certain regular forms; and if the sirup has been perfectly clarified, these crystals will be colourless and transparent, constituting white sugar-candy. Brown sugar-candy differs from this only in being formed from sirup that has not been so completely clarified. If a mass of sugar-candy, such as is usually sold in the shops, be examined, the form of the crystals can be easily made out by a little attention, and it will be observed that all the crystals are constantly of the same form, it being a law of nature that every distinct and separate substance crystallizes constantly in the same mode. There is at present much less demand for sugar-candy than formerly, when it was very generally used for coffee and tea; but it is still made in London by a few sugar bakers. The sirup from which candy is made is thinner than that employed for making loaf-sugar, in order that the crystallization may be more perfect; and the most perfect quiet is preserved, it being found that a very slight degree of agitation in the liquor will very materially diminish the size and perfection of the crystals. The sirup is poured into oblong boxes, in which a light horizontal frame, strung from end to end with fine packthread, has been previously placed for the crystals to form upon as the water evaporates when the boxes are placed in the drying stove, where they remain several days. At the end of this time, the finest crystals have formed upon the threads, and the whole inside of the boxes is found to be lined with crystals.

4018. *Sugar-candy is transparent and much harder than loaf-sugar;* its hardness causes it to dissolve less readily, except it be pounded very finely. Its inferior solubility in the mouth occasions it to be supposed by some persons not to be so sweet as loaf-sugar, but in reality there is no difference, as they are the same substance, differing only in the mode of crystallization; and the purer the sugar the sweeter it should be. It is also a very common error to suppose that moist sugar is sweeter than refined; this opinion arises from its great solubility, by which it affects our organs of taste more quickly.

4019. *Barley sugar* is sugar boiled in barley water to such a consistence that it will solidify when cold. It is flavoured with lemon peel, and then poured upon a stone slab, rolled out into little cylinders, and twisted.

4020. *Sirup* is sugar simply dissolved in water, and boiled till the water evaporates, and leaves the solution of a certain degree of strength and consistence. In making sirups, refined sugar should be employed; and if coarse sugar be used, the sirup should be clarified by heating to a froth the white of eggs with a small portion of water, and adding to it a solution of sugar and water before boiling. The albumen coagulates as the sirup boils, and, involving the impurities which the sugar contained, rises to the surface in the form of a scum, which must be carefully removed. If too much sugar be used, or if the sirup be too long boiled, the sugar soon crystallizes; and if it be in too small proportion, the sirup quickly ferments, and becomes acescent. In case of its appearing disposed to ferment, a small quantity of sulphate of potash will check the fermentation. The most certain test of the proper consistence of a sirup is its specific gravity, which, when cold, should be 1·385. But however well prepared in general, sirups are apt to ferment when kept in a temperature above 60°; and therefore the London College directs that "they should be preserved in a place the temperature of which never exceeds 55°."

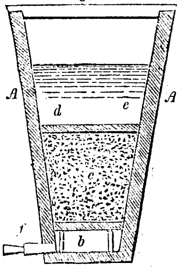
The sirup of the London Pharmacopœia is obtained by dissolving two and a half pounds of refined sugar in a pint of water by means of a water-bath, setting it aside for twenty-four hours, taking off the scum, and pouring off the clear part.

Sugar simply dissolved in water, and sugar boiled in water to a sirup, form compounds very different, as is well known to those who wish to give it to bees as a winter store. In the first case, the heat of the hive will dry up the water, and leave the sugar in crystals, which the bees cannot act upon; but by boiling, the water is made to enter into a more intimate union with the sugar, by which it is prevented from flying off, and the consistency of honey is retained, by which food bees may be preserved during the whole winter without any honey.

4021. *Vegetable sirups* are frequently mentioned; these consist of the juices of various plants boiled up with such a quantity of sugar or honey as will preserve them from spoiling by fermentation. The various kinds of these sirups are denominated from the fruits or flowers from which they are made, as sirup of oranges, of mulberries, of violets, &c. They were formerly much employed in a medicinal way, but at present they are regarded as chiefly useful in being made the vehicles of more efficacious medicines. See "Confectionery," Book XV.

4022. *A method of bleaching sirups made with raw sugar* is used in Paris, and is found so useful that many confectioners employ it instead of refined sugar. Charcoal is known to have the effect of destroying the colour of vegetable juices, and rendering them perfectly transparent. Vegetable charcoal had been used for this purpose in the sugar refineries; but it is found that animal charcoal is much more effective. The mode of using the former has been to boil the sirup with it, and then to strain the whole through a woollen cloth; but when animal charcoal is boiled with sirup it imparts to it a disagreeable flavour. The way of using it is, therefore, varied; and a filter has been contrived which answers the desired purpose. A A, *fig.* 605, is a wooden funnel lined with tinned copper. At a little distance above the bottom is a moveable bottom, *b*, supported upon feet, and pierced full of holes, with a piece of cloth laid over it; upon this is put the animal charcoal, *c*, reduced to grains like gunpowder; another moveable cover, also perforated, *d*, is put over the charcoal; and upon this the sirup to be deprived of colour, *e*, is put. The sirup passes through the charcoal and the two perforated divisions or covers without in the least deranging the charcoal, and flows into the space between the two bottoms, whence it is drawn off by a spigot, *f*. By filtering twice, a solution of raw sugar is completely bleached, and a sirup equal to that from refined sugar is produced, and the flavour peculiar to the raw sugar entirely removed. The sirups ought to be clarified and perfectly liquid before being put into the filter; and the cloths laid over the wooden divisions should be moistened before they are laid down, otherwise the sirup will find some difficulty in making its way through dry cloth.

Fig. 605.



Sect. IV.—On our supplies of sugar.

4023. *Our principal supply of sugar* is from our colonies in the West Indies, where it is raised chiefly by negro, now free labour, but it is interesting to inquire in what other parts of the world sugar is cultivated to a great extent. Besides what is made in the West Indian islands, we obtain sugar in a less quantity from Surinam, Brazil, British India, Java, and the islands of Mauritius and Bourbon.

In the numerous rich valleys of India, where the soil is productive and the climate congenial, it might be raised to any extent, sufficient to supply all Europe. But, hitherto, in Asia the process of sugar-making has been carried on in a very imperfect manner, to which alone must be attributed the inferiority of East India sugar. The sugar-cane grows to great perfection in China, but the Chinese only know the method of forming raw sugar, and sugar-candy by dissolving and crystallizing this. However, the great consumption of the higher classes throughout the East is furnished by China, which annually exports, chiefly to India, Arabia, and Persia, above three thousand tons. In Cochin-China they also make a great quantity of sugar. The annual importation of sugar at present into Britain is seen in the following table:

	Cwts.		Cwts.
From British West India Islands	3,913,269	From Java	5,950
Island of Mauritius	485,326	Philippines	35,780
British India	213,294	Foreign West Indies	223,256
Singapore, being the produce of Siam, Cochin-China, and China	38,535		4,915,619

The importation from the East is yet in its infancy: most of it is not of forty years' standing; and the manufacture of sugar in Siam, Tonquin, and the Philippines is not twenty-five years old.

4024. *Sugar may be grown, as far as climate is concerned, about thirty degrees on each side of the equator*, or the space contained between the dotted lines on the accompanying map, *fig.* 606, in which the shaded parts

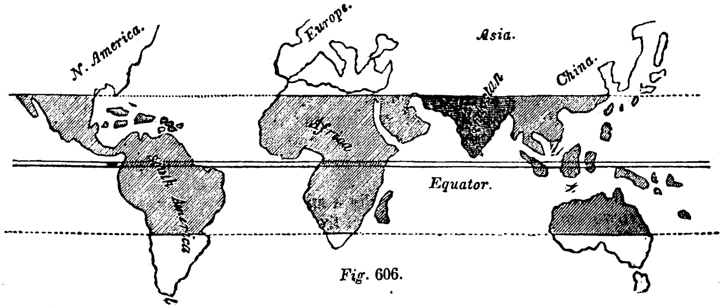


Fig. 606.

are those where it might be cultivated if the soil permits; yet, for various reasons, at present we derive comparatively only a small portion, except from a few West Indian islands, which, from their size, are barely visible on the maps; and some from Hindostan, shaded dark.

Sect. V.—Analysis of sugar.

4025. Although we have stated, Book VII., Chap. VII., Sect. V., that sugar belongs to that class of substances in which the oxyger and hydrogen exist in the proportion requisite to form water, yet the proportion of this water, or of the elements of water, varies in different kinds of sugar. Dr. Prout has paid much attention to this subject, and in a paper published in the Transactions of the Royal Society, he gives the following analysis, which has been made with extreme care:

	Carbon.	Water.		Carbon.	Water.
Pure colourless sugar-candy	42·85	57·15	East India refined sugar	42·2	57·8
			Maple sugar	42.1	57·9
Impure, or common sugar-candy	41·5 to 42·5	58·5 to 57.5	Beet-root sugar	42·1	57·9
			East India moist sugar	40·88	59·12
East India sugar-candy	41·9	58·1	Sugar of Narbonne honey	36·36	63·63
English refined sugar	41·5 to 42·5	58·5 to 57·5	Sugar from starch or potatoes	36·2	63·8

CHAPTER XIV.

SUGAR MADE FROM OTHER PLANTS BESIDES THE SUGAR-CANE.

4026. Although no vegetable produces sugar equal in quantity with the sugar-cane, yet it is well known that this useful substance may be procured by evaporating the sweet juice of many other plants; accordingly, sugar is obtained in various parts of the world from other sources, as several species of palms, the sugar maple-tree, beet root, and grapes.

Palm sugar is made only in the East; sugar from the maple-tree is manufactured in North America; and the beet root and grapes have been employed chiefly in France.

Sect. I.—Palm sugar, or jaggery.

4027. *Sugar is largely manufactured in India* by boiling the juice of several species of palm. The palms grow only in warm countries; augmenting in quantity, variety, and vigour, as they approach the equator. Although most of these afford large quantities of sweet sap, four species are only employed for the purpose of obtaining sugar. These are the wild date (*Elate sylvestris*), the Palmyra (*Borassus flabelliformis*), the Sagwire (*Borassus gomatus*), and the Cocoa (*Cocos nucifera*). All these are Oriental palms, the two latter being natives of countries within 10° of the equator. The Borassus flabelliformis is the most usual; in many parts of India it grows spontaneously, in others it is cultivated with great care. At eight or nine years of age, the trees yield a sweet juice fit for making sugar, or fermenting into liquor. To collect the juice, a man mounts to the top of the tree, having several bottles fastened to his belt. He then cuts off with his knife a thin slice from the membrane which surrounds the blossoms, and a clear sweet liquor distils from the wound; this he collects in his vessels; a good tree will afford daily about three quarts of juice, which turns sour if kept longer than three days.

4028. *To prepare the sugar called jaggery*, a little quicklime is mixed with the juice to absorb any acidity that may arise, and the latter is boiled on the day it is collected The process of making the sugar is so simple that it is produced at much less cost than that from the sugar-cane. Accordingly, it is this article, and not cane sugar, that is chiefly consumed by the poorer people.

Mr. Crawford, in the account of his embassy to Ava, mentions that, in the upper part of the River Irawaddy, there are immense groves of palm-trees grown for the manufacture of sugar, and that the price of it did not exceed a penny a pound. It nearly resembles the product which in Jamaica comes out of the cooler before it is taken to the curing-house, containing both sugar and molasses, being only a little more inspissated.

Sect. II.—maple sugar.

4029. *The sugar maple (Acer saccharinum,* Linn.) *is another of those vegetables which yield a large quantity of sugar* of the same kind as that from the sugar-cane. It grows abundantly in the southern parts of Canada and the northern parts of the United States, and proves a considerable source of wealth and domestic luxury in America. The farmers there manufacture it for their own use, and in the districts where it is produced no other sugar is employed. It is not equal in quality to West India sugar, except it be refined, which is seldom done.

The sugar or American maple is generally a smaller tree than the maple of this country; but it grows sometimes to the height of from sixty to eighty feet, and from two to five in diameter.

4030. *To procure the juice or sap,* holes in each tree are bored with an auger to the depth of about two inches, and slanting upward, and a piece of hollow cane is inserted for the sap to trickle through into a vessel placed below. The sap will continue to flow sometimes for six weeks, according to the temperature of the weather; and, according to Dr. Rush, a moderate-sized tree affords from twenty to thirty gallons of sap, from which five pounds of soft sugar may be obtained.

There are three modes of converting the sap into sugar: evaporation in the ordinary heat of the air, freezing, and boiling; the last is the most usual and the most rapid. Many farmers who make it for their own use, by no better apparatus than one or two iron kettles, obtain two or three hundred pounds in the space of a fortnight or three weeks; but manufactories of maple sugar on a great scale are now likewise established.

3031. *The usual method of making maple sugar by the farmers* is the following: it is necessary that the juice should be boiled as soon as possible after it is drawn, for if it be allowed to stand for twenty-four hours, it is apt to undergo the vinous fermentation, by which the sugar would be lost. The sap is boiled down in the woods where it is drawn, and the concentrated sap is then strained through a flannel and clarified with whites of eggs, into the iron pot for boiling it into sugar. The scum is taken off as it rises, and the whole should be well stirred. When it is supposed that most of the water is evaporated, and the sugar begins to form, a little should be taken with the ladle and tried; if the sugar is sufficiently boiled, it will granulate. The whole may now be poured into some shallow vessel, and kept well stirred till it cools and granulates. It should then be put into a wooden vessel, having holes in the bottom like a cullender, and stirred frequently for a day or two; the molasses will drain off, leaving the sugar finely granulated, and having a sparkling grain, like pounded sugar-candy, if the processes are well performed. One pound of sugar is obtained from forty pints of sap; and as, wherever there is sugar, the vinous fermentation can be induced, it is obvious that the juice could be fermented into wine, and that spirits might be distilled; indeed, a considerable quantity of rum is made from it in America, as well as excellent vinegar.

Sect. III.—beet-root sugar.

4032. Marggraf, an eminent Prussian chemist, first called the attention of the public to this subject in 1747. He was successful in obtaining from the roots of the white and red beet a sugar nearly in the state of Muscovado, or raw cane sugar.

Afterward, Chaptal, a celebrated French chemist, established a manufactory of beet-root sugar; and in 1825 there were twenty-five establishments in France. Of late, these manufactories have increased so much in that kingdom, that at present they amount to 407. The process for making it does not differ materially from that employed in making cane sugar. The white beet is the best, as giving no colouring matter; and 100 parts of the entire root afford from two to two and a half of refined sugar, exactly similar to that from the cane. In France, by various improvements, they make but little molasses, and they convert most of the Muscovado into refined sugar, which is of equal whiteness and beauty to that from the sugar-cane. Beet-root sugar is said to constitute one half of the sugar consumed in France.

Sect. IV.—grape sugar.

4033. *The grape contains a large quantity of saccharine matter mixed with mucilage;* and during the process of drying them into raisins, part of the sugar is seen to exude and concrete spontaneously on the external part of the fruit, from which it might be supposed that to obtain this sugar in a purified state would be a work of no great difficulty. *But the sugar of grapes is not of the same kind nor composition as cane sugar,* and therefore it cannot be made to imitate it. It agrees with sugar from starch or potatoes. It is not of so good a quality for domestic purposes as cane sugar, being soft, mealy, and liable to become damp; neither is it so sweet as that of the cane, that is, a greater quantity is required to produce an equal degree of sweetness, though the flavour is agreeable; it is also very liable to curdle milk, and is therefore inapplicable to many culinary purposes; and it does not answer for sweetening coffee. It is, however, made in some foreign countries, particularly in Hungary.

3034. *Although it does not appear desirable to attempt making sugar from grapes, the rob or must of grapes, or the juice boiled down to the consistence of honey or sirup,* has been long known, and is much used in some parts of France. The invention of this preparation is probably of great antiquity; and it was well known to the ancient people of Syria and Egypt, where it is still largely employed. Dr. Shaw, when in those countries, ascertained that two thousand quintals of this article are annually exported to Egypt from the neighbourhood of Hebron alone; and Dr. Russell, in his "History of Aleppo," represents it as a common article of food at that place. The boiling of the juice destroys its liability to ferment; it is boiled to a half, and sometimes to a fourth part.

SECT. V.—SUGAR FROM TURNIPS, PARSNIPS, AND GRASS.

3035. *Sugar from Turnips.*—During the continental system of exclusion, attempts were made in Germany to produce sugar from a variety of native plants, and, according to Professor Von Thaer, turnips were found best adapted for that purpose. Sugar was made from them equal, in strength, colour, and hardness, to that from the sugar-cane. *Carrots and parsnips* have also been tried, and have yielded a considerable portion of sugar. *Many grasses contain sugar.* A large grass (*Holcus Cafer*), brought from the south of Africa, has begun to be cultivated in some parts of Italy, Bavaria, and Hungary, for sugar; and what is made from it equals cane sugar. But none of these vegetables yield sugar in such quantity as to render the manufacture desirable.

SECT. VI.—STARCH SUGAR AND SUGAR FROM POTATOES.

4036. *The discovery that sugar can be made abundantly from starch* is one of the most interesting in chemistry, the principle of which has been already described when treating "On Brewing." Wheat starch is not necessary; it may be made from potato starch: 100 parts of starch are to be mixed with 200 of water, and added gradually to another 200 of water, previously mixed with one of oil of vitriol, and brought to a boiling heat in a tinned copper vessel; the mixture is kept boiling for thirty-six hours, water being occasionally added to keep up the original quantity; some bone-black is then added, and also some chalk, to get rid of the acid; it is afterward strained and evaporated, by a gentle heat, to the consistence of a sirup, and set by to crystallize. This sugar resembles that of grapes, and not cane sugar. If the quantity of oil of vitriol be in creased to five or six parts, a few hours' boiling will suffice.

It is said that eleven pounds of sugar may be obtained from 110 pounds of potatoes. From one to two parts of sulphuric acid is sufficient for each hundred parts of potatoes, if the heat be a few degrees above 212°. The heat may be applied in wooden vessels by steam.

Of late a manufactory has been established near London for making sugar from potatoes. The sugar is of the Muscovado kind, and is remarkably white, much resembling East India sugar. It is sold at a price considerably below that of cane sugar; but it is important to be known that it is entirely a different species of sugar, being much less sweet, and, therefore, in reality not a cheap sugar. There is great danger lest potato sugars should be employed to adulterate the usual sugar from the sugar-cane; indeed, we have reason to believe that this kind of adulteration is already put in practice. It is also employed for distilling potato spirit, which is said to be used in the manufacture of home-made brandy, and for adulterating wines. *Sago is employed* in the same manner as potato starch.

CHAPTER XV.

ON HONEY AND MANNA.

4037. *Honey is produced by several species of bees; but most abundantly by the garden or hive bee* (*Apis mellifica*), which is found wild in many parts of the world, and always congregated in swarms. In their wild state, they frequently inhabit the hollow trunks of trees, in which they build their combs, particularly in Livonia and Poland; but with us this species may be said to be domesticated, all of them being under the protection of man.

4038. *Bees collect, by means of their tongue, or, rather, their proboscis or trunk, the sweet juice contained in the nectaries or honey-cups of flowers.* Of this saccharine juice, a part passes into its stomach, and constitutes its food; the rest goes into what is called the honey-bag, which is an enlargement of the gullet, and when full of honey is about the size of a pea. When the honey-bag is filled, the insect returns to the hive and disgorges its contents into one of the hexagonal cells of wax which it had previous prepared for its reception, and which forms what is called the honey-comb. The cells, when filled, are sealed up with a thin covering of wax, and the honey is intended for the support of the community during the winter.

4039. *It has been questioned whether honey is not merely the sweet nectarial fluid so collected;* but it is most probable that it has been altered in some degree while in the body of the animal, because, when bees are fed upon sugar alone, they still produce honey.

4040. *The nature of the honey is very much influenced by the species of flowers* from which it is obtained, and the vegetation which supplies the bees with food. The honey afforded by bees that have access to wild thyme, lavender, rosemary, and flowers belonging to the natural order Labiatæ, abounding in aromatic and essential oils, is of the first quality; and it is said to be very bad where the bees live near to fields of buckwheat. The difference in the food occasions the honey of each country to have a peculiar character. The honey of Hybla, on the east coast of Sicily, and that of Hymettus, a mountain near Athens, were reckoned by the ancients the finest in the world; that of Crete was also celebrated; and excellent honey is still produced in some of the islands of Greece, where the bees inhabit hollow trees and rocks. Palestine is described as formerly flowing with milk and honey. The best now known is said to be from the Peak of Teneriffe. That of Minorca is also very fine; it is very white, and when new has the odour of rosemary, derived from the rosemary and other wild shrubs that grow in that island; the honey of Murcia, Valencia, and Catalonia is of the same kind. A softer, less crystalline, pale-coloured, and nearly flavourless honey is collected in Switzerland, and is known in our shops by the name of Chamouni honey. The finest honey in France is that of Narbonne; it is of a pale colour, and, on keeping, deposites larger and harder granulations than common, and is characterized by the flavour or odour of rosemary; that of Haut Provence has the fine flavour of lavender. It is, however, suspected that some of these flavours are artificial.

4041. *The whitest honey is met with in the lime-tree forests near the town of Kowno in Lithuania;* it is considered on the Continent as the most valuable, not only on account of the superiority of its flavour, but also for the estimation in which it is held for pulmonary complaints, being less heating than the ordinary kinds. The great demand for it occasions it to bear a high price, so much as two ducats per pound on the spot. This species of lime-tree is peculiar to Lithuania, and is different from the rest of the genus Tilia.

4042. *The common honey of Britain,* being chiefly derived from agricultural crops or wild plants of the leguminous kind, such as clover and beans, gorse and broom, is, when pure, of good quality, though not equal to some of those already mentioned; the Hampshire honey is reckoned the best in England. *Mr. Aikin observes* that "there is a shallow vale in Shropshire, extending from Wenlock towards Ludlow, which from time immemorial has borne the name of Apes-dale, from the number of hives formerly kept by the cottagers and small farmers who inhabit it, and who are said to have paid the priory of Wenlock a considerable part of their rents in honey. The soil is entirely calcareous, and during the whole summer it is covered with flowers. Select specimens of its honey," says Mr. Aikin, "bear a close resemblance in colour and hardness of granulation to that of Narbonne; it wants, indeed, the odour of the latter, which perhaps is not natural to it."

4043. *It is a remarkable fact that the honey of some countries is poisonous.* An instance of this kind is mentioned by Xenophon, in his history of the retreat of the 10,000 Greeks; when on the shore of the Euxine Sea, two days' march from Trebizond, those who ate of the honey found there were seized with delirium that had nearly proved fatal. Pliny speaks of another case of the same kind in the same country; the truth of which statements was confirmed in modern times by Tournefort, who ascertained that plants with poisonous flowers grew there. Dr. Barton mentions a poisonous honey in Pennsylvania, and Humboldt met with one on the Oronoco.

4044. *It has been observed, indeed, that, with respect to the wholesomeness of honey,* many persons can eat one kind with impunity, but not another.

The different species of heath which cover large tracts of hilly country in our own island, and overspread the sandy wastes of Brandenburgh, Pomerania, and, generally, of the north of Germany, afford a considerable quantity of reddish-brown honey, of a strong odour and flavour, and very liable to disagree with those who are unaccustomed to it. In the market it bears the lowest price, and little or no demand exists for it in London. It is probably the same as the heath honey (Ericæum mel) of the Romans, which, according to Pliny, is the worst of all.

4045. *Honey is a species of sugar* consisting of two varieties; one part of it is always liquid like sirup, and cannot be rendered solid or crystallized; the other may be separated, granulated, or crystallized, and made into a solid sugar. These two substances are always mixed together in honey, but in variable proportions, and the quality of the honey depends much upon the quantities of each of the two sorts of sugar. The best honey is that which contains the largest proportion of the crystallizable sugar. Both are soluble in water; but the sirupy part only is dissolvable by cold alcohol, which leaves the other untouched. To separate them, mix the honey with alcohol, and, after it has had time to dissolve, put the whole into a linen bag, and press the liquid part through; a granular mass will remain behind; to crystallize this, it must be boiled in alcohol, which will dissolve it, and then, by slow evaporation, it will crystallize into sugar. By evaporating the other solution in alcohol the sirup may be obtained in a concentrated state. Besides these two kinds of sugar, honey contains also a free acid matter not yet well understood, mucilage, and sometimes a little wax, together with colouring and odoriferous matter.

4046. *New honey appears a uniform transparent sirup,* varying considerably in colour from nearly white to a yellowish brown, intensely sweet to the taste, but having always more or less of a peculiar flavour and an aromatic odour; and besides its sweetness, it has a sharp, acidulous taste; by keeping, the colour becomes deeper, and it acquires more sharpness. It is laxative, and, when indulged in freely as food, it is liable to induce colic in some habits. After a few weeks, it generally grows thick, from the formation of small, soft crystalline grains, which remain mixed with the fluid parts. The same effect is produced by a cold temperature. The lighter-coloured honeys are the most liable to granulate.

4047. *In taking the honey from the hives*, a slice is cut off from the surface of the comb, so as to unseal the cells; after which it is laid on a sieve to allow the honey to drain out. The honey obtained in this manner is the purest and best flavoured; but sometimes a little warmth is employed, which injures the flavour. Generally, pressure is employed to save time; by this a greater quantity of honey is obtained, but as it is then mingled with some wax, and fouled by the juice of those bee-maggots which happened to be in the comb, and which are crushed by this process, the taste of the honey is deteriorated. *Virgin honey* is what is first made in a clean new hive by bees that have never swarmed. The honey made in the spring is preferred to that of the autumn.

4048. *To prevent the practice of destroying the bees* to obtain their honey, several plans have been tried: that lately put in practice by Mr. Nutt appears to be quite successful. By the method which he employs he procured 296 lbs. of honey from one stock of bees, the usual product being from 100 to 190 lbs.

4049. Honey was much in request before the discovery of sugar; at present it is little in demand, except for the purposes of medicine; the finer kinds, however, as articles of luxury, still bear a high price; that of Narbonne and Minorca are most in estimation.

4050. *Honey is sometimes blanched.* Dr. Bright, in his "Travels in Hungary," informs us that the Jews bleach common honey to such a degree of whiteness as to sell it for Kowno honey, which is very fine, and exclusively made from lime-tree blossoms. They do this by exposing it to the frost for three weeks, sheltered from the snow; the honey does not freeze, but acquires transparency and hardness. Both honey and wax may be bleached by steam, or by exposing them to a humid atmosphere; in frosty weather the operation is rapid.

4051. *Honey is clarified* by melting the best kind with water over a water-bath, adding the white of egg, and boiling it to throw up the scum; when the scum is removed, the water must be evaporated and the honey brought to its former consistence.

4052. *Honey enters into the vinous fermentation* without the addition of yeast, and yields the liquor called *mead*, of which formerly vast quantities were made before so much land had been brought into cultivation for grain. See "Mead," Book VIII., Chap. V., Sect. III.

The noted Italian liqueur *rosoglio*, which is also made at Dantzic, is prepared from a spirituous liquor and honey blanched by the Jews in the manner mentioned above.

4053. *A substance much resembling honey* may be made by boiling the must of grapes to a sirup, and the sugar of honey resembles that of grapes more than that from the sugar-cane.

Manna.

4054. *Manna has been supposed to be a species of sugar;* but its sweetness is owing to a distinct principle called *Mannite*, holding an intermediate place between cane sugar and honey. This, when prepared pure, is agreeably sweet, and free from the nauseous taste of manna; it is readily soluble in water, and instantly melts in the mouth. Manna is used only as a medicine; it is a vegetable substance that exudes spontaneously, and is obtained by incisions from the stem of a species of ash (*Fraxinus orrus*), a native of the south of Europe, particularly of Sicily, Calabria, and Greece. The juice concretes into solid masses, or is dried in the sun or in stoves. The best manna comes to us closely packed in chests, and is called *flake manna*.

Mr. Madden, in his "Travels into Syria and Arabia," mentions a species of manna, called at present by the Arabs *mann;* it is produced by a species of tamarisk that grows in Wady Amara, and near Gibel Tor (the ancient Mount Sinai). It exudes in the month of June, during the night, from the thorns of the tree on the leaves and twigs beneath, but if exposed to the heat of the day it melts. The Arabs boil it, and, after straining it, put it into leathern bags, to preserve it for use; it has much the appearance of honey.

BOOK IX.

ON MAKING BREAD.

CHAPTER I.

INTRODUCTION AND HISTORY OF BREAD.

4055. *The quality of bread is universally allowed to be a matter deserving of serious consideration;* for good bread is not merely an article of luxury, but is essential to our health. The changes which have occurred in the habits of society have, in a great measure, taken the manufacture of bread, among other things of the first necessity, out of the hands of individuals, and placed it in those of public bakers, on whose skill and probity we now depend for an article which has been emphatically termed the "*staff of* *life.*" This is, perhaps, to a certain extent, unavoidable in the present condition of things, particularly in large cities; but while many persons are thus freed from what would otherwise be a continual source of trouble, and to whom this arrangement is a convenience of no small importance, it begins to be overlooked and forgotten that there are any advantages to counterbalance the inconveniences of private or domestic baking. Previously to our determining on this question, it will be well to inquire carefully into the nature of this kind of food, and into all the circumstances connected with its production. We shall thus be enabled to form an accurate judgment how far domestic baking is worth attending to.

4056. *We shall divide the subject into several chapters:* in the first we propose giving a short history of the introduction and progress of making bread among civilized nations; in the second we shall treat of the materials from which bread is prepared; the third shall describe the practice of making bread of various kinds; in the fourth we shall point out several farinaceous substances used instead of bread in various parts of the world; in the fifth we shall describe the construction of bakers' ovens, with some remarks upon baking.

4057. *History of Bread.*—Of the various kinds of aliment to which civilized man has had recourse within the historical period, none has been so universally employed as bread. The cultivation of grain for the regular supply of a superior vegetable food always denotes an advanced state and settled condition of society, from which may be dated the accurate division of territorial property; for the districts which had been used for hunting and pasturage were not divided with any degree of exactness.

Like most arts of primary importance, the invention of bread long preceded the period of its history, which is involved in the usual obscurity of early times. The Greeks were accustomed to deify the authors of discoveries, and they accordingly ascribed the introduction of agriculture to Ceres, and the invention of bread to Pan; but the Chaldeans and Egyptians were acquainted with these arts at a still more remote period. The sacred writings make mention of it in the days of Abraham: "And Abraham hastened into the tent to Sarah, and said, Make ready quickly three measures of fine meal, knead it, and make cakes upon the hearth." In the paintings recently discovered in the tombs of Egypt, the various processes used by the ancient Egyptians in making bread are distinctly represented.

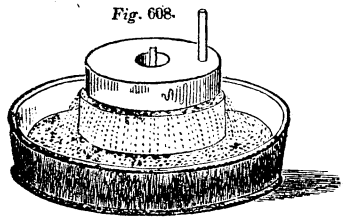
But when we consider how small is the quantity of nutriment that might have been expected from seeds like the farinaceous grains, we may suppose that these would not have been resorted to at first, except in the deficiency of larger supplies of food derived from hunting, fishing, and fruits. We find at the present day some of the savage tribes in America using occasionally, when unsuccessful in the chase, the seeds of a wild corn; but they never attempt its cultivation. Some kinds of grain are more easily deprived of the chaff than others, which have a hard or horny covering so close that it cannot be separated by mere rubbing. Also, grain, when full grown, but yet soft and milky, is more palatable than the same when dry and ripe; and the species with naked pods are often used as food in this state by persons in low or very simple conditions of society, without any farther preparation than merely toasting them. Ears of maize are thus treated by farmers in the United States of America; and Hasselquist, in his "Travels in Palestine," gives us an account which has been confirmed by late travellers. "On the road from Acre to Leide," he observes, "we saw a herdsman eating his dinner, consisting of half-ripe ears of wheat, which he roasted and ate with as good an appetite as a Turk does his pillau. In Egypt such food is much eaten by the poor, being the ears of maize or Turkish wheat, and of their *dhourra*, which is a kind of millet. When this food was invented, art was in a simple state; yet the custom is still continued in some nations, where the inhabitants have not, even at this day, learned to pamper nature."

Boiling demands the possession of metals and the art of working them, or of some material capable of resisting fire; but this is so simple and advantageous a mode of using corn of all kinds, that it was probably employed long before the more artificial method of grinding the grain into meal, and baking it as bread. Burckhardt observes that the inhabitants of Nubia boiled the green ears of barley in water, and ate them with milk.

4058. In the remotest parts of Scotland, until very lately, a custom existed among the poorest classes, which may very well illustrate the manners of the most simple nations of antiquity. Barley, well dried by the fire, was put into a hemispherical cavity worked out of a block of stone, *fig.* 607, where it was beaten for a short time by a wooden mallet until the husk was pretty well separated: a small quantity of the bruised barley was next taken up in the hand, and cleaned by blowing gently with the mouth, which was sufficient to drive away the husks; and the cleaned barley was then put into the pot for broth. Those who are not accustomed to trace the progress of inventions have no idea of the slowness with which they are improved. It seems very easy to grind corn into flour, yet probably ages elapsed before

Fig. 607.

Fig. 608.



this was properly effected. The *quern, fig.* 608, used in the Highlands of Scotland, was, perhaps, a legacy left to this island by the Romans, who were accustomed to carry hand-mills in their camps, as is seen in the Trajan columns; or it may have been used by the Celtic nations, as it was known in the East at a period preceding that of the earliest records. It is thus described by Dr. Johnson: "The quern consists of two stones, about a foot and a half in diameter; the lower is a little convex, to which the concavity of the upper must be fitted. In the middle of the upper stone is a round hole, and on one side is a long handle. The grinder sheds the corn gradually into the hole with one hand, and works the handle round with the other. The corn slides down the convexity of the lower stone, and, by the motion of the upper, is ground in its passage." This, the simplest, and no doubt the most ancient of all corn mills, will soon, perhaps, be no longer seen in this island; but it has been discovered among the inhabitants of the Himalayan regions, where many Celtic customs may be traced. The quern illustrates so well the usual millstones by which our flour is now ground, that it is not necessary to add anything except to say that our corn mills may be considered as querns upon a large scale driven by machinery; but the grinding surfaces of millstones have radiating lines cut into them for the more effectual bruising and cutting the grain, and reducing it to the state of powder. It is unnecessary to pursue the history of corn mills through those ages when attention was successfully turned to the best methods of saving labour, and when the science of mechanics had brought under contribution the natural powers of water, wind, and steam. Before the art of converting the nutritious matter of corn into so convenient and portable a substance as bread, various expedients, no doubt, were resorted to; the modern Italians at this day consume the greatest part of their flour in the state of maccaroni and vermicelli, and in the other forms of polenta or soft pudding.

The *pottage*, or *porridge*, of the northern part of Britain, made by boiling meal in water or milk, and the *brose*, consisting of roasted meal stirred up in the liquor in which salted meat has been boiled, are more humble remains of very ancient customs.

We may conceive, then, that the preparation of unfermented bread, or cakes, was as early as the use of grain; since the method of making them is so simple that it would easily suggest itself to the rudest nation.

4059. *At what time, and by whom, the art of fermenting bread was discovered is not known;* but accident is very likely to have given rise to it in more places than one. We learn from the Scriptures that leavened bread was known to the Israelites, as it was also to the Egyptians and inhabitants of Greece; but it appears that fermented bread was not introduced into Rome until 550 years after its foundation, or about 200 years before the Christian era: Pliny informs us that the Romans learned this, with many other improvements, during the war with Perseus, king of Macedon. The armies, on their return from Macedonia, brought Grecian bakers with them into Italy; and these were called *pistores*, from their ancient practice of bruising the grain in mortars. The profession of a baker was held in great estimation; and in the reign of Augustus there were 329 public bakehouses in Rome, which were chiefly occupied by Greeks, who long continued to be the only persons who understood the art of making good bread. These bakers were incorporated, and enjoyed considerable privileges, and had the care of the public granaries. The art of baking fermented bread found its way into Gaul; but it seems to have remained long unknown in the north of Europe. In the middle of the sixteenth century, unfermented cakes, kneaded by the women, were the only bread known in Sweden and Norway. In this country, probably, the baking of bread was at first universally a part of domestic economy, and it does not appear at what period it became a distinct profession; nevertheless, it is so at present, more or less, in every country of Europe; and the practice is nearly the same in all.

There is reason to think, from a passage in Pliny (*Nat. Hist.*, lib. xviii., c. 7), that the ancients were acquainted with the use of yeast in fermenting bread; yet it was only towards the end of the seventeenth century that it became generally employed for this purpose in the north of Europe. About this time, the bakers of Paris brought yeast from Flanders for the purpose of baking, and as a substitute for leaven. Although by this means the bread was manifestly improved both in appearance and flavour, the French government prohibited the bakers from employing yeast in its manufacture under a severe penalty, in consequence of the representations of the College of Physicians in 1688, who declared it to be injurious to health. This order was, however, evaded; the yeast was put into sacks in Flanders, and the moisture being suffered to drop out, it was secretly brought in a dry state to the capital of France. The superiority of yeast bread in every respect soon became apparent; the decisions of the medical faculty were forgotten; the prohibitory laws were allowed tacitly to sink into oblivion, and the new mode of baking found its way into other countries.

4060. *The history of bread is, therefore, naturally divided into three parts*, consisting of so many remarkable stages of improvement in the art: first, the formation of unfermented bread; second, the fermentation of leavened bread without yeast; third, the fermentation of bread by means of yeast, which is the method now in general use. The subject of bread-making will be treated of most distinctly by following this order, which is not only historical, but also the most simple. But before proceeding to describe each of these, we must take a view of the materials of which bread is composed.

CHAPTER II.

MATERIALS OF WHICH BREAD IS COMPOSED.

Sect. I.—GENERAL OBSERVATIONS ON THE CEREALIA.

4061. *In our general observations on food, we explained at some length the chemical principles in the various products of the vegetable kingdom*, and pointed out that they were distinguished from each other, as to their nutritive properties, by their abounding more or less in their proportions of starch, gluten, mucilage, sugar, jelly, fixed oils, and acids. The first three constituents are the most valuable, and plants which contain a large proportion of them are termed *farinaceous*, because they yield, on being dried and pounded, or ground, a farina, or meal, which, when boiled in water, forms a pulpy substance, sometimes used as food, and which, by proper management, can likewise be converted into bread.

4062. *Among the farinaceous vegetables, by far the most important are the seeds of the Cerealia, or corn plants*, which belong to the natural order of Gramina, or grasses, in botanical systems. Next to the Cerealia are the Leguminosæ, or leguminous plants, whose seeds are found in a pod botanically called a legumen, such as pease and beans. Many roots, fruits, and even the stems of foreign trees, yield a large proportion of farina, of which the most valuable that we possess is the potato. Almonds, walnuts, and filberts contain farina mixed with oil and mucilage, but they are not, with us, employed for the purpose of making bread. Other substances will be mentioned at the end of this article; but at present our object is to confine ourselves to such farinaceous materials as are in common use in this country for the manufacture of bread.

4063. *It appears to be one of the wise dispensations of Providence*, of which the study of nature furnishes so many and such striking examples, that the Cerealia, or corn plants, are distributed all over the face of the earth, or, at least, in all those parts where it is most desirable that man shall fix his abode; and they are likewise now become to such a degree the object of culture, that no civilized country is destitute of this valuable addition to its means of sustenance.

4064. *The principal corn plants* are wheat, rye, oats, rice, maize, and millet; there are many others belonging to the same tribe, but they are little in request, on account of the smallness of their seeds. The term *corn* is generally applied, in every country, to that species particularly which is raised in the greatest quantity, and which is most generally employed; thus, in America, maize, almost solely, is called corn. Wheat is the most valuable of the grains used in the fabrication of bread; it is, in fact, the only one of which light, porous bread can be made; the others are only used in climates not suitable to the cultivation of wheat, or for malt, or for the food of cattle.

4065. *All the corn plants are annuals*, the head, or ear, containing the seed being supported upon a straw, or culm, which is hollow, and divided by joints (hence they are called culmiferous plants), a single leaf proceeding from each joint. It is worthy of remark that the stems are coated with a glossy varnish, consisting of actual silex, or flint, which the vegetable has the power of extracting from the soil and dissolving, although the particular means by which this is effected are unknown to us. This is well seen in the bamboo and canes, which, though not Cerealia, belong to the Gramina. Masses of spongy glass derived from this source have been found where stacks of corn have been burned down; and this is the reason why the ashes of straw form an excellent polishing material, the siliceous part not being destroyed by the combustion.

4066. *The Cerealia are all remarkable for their extraordinary power of multiplication*, each grain or seed throwing out several stalks, all of which bear ears; and the number of these is not limited, but depends upon the more or less favourable circumstances. This increase in the stalks is called *tillering*, and is performed by a second set of roots, called coronal roots, shooting out at the surface of the ground subsequently to the first or seminal roots. Some extraordinary instances are related of this kind of multiplication. In 1660, a plant of barley was preserved in Paris, as we are told, by Kenelm Digby, that had 249 stalks springing from one grain, and in the ears were counted 18,000 seeds. A still more extraordinary fact is related in the Philos. Trans., vol. lxviii.: Mr. Miller, of Cambridge, found that a single grain of wheat, sowed on the 2d of June, had produced 18 stalks; on the 8th of August he took up the plant, and divided the stalks from each other, each having its root, and planted them again separately. Every separate plant now again tillered, throwing out fresh roots and stalks. These he again took up, divided, and planted as before, and so on several times, till by the next April they had multiplied to 500 plants, all extremely vigorous; the number of ears from these amounted to 21,109, and the number of grains to 576,840. But such instances are uncommon. The straw of the Cerealia is useful as fodder for cattle, for thatching, and various other purposes.

4067. *The corn plants have been so long the produce of cultivation*, that all knowledge of their native countries is lost; and, indeed, they have undergone so much change from the progress of agriculture, and so different are they at present from what they were in their wild state, that the originals cannot be recognised with certainty; nor is it clear when these plants are discovered in unfrequented regions, whether they may not have been brought there at some distant time, and have remained as a trace of ancient civilization. It is most probable, however, that it was from the central parts of India the rest of the world has derived this important gift of Providence, as well as most of the other useful vegetables and fruits cultivated in Europe. They were all, except maize, unknown in America on its discovery.

The corn plants do not grow equally in all climates; and the globe may be divided into several zones, according to the prevalence of some particular grain. Rice requires the warmest climate; next maize; then wheat, rye, barley, and oats. The first three are the most extensively distributed; maize has the greatest range of temperature; but rice may be considered as supporting the largest number of the human race. The natural distribution of these grains over the globe depends not only upon climate, but likewise upon the industry of man, the state of commerce, and other causes by which the limits of their cultivation are extended.

4068. *The following view of the distribution of the Cerealia* is abridged from a German work quoted in "Jameson's Journal" for 1835:

Within the polar circle agriculture is found only in a few places. In Siberia, grain reaches to the utmost only to 60°; in the eastern parts scarcely above 55°; and in Kamtschatka there is no agriculture. On the northwest coast of America the polar limit of agriculture appears to be somewhat higher; for in the more southern Russian possessions barley and rye come to maturity. On the eastern coast of America it is scarcely above 52°. It is only in Europe, in Lapland, that grain is cultivated at so high a latitude as 70°; beyond this, the bark of the pine, dried fish, and here and there potatoes, supply the place of grain. The grains which extend farthest to the north in Europe are barley and oats; these, which in the milder climates are not used for bread, afford to the inhabitants of the northern parts of Norway and Sweden, and part of Siberia, their chief vegetable food. Rye is the next which becomes associated with these. This is the prevailing grain in a great part of the northern temperate zone, namely, in the south of Sweden and Norway, Denmark, and in all the lands bordering on the Baltic, the north of Germany, and part of Siberia. In the latter, another very nutritious grain, buckwheat, is very frequently cultivated. In the zone where rye prevails, wheat is also generally to be found, barley being here chiefly cultivated for the manufacture of beer, and oats supplying food for horses.

To these there follows a zone in Europe and Western Asia, where rye lessens or disappears, and wheat almost exclusively furnishes bread. The middle or south of France, England, part of Scotland, a part of Germany, Hungary, the Crimea and Caucasus, as also the lands of Middle Asia, where agriculture is followed, belong to this zone. Here, also, the vine is found; wine supplants the use of beer, and barley is, *consequently*, less raised. Next comes a district where wheat still abounds, but no longer exclusively furnishes bread, rice and maize becoming frequent. To this zone belongs Portugal, Spain, part of France on the Mediterranean, Italy, and Greece; farther, the countries of the East, Persia, Northern India, Arabia, Egypt, Nubia, Barbary, and the Canary Islands; in these latter countries, however, the culture of maize or rice towards the south is always more considerable; and in some of them several kinds of Lorghum (Doura) and Poa Abyssinica come to be added. In both these regions of wheat, rye only occurs at considerable elevations; oats, however, more seldom, and at last entirely disappear, barley affording food for horses and mules.

In the eastern part of the temperate zone of the old Continent, in China and Japan, our northern kinds of grain are very unfrequent, and rice is found to predominate. The cause of this difference between the east and the west of the old Continent appears to be in the manners and peculiarities of the people. In North America, wheat and rye grow as in Europe, but more sparingly. Maize is more reared in the Western than in the Old World, and rice most cultivated in the southern provinces of the United States.

In the torrid zone, maize predominates in America, rice in Asia, and both these grains are in nearly equal quantity in Africa. The cause of this distribution is, without doubt, historical; for Asia is the native country of rice, and America of maize. In some situations, especially in the neighbourhood of the tropics, wheat is also met with, but always subordinate to the other kinds of grain. Besides rice and maize, there are in the torrid zone several kinds of grain, as well as other plants, which supply the inhabitants with food, either used along with them, or entirely occupying their place. Such are in the new Continent, yams, the manihot, and the batatus, the root of which and the pisang furnish universal articles of food. In the same zone in Africa, doura, pisang, manihot, and yams. In the East Indies and on the Indian islands, Panicum frumentaceum, several palms, and cycadeæ, which produce the sago, pisang, yams, batatas, and the bread fruit. In the South Sea Islands grain of every kind disappears, its place being supplied by the bread-fruit tree, the pisang, and Tacca pinnatifida. In the tropical parts of New-Holland there is no agriculture, the inhabitants living upon the sago of various palms, and some species of arum.

In the high lands of South America there is a distribution similar to that of the degrees of latitude. Maize, indeed, grows to the height of 7200 feet above the level of the sea, but only predominates between 3000 and 6000 feet of elevation. Below 3000 feet it is associated with the pisang and the above-mentioned vegetables, while from 6000 to 9260 feet the European grains abound, wheat in the lower regions, and rye and barley in the higher. Potatoes alone are cultivated from 9260 to 12,300 feet.

To the south of the tropic of Capricorn, wherever agriculture is practised, considerable resemblance with the northern temperate zone may be observed. In the southern parts of Brazil, in Buenos Ayres, Chili, at the Cape of Good Hope, and in the temperate zone of New-Holland, wheat predominates; barley, however, and rye, make their appearance in the southern parts of these countries and in Van Diemen's Land. In New-Zealand the culture of wheat is said to have been tried with success, but the inhabitants avail themselves of the Acrostichum furcatum as the main article of sustenance.

SUBSECT. 1.—*Wheat.*

4069. In every climate where wheat can be cultivated it is raised in preference to all other kinds of corn. It contains the greatest quantity of starch, and likewise by far the most gluten, a principle from which it derives the quality that fits it for bread above every other grain. The expense of its cultivation is, indeed, somewhat greater; but from its superiority as a bread corn, it is always chosen where the climate permits, or the poverty of the country has not constrained the inhabitants to be content with cheaper food.

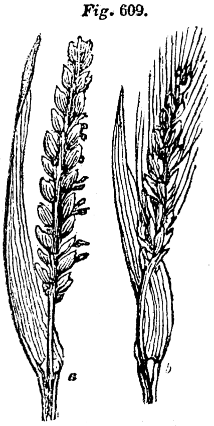
4070. *Wheaten bread is now almost universally used in England;* and in Scotland it is becoming much more general; but in the reign of Henry VIII. it was confined to the gentry, and the poorer class atè only rye, barley, or oaten bread. About the middle of the last century, very little wheat was cultivated in the northern parts of England, and the crust of the Christmas goose pies of Cumberland was composed of barley meal.

4071. *The native country of wheat is not certain;* but Bruce found it growing wild in Abyssinia. It requires a climate moderately warm; it does not extend to high latitudes, and it is finest in the warmest parts of the temperate zone.

4072. *Of wheat, agriculturists reckon several varieties;* but of these, only two are generally cultivated in this country.

1. *Winter wheat* (*a*, *fig.* 609), *Triticum hybernicum*, Linn., sown in winter, and sometimes called "Lammas wheat," is by far the most general and valuable in England, being the most productive; but it is liable to fail in cold springs. The spikes, or ears, of this wheat are long, are without awns, or, at most, have very short ones; and they are disposed in four rows, being laid over each other like the tiles in a house. Of this variety there are two sorts, the white and the red: the first is the most hardy, but the latter is said to produce the best flour.

Fig. 609.



2. *Spring wheat* (*b*, *fig.* 609), (*Triticum æstivum*, Linn.), called also "Summer wheat," is easily distinguished from the last, because it has a beard, or awns, like barley. It is sown in the end of April or the beginning of May, and ripens in autumn, generally a fortnight before the winter wheat. The grain is smaller than that of winter wheat, and it does not yield so much flour; but, though somewhat less productive, it affords greater security against unfavourable seasons, and grows rapidly. It is chiefly cultivated in Lincolnshire. Its straw is very fine, though short, and is much used for straw plait.

4073. Other varieties of wheat not usually cultivated in England are, *Polish wheat*, cultivated in Poland; *Spelt wheat*, probably the Triticum of the Romans, the Zea of the Greeks, the Epautre of the French and the south of Europe. *Victoria wheat* is a species of bearded wheat, which had been observed by Humboldt at the village of Victoria, in the province of Caraccas; this was very productive, and ripened in seventy or seventy-five days from the time of sowing, consequently affording several crops in a year. Some of the seeds have been sent over to this country by Sir R. K. Porter, and distributed to various individuals. Sanguine hopes have been entertained of its success, even in this climate, but there is not yet time to decide upon its merits. It is found to ripen about a fortnight sooner than the common wheat, which is a circumstance of importance in the northern districts; and it is thought that in the south of England it may give two crops in the year. *Nepaul wheat*, a species of wheat which has been lately introduced, brought from *Nepaul*, in India: it ripens in a very short time, and affords great produce. *Talavera wheat* was brought from Spain, and is occasionally cultivated in the light soils of Norfolk. Botanists, in general, look upon all the cultivated wheats as mere varieties produced by peculiarities in the soil and climate, and that they mostly form hybrids when mixed in the sowing. They have also been divided into the *hard* and *soft* wheats. The hard wheats are the produce of warm climates, such as Italy, Sicily, and Barbary: the wheat of Poland likewise belongs to them. The soft wheats grow in the northern parts of Europe, as in Belgium, England, Denmark, and Sweden. The hard wheats have a compact seed, nearly transparent, which, when beaten through, breaks short, and shows a very white flour within. The hard wheats contain more gluten than the soft varieties, which renders them fitter for bread and pastry. The soft wheats, those usually cultivated in Britain, have no opaque coat, or skin, which, when first reaped, give way readily to the pressure of the finger and thumb: these require to be well dried and hardened before they can be conveniently ground into flour. The soft wheats contain most starch, which fits them best for the vinous fermentation in brewing and distilling.

4074. *Wheat grown in different countries varies considerably.* The climate of the northern parts of Europe is not favourable to its cultivation. This grain has, however, been slowly making its way in this part of the world; but in Sweden, to this day, nothing is met with, usually, except rye cakes, almost as hard as flint, as they bake only twice a year. Wheaten rolls may be seen occasionally in some of the towns, but never loaves. In 1812, a baker in Gottenburgh received an order from the captain of a vessel to bake wheaten bread to the value of 1*l.*; but the baker, alarmed at the risk, required security for the payment, since, had the bread been left upon his hands, he could not have disposed of so large a quantity in that town, notwithstanding it had a population of 23,000 inhabitants.

The wheat of Essex and Kent bears a higher price than that of East Lothian and Berwickshire. The general quality of Irish wheat is about sixteen per cent., and that of Scotland eight per cent., inferior to that of England.

If we except the Russian, which is inferior, the wheat of the Continent is, in general, superior to English wheat by five per cent.: hence it is said that the London flour is inferior to that of most large towns on the Continent.

4075. *Large quantities of this grain, of a superior quality*, are imported from Dantzic and other ports in the Baltic. The best is grown in Poland and Pomerania, and is conveyed down by the rivers, in large barges and rafts, from the interior of the country. The grain is beautifully white, hard, and thin-skinned, and, in consequence of its small quantity of bran, it yields a large proportion of excellent flour. French wheat is, in general, superior to that of England. The Italians have the superiority over the French in their wheaten crops; and perhaps the best wheat of all is raised in Barbary and Egypt. The Sicilian is the finest in Europe: it is of two kinds; one is a long grain, much larger than English, and is generally boiled whole, as a substitute for barley or rice; the other is an oval soft wheat, yielding a flour that is remarkably white, and employed only in making the best sort of bread, biscuits, pastry, &c.; but, from government restrictions, very little is exported.

It is said that a very hard wheat is grown at Odessa, that contains more sugar than the French, and that the starch in it differs from that of ordinary wheat flour in being in more transparent grains, resembling gum, and absorbing less water; but a softer wheat is grown at the same place. The wheat of the south of Europe and other warm climates abounds more in gluten than that of more northerly countries, and consequently is more nutritious; it is also fitter for making maccaroni and other preparations of flour, where a glutinous quality is considered as an excellence. These wheats are of greater specific gravity, harder, and more difficult to grind, than the wheat of England.

Sir H. Davy makes the following comparison:

	Middlesex Wheat.	*Sicilian Wheat.*	*Barbary Wheat.*
Starch - -	77	75	74
Gluten - -	19	21	23

Analysis of Wheat quoted by Dr. Pereira:

	French Wheat.	*Odessa Hard Wheat.*	*Odessa Soft Wheat*
Starch - -	71·49	56·5	62·00
Gluten - -	10·96	14·55	12·00
Sugar - -	4·72	8·48	7·56
Gum - -	3·32	4·90	5·80
Bran - -	—	2·30	1·20
Water - -	10·00	12·00	10·00

4076. *Wheat is liable to several diseases*, which affect the flour made from it, and render it unfit for good bread. The principal of these are the blight, mildew, and smut, which are occasioned by microscopic fungi which sow themselves, and grow upon the stems and ears, destroying the nutritive principles, and introducing matter of a deleterious kind. The farmer is at the utmost pains to keep away these intruders. Wheat, as well as all kinds of corn, is also very liable to be injured by being stacked before it is quite dry; in which case it will heat and become musty in the ricks. In wet harvests it is sometimes impossible to get it sufficiently dried, and a great deal of corn is thus often spoiled. It is generally reckoned that the sweetest bread is made from wheat threshed out before it is stacked, which shows the importance of studying the best modes of preserving it.

SUBSECT. 2.—*Barley.*

4077. This grain is next in importance to wheat, and has one advantage over it, that it can be propagated through a greater range of climate, bearing heat, cold, and drought better, growing upon lighter soil, and coming so quickly to maturity that the short summers of northern countries, which are not sufficient to ripen wheat, are yet long enough to bring barley to maturity. In Lapland it is sown and reaped within six weeks. In Spain they have two crops in one year. Its native country is not known; but it has been cultivated from the earliest antiquity by the Egyptians. It was much in use among the Romans, and formerly, also, as a bread corn in England, as it still is in Westmoreland, Cumberland, Wales, and Scotland; but in the south of Britain it is now chiefly raised for malt.

4078. *Botanists and agriculturists enumerate many species and varieties of barley;* but those chiefly cultivated in this country are,

1. *Spring or summer barley, a, fig.* 610 (*Hordeum vulgare*), in which the grains are disposed in two rows on the ear, one on each side, and its beard, or awns, standing erect. This is the species usually cultivated in the southern and eastern districts of England and Scotland: its husk is thin, and the grains large, which renders it favourable for malting.

2. *Winter barley, b, fig.* 610 (*Hordeum hexasticon*, Linn.). In this the grains are disposed apparently in six rows, but in fact the rows are only double, three of them springing

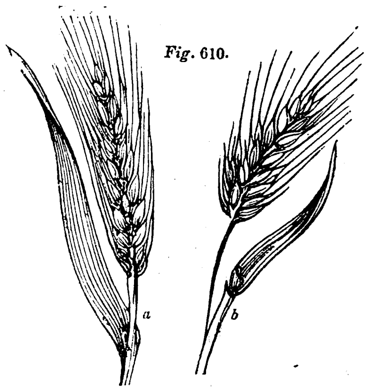


Fig. 610.

from the same point. It is cultivated chiefly in the north of England and in Scotland, being much more hardy than spring barley, and ripening earlier: hence it is better adapted for cold and high situations, such as the Highlands and north of Scotland, where a variety of it is called *bere*, and in Aberdeenshire *bigg*. Its grain is smaller and rind thicker than the spring barley, and it has less of the saccharine principle than those kinds of barley that grow under the influences of a more genial sun; it is, therefore, less proper for malt, and is going out of use for that purpose; but it makes good barley bread, and is also fit for the distiller. It appears that the thickness of the skin of barley increases according to the coldness of the climate in which it is cultivated; the cuticle of Norfolk barley being thinner than that of the species in Berwickshire or East Lothian: yet if Norfolk barley is sown in Scotland for several successive years, its cuticle is found to become thicker; but the difference between the cuticle in spring and winter barley depends upon their being different species.

3. *Common, or long-eared barley* (*Hordeum distichon*, Linn.), has the grains arranged in two rows, and is known by its very long spike or ear, and the awn being also very long. This is cultivated in many parts of England and Scotland, and is best adapted for malt of any of the varieties.

Besides these there are many other varieties, little cultivated here, as *sprat*, or *battledore* barley, *naked* barley, the awns of which fall off when ripe, *Siberian* barley, *chevalier* barley, &c.

4079. *Barley contains*, according to Einhoff, in 100 parts, volatile matter, 9·37; vegetable albumen, 1·15; saccharine matter, 5·21; mucilage, 4·62; phosphate of lime with mucilage, 0·24; gluten, 3·52; husk, with some gluten and starch, 7·29; starch, not quite free from gluten, 67·18; loss, 1·42. Sir H. Davy found Norfolk barley to contain in 100 parts, starch, 79; gluten, 6; saccharine matter, 7; husk, 8.

4080. *Dr. Thomson states* that the gluten of barley is partially soluble in cold water, as is shown in the steeping of barley for malting; but it coagulates in 120° or 130°, and falls down in gray-coloured flocks. He also extracted from the husks of barley a small quantity of an oily matter, of an asparagus green colour, and taste resembling that of the spirits from raw grain, to which, no doubt, the flavour of whiskey is owing. He likewise found in barley some nitrate of soda capable of crystallizing.

Barley has less nutritious matter than wheat, and this is differently composed. It has more mucilage, only about a third of the quantity of gluten, and as much sugar, with nearly the same proportion of starch.

It is owing to the larger proportion of mucilage contained in barley, and the smaller quantity of gluten, that this grain, though less nutritive, is a lighter and less stimulating food than wheat; and hence a decoction of barley is peculiarly adapted to invalids whose digestive powers are weak. The meal of the bigg, which grows on the mountain, is more palatable than that of the long-eared barley from a rich soil; and the barley cakes made from it in the Highlands are particularly sweet and delicate. The superior flavour of Highland whiskey is probably owing, in a great measure, to the quality of the grain.

4081. *The rapidity with which barley germinates favours its conversion into malt;* but from this circumstance, it is very liable to commence sprouting, even while yet in the ear, and quite ripe, if the season should prove very wet, yet warm and genial; and it is scarcely necessary to state that this injures its quality for bread.

4082. *Pot barley* is barley of which the husk or outer skin only has been removed by mill-stones; it is used for making broth.

4083. *Pearl barley* is the small round kernel which remains after the skin and a considerable portion of the barley have been ground off. For this purpose, the spring barley is chosen; it is steamed to soften the skin, dried, and passed between mill-stones of a peculiar kind, to take off the husk, all except what lies in the deep furrow of the seed, and which is the cause of the short dark line to be seen on pearl barley. The Scotch pearl barley is quite round, and is made from the sort called bere, or bigg. A decoction of pearl barley was the " ptisan" of ancient medicine, now better known by the name of *barley water*. Besides its use in broth, it is sometimes boiled in water, and eaten as rice with milk.

In Holland, pot barley, boiled in butter-milk and sweetened with treacle, is a common mess for children and servants.

4084. *Patent barley*, now much used for making barley water expeditiously, is the pearl barley ground to flour.

As pot and pearl barley are extremely wholesome and nutritious, it is to be regretted that they are not more used as food by the labouring classes in England, as they are in Scotland, Germany, and Holland.

SUBSECT. 3.—*Oats* (*Avena sativa*, Linn.).

4085. *This grain prefers a cold climate*, and is one of the hardiest of all the cereal plants. It cannot be cultivated in the southern parts of Europe, and is scarcely seen south of Paris. Even in England, its produce in the southern districts is inferior to that of the northern, and still more to that of Scotland. It has this advantage, that it will grow where neither wheat nor barley will flourish, and, indeed, on any land, from the stiffest clays to crude mossy soils, if sufficiently dry: it is also the most easily cultivated. Indeed, if it can be ripened before the frost sets in, the flavour of the meal is superior when the climate is rather bleak and soil not very rich.

It differs from wheat and barley in the form of the ear. It is not a spike with a single rachis, but a panicle, resembling, in some degree, the branches of a pine, from the grains hanging with their open extremities downward; these being covered by the chaff, are defended from rain, and are not liable to some diseases incident to barley and wheat.

4086. The native country of the oat is unknown. It was found by Lord Anson growing wild in the island of Juan Fernandez: a kind of wild oat is indigenous to this country, and is a very troublesome weed, from which it may originally have been produced by cultivation; but the best varieties now in use have been introduced from abroad.

4087. *The most common sort which has been long cultivated here is the white oat* (*fig.* 611); but the best variety now raised in Scotland and the north of England is the *potato oat*, which was accidentally discovered some years ago, in Cumberland, growing upon a heap of manure, in company with some potatoes: other varieties are the common *feed oat*, the *Poland*, the *Dutch*, and the *Tartarian*, &c.; all probably derived from one parent stock.

Fig. 611.

4088. *An analysis of oats* by Sir H. Davy gave, in 1000 parts, starch, 641; gluten, 87; saccharine matter, 15. From this it appears that there is less nutritive matter in oats than any other cereal grain; and the very small portion of saccharine matter which it contains renders it unprofitable for malt: it may, notwithstanding, be fermented, but with some difficulty. It contains, however, more gluten than barley, though less than wheat; and experience shows that it is very nutritive, since the labouring classes in Scotland, Lancashire, Derbyshire, and in some other parts of England and Wales, subsist and keep up their strength perfectly upon bread and other preparations made from it. Many, indeed, who are used to oaten bread, prefer it to every other kind. In the south of England oats are not employed for bread, but only in feeding horses, with whom it is supposed to agree better than any other species of grain.

4089. *Oatmeal is cooked for human food in several ways.* In Scotland it forms the dish called *pottage* or *porridge*, the universal breakfast, in many parts, of labouring people and children: deprived of the husks, it constitutes *grits*, or *groats*, much used for making oatmeal gruel, which is taken both as food and medicinally. The advantage of grits over oatmeal is, that the *fecula*, or starch, of which the meal, or farina, of the oats chiefly consists, is alone extracted by the boiling water, and that thus none of the cuticle which covers it is mixed with the gruel; but in the oatmeal, this thin cuticle, which encloses it (not the husk of the oat), is ground up with the meal, and gives to it a harsh and rough taste: for, although the gruel made of oatmeal may be strained, still a quantity of the minute fragments of the cuticle escape through the strainer; whereas, in the case of grits, this cuticle is entirely kept back, which accounts for the smoothness, as it is termed, of grit gruel. Scotch oatmeal is superior to English, which is partly owing to the superiority of the grain and the climate, but in part to the greater care employed in its cultivation. In Scotland, also, the oats are dried in a kiln previous to grinding, which gives it an agreeable flavour.

SUBSECT. 4.—*Rye.*

4090. At present rye (*Secale cereale*, Linn.) is very little employed among us for bread, and is cultivated chiefly to be eaten by the cattle as green fodder; nevertheless, rye bread was very general in England about two centuries ago, and is still used as the food of the peasantry in Russia, northern Germany, some parts of France, and great part of the north of Europe.

4091. *Rye*, according to Einhoff, *is composed of* albumen, 3·27; moist gluten, 9·48; mucilage, 11·09; starch, 61·09; saccharine matter, 3·27; husk, 6·38; moisture, 5·42. From this analysis, it appears that rye contains more gluten than any other grain except wheat, and therefore should be next to it as a bread corn.

The husk possesses an aromatic and slightly acidulous flavour, which renders it agreeable to the palate. The bran should not, therefore, be entirely separated from the flour; for if the grain be ground fine and divested entirely of the husk, the bread will be deprived of much of its pleasant taste. Rye bread is, consequently, made of coarse flour, which, together with its dark colour, has probably given rise to much of the dislike to it in this country. The quantity of gluten which it contains accounts for the facility with which it may be fermented into spongy bread, which is not the case with oats and some other grains. But bread made of it very soon becomes sour; indeed, it undergoes an acetous fermentation in the process of baking, and is thought, in consequence, to have a gentle action on the bowels.

Some persons express regret that there is here a prejudice against rye bread, since the grain thrives upon poor sandy soils on which wheat would scarcely return the seed: this is the case where rye is extensively cultivated, in the poor sandy land on the south coast of the Baltic, where its weight of corn is nearly as great as that grown upon good land, and it is produced at little expense. It also yields a large quantity of straw, good for thatching.

In some farmers' families, household bread is made of a mixture of one third rye and two thirds wheaten flour, which makes a sweeter bread than that made solely of wheat, and is preferred to any other by those who are in the habit of using it. The bread is very firm and solid, and retains its juiciness and moisture long, being also very nutritious. For this purpose, rye is sown along with wheat, under the appellation of "meslin."

4092. *From the quantity of saccharine matter which rye contains*, though less than barley, it is convertible into malt, and, of course, into beer and spirits; but it is much inferior to barley, in some respects, for these purposes, though it is said to give a great quantity of spirit. Unmalted rye meal mixed with barley, in the proportion of two parts of the former to one of the latter, is employed in Holland for the distillation of Geneva. It is said that the essential oil which rises with the spirit has a peculiar flavour, and it is thought that this resides in the husk; for the black bread of the Russians, which contains the husk ground up with the meal, has a different flavour from the fine rye bread made of rye flour only.

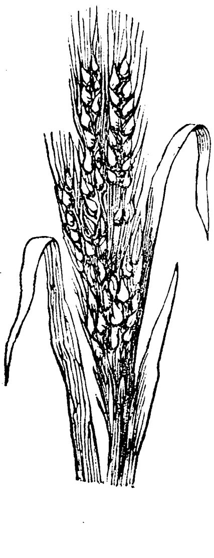
4093. *But this grain, which has been, and still is, so much cultivated as a bread corn, is subject to a disease called ergot*, or horned rye, which consists of a fungous substance that grows in it occasionally, enlarging and deforming the grain; and the effects produced upon the human constitution by this poison are so very dreadful, if what is recorded can be depended upon (and there is no reason to doubt the authenticity of the accounts which have been published), that we can scarcely regret its almost entire banishment from this country as a material for food. It is stated that those who have eaten bread made from rye infected with ergot have been attacked by disorders of the most appalling kind, such as epilepsy, which ended fatally; others have been rendered irrecoverably insane; while in others, again, the disease has been so virulent as to terminate in mortification of the limbs. It appears that these misfortunes have occurred frequently in some parts of Germany and France, particularly in Sologne, a district between the Loire and Cher. The ergot is seldom found in England, although it does occasionally appear, and not only in rye, but sometimes in wheat and other grain.

Even damaged corn is known to have acted as a fatal poison. (See this subject treated of at length in Prof. Burnett's "Outlines of Botany," p. 211, 212.) The mouldiness on stale bread is a minute plant, and always connected with a state of decomposition of the bread, which renders it very unwholesome, and even dangerous, if eaten.

Subsect. 5.—*Rice.*

4094. *Rice* (*Oriza sativa*, Linn.) *is a plant of Asiatic origin*, and has formed the chief food, from time immemorial, of the population of India and the Chinese empire. It is cultivated in Europe, but chiefly in the southern part, requiring a warm climate. It grows extensively in the rich meadows of Lombardy, and also in the province of Valencia in Spain; but the chief countries from which we obtain this grain are Carolina, into which it was introduced in the last century, and the East Indies. It probably nourishes more human beings than all the other seeds together.

Fig. 612.



4095. *Common rice is a marsh plant*, and the land where it grows requires to be flooded by irrigation, which renders the vicinity of rice grounds unhealthy, giving rise to marsh fevers. It grows very rapidly, and its cultivation is easy. There is, however, a variety of rice in Nepaul, in India, called *Hill rice*, cultivated upon the slopes of hills, where it can receive moisture only occasionally; and it has been supposed that this might in time be acclimated in England; but we should not thus obtain it at a cheaper rate than that at which it is now imported. Rice, in its growth, resembles barley more than any other corn plant, rising to the height of a foot and a half, with a stalk not unlike that of barley, but fuller of joints, and with leaves resembling those of the leek. It branches out into several stems, at the top of which the grains form in clusters. The grains or seeds grow on separate pedicles, which spring from the main stalk (*fig.* 612); each grain is terminated by an awn or beard, and is enclosed in a yellow husk. The whole head forms what is termed by botanists a spiked panicle, that is, something between a spike like wheat, and a panicle like oats. There are various methods of cultivating and dressing rice practiced in different countries: the following is the mode which Captain Basil Hall observed in Carolina:

The grain is sown in rows in the bottom of trenches made by slow labour. These ridges lie about seventeen inches apart, from centre to centre. The rice is put in by hand about the 17th of March, generally by women, and is never scattered, but cast so as to fall in a line. By means of flood-gates, the water is then permitted to flow over the fields, and to remain on the ground fifteen days, at the depth of several inches. The object of this drenching is to *sprout* the seeds, as it is technically called. The water is next drawn off, and the ground allowed to dry, until the rice has risen three or four inches. This requires about a month. The fields are then again overflowed, and they remain submerged for upward of a fortnight, to destroy the grass and weeds. These processes finish about the 17th of May, after which the ground is allowed to remain dry till the 15th of July, during which interval it is repeatedly hoed to remove such seeds as have not been effectually drowned, and also to loosen the soil. The water is then for the last time introduced, in order that the rice may be brought to maturity; and it actually ripens while standing in the water. The harvest commences about the end of August, and extends into October. It is all cut by the male slaves, who use a sickle, while the women make it up in bundles.

4096. From the pedicles the rice must be separated by a hand-flail, as no machinery has yet been devised for effecting this purpose. The next process is to detach the outer husk, which clings to the grain with great pertinacity. This is done by passing the rice between a pair of millstones removed to a considerable distance from each other. The inner coat or film, which envelopes the grain, is removed by trituration in mortars under pestles weighing from 250 to 300 lbs. These pestles consist of upright bars shod with irons, which, being raised up by the machinery to the height of several feet, are allowed to fall down upon the rice, the particles of which are thus rubbed against one another till the film is removed. It is now thoroughly winnowed, and being packed in casks holding about 600 lbs. each, is ready for distribution over all parts of the world. Each plantation has a mill. Though rice is now so largely cultivated in Carolina that it constitutes the chief produce, the swampy land being well suited to it, it is not used so much for food in America as maize and wheat, and it is mostly raised for exportation, the Carolina rice being found superior to every other. The cultivation of it is the most unhealthy work in which the slaves of Carolina are employed. They are obliged frequently to stand ankle-deep in the mud, with their bare heads exposed to the fierce rays of the sun. The consequence is, that numbers sink under it and die. This causes a constant diminution of the slaves, which the proprietors are obliged to supply by importations from the other states of North America. At the unhealthy season, when the harvest commences, all the white proprietors leave the spot, and go to higher ground, or to the north.

4097. *Rice in the native rough state*, with the husk on, is called *paddy*, both in India and America; and it will keep better, and for a much longer time, in this state than after the husk has been removed; besides which, prepared rice is apt to become dirty from rubbing about in the carriage on board ship, and in the warehouses. These facts recently suggested to some enterprising capitalists to bring it to England in the shape of paddy, and then to detach the husk. The experiment has been completely successful, and such rice may now be had in London, of Messrs. Lucas and Ewbank, as fresh in taste and appearance as any in Carolina. Paddy pays less duty than shelled rice.

4098. *Rice consists* almost entirely of starch or farina, with little or no gluten, and no ready-formed sugar; hence its nutritive qualities are very much inferior to wheat, though it is light and wholesome. Dr. Paris observes that rice is not much disposed to acescency or fermentation, and furnishes a wholesome aliment when mixed with other food; but if taken in large quantities by itself, from its low degree of stimulant properties it is apt to remain for a length of time in the stomach; and this effect is greatly increased by protracted boiling. When the stomach is in a state of relaxation or debility, it ought not to be taken without condiment; it is for this reason found necessary, in the warmer climates, to conjoin with it a considerable quantity of warm spices.

Rice, however, with proper management in cooking it, forms a very valuable and cheap addition to our farinaceous food; and in years of scarcity has been found eminently useful in lessening the consumption of flour. When boiled, it should be so managed that the grains, though soft, should be as little broken and as dry as possible; the water in which it is dressed should only simmer, and not boil hard. Very little water should be used, as the grains absorb a great deal, and consequently swell much; and if they take up too much at first, it is difficult to get rid of it. Baking it in puddings is the best mode of preparing it.

4099. *There are many varieties of rice* produced, probably, by the difference of climate and culture. The rice exported from Bengal is chiefly of the species denominated *cargo rice*; it is of a coarse reddish-brown cast, but peculiarly sweet and large grained; it does not readily separate from the husk, but it is preferred by the natives to all the others. *Patna rice* is more esteemed in Europe, and is of very superior quality; it is small grained, rather long and wiry, and is remarkably white. *Hill rice* is not imported. *The Carolina rice* is considered as the best, and is likewise the dearest in London, as it pays a much higher duty than the East Indian Rice.

Subsect. 6.—*Maize, or Indian Corn* (*Zea Mays*, Linn.).

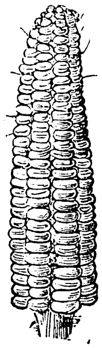
4100. *This, the noblest of the cereal grasses*, was found native in America when that country was discovered; and it now constitutes the bread corn of North America, Mexico, and a great part of Africa. It is not indigenous in any part of Europe, but is generally cultivated in the southern and eastern part of the Continent as bread corn, having acquired the name of *Blé de Turquie*, or *Turkey corn*, from its being presumed to have been introduced from the Levant by the Mohammedans after their conquest of

Constantinople. It is nearly as extensively used for the support of man as rice, but there are great differences of opinion as to its merits.

4101. *It is said to contain* very little gluten and sugar ready formed, and hence it is asserted that its nutritive power must be small; and it certainly cannot be fermented into good bread without an addition of wheat flour: and yet the people who live upon it are as strong and healthy as any, and horses and other domestic animals feed well upon it. The American and West Indian labourers think no bread so strengthening as that which is made of Indian corn; and the athletic peasantry of the Tyrol sufficiently demonstrate its wholesomeness.

4102. The American are the largest varieties; one is generally four or five feet high, but sometimes acquires the height of seven or ten feet in favourable situations, and has been seen even fourteen feet high. Its spike or ear, called the *cob* (*fig.* 613), containing the seeds, is eight or ten inches in length, and five or six in circumference. A second smaller variety is cultivated in Spain, Portugal, and Lombardy, and partially in France, forming a principal food on all the shores of the Mediterranean. These two varieties will not come to maturity in England; but a third sort, still smaller, will ripen here in ordinary seasons, and, it is supposed, might be cultivated, its growth being so rapid that it escapes the frost of spring and autumn. This last is partially used in America and Germany for making malt and feeding animals.

Fig. 613.



4103. Cobbett spoke highly in its praise, but he was probably too enthusiastic; and, upon the whole, our summers are scarcely warm enough for its successful cultivation. In America, the tender young ears, in their milky state, are roasted, and eaten with butter and salt as a delicacy, or boiled with meat. When green, they are pickled as cucumbers; dried, they keep all the year. When the grains are ripe, the skin is taken off, and the farinaceous part is boiled whole, or ground into meal, and made into puddings or cakes.

4104. *The meal*, or *flour*, is inferior to that of wheat, but mixed with it makes good bread; it is seldom used alone. In Brabant it forms the ordinary food of the peasants, fried with fat bacon. The tops, when dried, serve as fodder for horses, cattle, and sheep; and the stalks afford a sweet juice, from which the Indians of America make a variety of fermented liquors. The cob, after the seeds are taken off, is used as fuel, makes excellent corks, and forms, when bruised, a useful kind of chaff for stuffing mattresses or other purposes. Maize is far more productive than any other grain.

SUBSECT. 7.—*Millet.*

4105. *Millet* (*Panicum Sorghum*, Linn.) *is the smallest seeded of the corn plants*, being a true grass, but the number of the seeds in each ear makes up for their size. It grows in sandy soils that will not do for the cultivation of many other kinds of grain, and forms the chief sustenance in the arid districts of Arabia, Syria, Nubia, and parts of India. There are several kinds of millet.

1. *Great Indian millet*, or *Italian millet* (*Sitaria Italica*). This is cultivated in Egypt and Nubia, where it is called *dhourra*, and is used as human food, as well as for the fermentation of beer. It will grow on poor soils, and is extremely productive. It has been introduced into Italy, where they make a coarse bread from it, and it is also employed in pastry and puddings; they also use it for feeding horses and domestic fowls. It is the largest variety, growing to the height of six feet; but it requires a warm climate, and will not ripen in this country. A yellow variety, called golden-coloured millet (*Sorghum saccharatum*), is sold in the grocers' shops for making puddings, and is very delicate and wholesome.

2. *German millet* (*Sitaria Germanica*, Linn.) is cultivated for bread in some of the northern countries of Europe.

3. *Common millet* (*Panicum miliaceum*, Linn.) is the variety usually cultivated in England. There are two kinds, the brown and the yellow. The first is sometimes used as a substitute for sago.

4. *Polish millet* (*Panicum sanguinalis*, Linn.) grows abundantly in Poland, and is a native of England, but is not common. When it is cultivated, it is employed as a substitute for rice and sago, or for puddings.

SUBSECT. 8.—*Buckwheat* (*Polygonum Fagopyrum*, Linn.).

4106. This plant does not properly belong to the class of the cerealia, notwithstanding its name, which, though English, is taken from the German *beechwaizen*, beech-wheat, from the resemblance which the seeds bear to beech-mast. Its leaves nearly resemble those of the ivy; its flowers are purplish, and the seeds are triangular and of a brownish-black colour. It is not cultivated in England as human food, but it is raised partially in Norfolk, and cut, when green, as fodder for cattle. Nevertheless, it is employed as a valuable bread corn on the Continent, and in some other parts of the world. It contains some gluten and starch, though much less than wheat, and, consequently, it is not so nutritive; but it has more sugar than even barley, and the cakes made from it are sweet and agreeable.

4107. *It is much used as food in Saxony, Ukraine, Silesia,* and some parts of France, not only by the peasantry, but by the wealthier classes. The mode of dressing it is generally by boiling as pottage or puddings, or in tarts. In Tuscany it is mixed with barley, and made into bread, which is very nutritive. It is also used in North America. From the large quantity of sugar which it contains, it is employed in brewing; and a spirit is distilled from it a good deal resembling French brandy in flavour; it is said to be employed in the goldenwasser of Dantzic, and even by the gin distillers in England, who import it from Holland. Some are of opinion that its cultivation is too much neglected in England, as it grows upon very poor sandy soils, even enriching them, and preparing them to receive other grains. Its growth is rapid, though it is a tender plant, and is easily destroyed by cold, being originally a native of the south of Europe. It is excellent for fattening pigs and poultry, and pheasants are particularly fond of it. Cows feed greedily upon it, and it communicates to their milk a great richness and an excellent flavour.

Subsect. 9.—*Pease and Beans.*

4108. Formerly these varieties of pulse were much used by the peasantry of England for bread; but since the almost universal adoption of wheaten bread, they are very little employed for this purpose. Independently of their use as garden vegetables (for which see Book VII., Chap. VIII.), beans are only given to cattle as a strengthening food Pease are sometimes ground with meal, which is never made into bread alone, but mixed with the flour of wheat; and if millers be not much belied, it is said that, when pea-meal is ground fine and properly bolted, it is sometimes used for adulterating wheat flour.

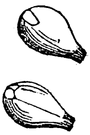
Sect. II.—PREPARATION OF FLOUR FROM GRAIN.

Subsect. 1.—*Description of Grain.*

4109. Having described the various cereal plants which are cultivated as food, we shall now call the reader's attention more particularly to those seeds from which the material of bread is usually obtained.

4110. *The seeds of the corn plants,* commonly termed *grain,* are covered by a skin, or husk, called by botanists the *testa.* The whole of what is enclosed is the *farina,* or meal, from which we derive the adjective *farinaceous,* applied to all vegetables that possess a similar substance. The farina of the grain is that part alone of which bread is generally made; the husks or bran being seldom employed except for feeding cattle, poultry, &c.; sometimes, indeed, a portion of it is ground up with the meal, but we shall now consider the meal and the husks separately.

Fig. 614.



4111. *When we examine a grain of wheat,* we find that it is enclosed in a husk which is covered by minute chaffy scales; and on one side of the grain may be observed a groove, which, when the plant is growing, is turned towards the central axis of the ear, called by botanists the rachis. The husk itself is a membranous substance investing the seed closely, but which may be readily pulled off after the grain has been soaked in warm water; and this, when ground off by the mill, constitutes the bran. Immediately beneath this exterior covering is the part of the farinaceous matter which affords the coarsest flour, called *pollard;* it is soft to the touch, of rather a darkish colour, not very easily reduced to an impalpable powder, and of a sweetish taste. It constitutes about one half of the farina, and enters into the composition of brown bread. Underneath this lies what is termed by the millers the *kernel,* or heart of the wheat, which is a hard, whitish, and almost pellucid substance. This part is readily reduced to an impalpable powder, and it alone constitutes the *fine white flour.* The internal part of wheat varies in its hardness in different countries; when the Spanish wheat was introduced into the English market, a difficulty was experienced in grinding it, from the extreme hardness of the grains. This distinction of qualities is not observed in the other grains, as in them the whole of the farinaceous matter is of a uniform quality. The flour or ground farina of wheat is therefore subjected to processes not necessary for the rest, in which it is sufficient to separate the husk bruised by grinding from the meal. The husk of barley, when dry, is very firmly attached to the kernel, and does not separate easily in grinding, and a good deal of it generally remains in the meal, which is one of the causes of the huskiness of barley bread; when the meal is ground very fine, this is less apparent. The husk of oats and of rice separate easily and entirely; oatmeal and rice are therefore quite free from the husk.

Subsect. 2.—*Cleaning Corn previous to grinding.*

4112. *Corn frequently contains impurities* which, if ground up with the flour, injure its qualities. These consist of more or less, in some cases, of the smut-ball, mildew, and substances produced by other diseases to which corn is liable; or it may be composed of sand, earth, grains partially destroyed by insects, &c.

It is cleaned from sand or any other foreign matter by putting it into a revolving hollow cylinder made of wire cloth. From that it passes into the screen for the purpose of cutting off the fine fleecy down which is found at the *rough* end of the grain, as it is named by the millers. The screen is a cylinder of sheet iron punched full of holes from the outside, the burr pointing inward like a grater. Within this is another cylinder having the holes punched outward from the inside; consequently, the two burrs point towards each other. The space between the two is about five eighths of an inch wide, and in this space is the corn. By the action of the burrs during the rotation of the cylinder, the round end of the grain is rasped off, and it falls out through the holes. The next cleansing process is by the *joggling screen and fans;* this screen has a wire bottom, and is put into a joggling motion by the mill; the corn is completely sifted by this, and the fans blow off any dirt that may adhere.

Various machines have been contrived for cleaning corn completely, but the most effectual seems to be one for which a patent has been lately obtained by Mr. Herbert, who calls it a "scouring, washing, and separating machine." The grain to be cleaned is mixed with some sharp sand, very well washed and sifted, so as to consist only of particles from a sixteenth to a thirtieth of an inch in diameter, in the proportion of five shovels full of grain to one of sand, the latter in a wet state. The whole is then put into the scouring cylinder, which is turned round for a few minutes, that the angles of the sand may rub off the impurities from the grain; after this the grain is transferred to a large sieve working under water, by which the sand is completely separated again from the grain that has been cleared. The sand falls through the sieve, and the bad grain floats to the top.

SUBSECT. 3.—*Grinding and dressing the Flour.*

4113. *Mills for grinding corn into meal or flour* are of a variety of constructions. We have, in our "history of bread," described the ancient Roman hand-mill, still used in many parts of the world.

4114. *The ordinary corn mills* in the present day are driven either by water, wind, or steam. The first two powers appear to have been known to the ancients; the latter is a modern invention. Whatever be the nature of the moving power, the grinding apparatus is the same. It consists of two circular stones, placed very near each other (*fig.* 615), the lower one, *a*, fixed, and the upper one, *b*, revolving; the grain being crushed and ground between them. The upper or grinding surface of the nether millstone is a little convex, as is shown in the annexed woodcut; and the lower or grinding surface of the upper stone is a little more concave, so that the two stones are a little farther from each other in the middle than at the edges. The corn to be ground is put into a hopper, *c*, above the millstones, and it falls down through a hole in the upper one into the space between the two. By this means the corn is, at its first entrance between the millstones, only bruised; but, as it goes farther towards the circumference or edge, it is cut smaller and smaller, and at last finally ground; when it flies out from the stones, by virtue of what is termed the *centrifugal force*, and is received into a circular tray or other vessel. In order to grind the corn both millstones have their grinding surfaces cut into grooves or channels. When these furrows become blunt by wearing, the stones are new dressed with a chisel. The millstones require to be of very hard stone, not to wear away soon: when they are of too soft a material, there is not only the inconvenience attending wearing, but the sand formed from the stone mixes with the flour.

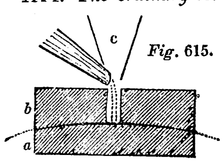


Fig. 615.

Previously to the wheat being ground in the mill, it is dried to a certain degree in a kiln by spreading it on a perforated tile floor.

4115. *Before we treat of domestic grinding*, it is proper that we should describe the various sorts of flour as they are usually prepared, as well as the principle upon which the distinction of the various qualities of coarseness and fineness of bread in common use is founded.

4116. *It was formerly the custom for the baker* to purchase the wheat and give it to the miller to grind. The miller separated it into three parts; flour, pollard, and bran. The *bran* was the outside of the grain; it was not used for human food, but only given to horses. The *pollard* was the portion of the grain next the husk, as described above; and the flour, at an average, amounted to three fourths of the grain. But by insensible degrees the manufacture of bread became separated into two distinct employments; that of the mealman, who bought the wheat and ground the flour, and that of the baker, who converted it into bread. This led to greater variety of sorts in the manufacture of flour, in order to suit the tastes of different customers; at present the following is the practice of the miller:

4117. *After the corn is ground, the separation usually made for the bakers* is as follows: When, as formerly, it was intended merely to separate the husk from the meal of wheat, as is the case in barley and oats, a sieve only was used, and only one quality of meal wa.

prepared. But as we have stated that in wheat there are two kinds of farina, the coarse immediately under the skin of the grain, and the interior white part in the centre, means have been devised for separating these also from each other. Instead of a common sieve, a cylinder of wire-work is employed for sifting or dressing, as it is called, and this is placed sloping so as to incline about 40° to the horizon. This cylinder has likewise the wires in the upper half closer together than in the lower half, so that only the finer parts of the flour can go through the first, and not through the second. The cylinder does not turn round, but, instead of that, hair brushes are made to revolve inside, and, by rubbing against the wires, force the flour through. When the whole meal or produce of the grinding is put into this wire cylinder or dressing machine, the very finest part of the flour goes through the closest wire-work, which has sixty-four wires to an inch, into a binn below, and constitutes the finest or *best flour* used for pastry, and is known by the name of *Hertfordshire whites.* What is too coarse for that is called *middlings,* and falls through the next or more open wire-work into another binn, leaving the bran and pollard to fall out at the bottom. The middlings are sometimes used for household bread, but it is occasionally reground in the mill, the stones being set closer than at first; this, in like manner, is then passed through another dressing machine, called the bolting cloth, which separates a portion of flour called *seconds.* What remains, consisting of bran and pollard, is put into the clearing off machine, which is a coarse wire cylinder, and by it the brand is separated from the pollard, the latter being used for sea biscuits and gingerbread, and for fattening hogs and poultry. A quarter of wheat, or thirty-two pecks, yields, in the London mills, 38½ flour, 8 pollard, and 12 of bran; the bulk being doubled by the grinding into flour. It is obvious from this enumeration, that so many varieties of flour, formed by the dressing, afford the miller and the baker more opportunities of dealing unfairly than if there were fewer kinds.

4118. *These various qualities are employed for different purposes. The best and whitest wheaten bread* ought to be made from the finest and whitest flour, called *firsts,* obtained from the first grinding.

4119. *Ordinary bread* is usually made from a mixture of firsts and seconds; but probably too often from a large proportion of the latter.

4120. *The best brown bread* is made of what is called *whole* meal, or *grist flour,* that is, meal or flour which has had only the bran taken from it, the pollard and the fine flour being ground up together. This flour can only be had by those who purchase their own wheat, and either grind it at home or send it to the mill. The expense of the latter is 1*s.* 6*d.* or 2*s.* per sack, and the bran is sent home as well as the flour; and one of the advantages of private or domestic grinding is, that the flour may be dressed in any manner that may be wished, without trusting to the miller. A bushel of wheat produces 60¾ lbs. of meal and bran, 1¾ lb. being lost in dust. A sack of wheat weighs 240 lbs.; and this produces from 178 to 190 lbs. of flour, together with from 40 to 45 lbs. of bran; some mix with the grist flour a little firsts or seconds. *For an inferior brown bread,* some mix one fifth of pollard with the grist flour; and the common brown bread of the farmhouses is made from country household flour, or wheat, of which the bran is retained in the meal, being ground down extremely fine. This bread is considered as possessing, for some constitutions, a laxative quality.

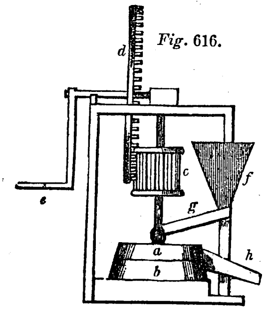
4121. *Domestic mills* are sometimes employed to grind corn, either in cases where a public mill is not accessible, or where it is wished to take certain means of preventing the possibility of any adulteration of the flour. Various contrivances have been made for this purpose; and it may be proper to state what they are capable of effecting in general.

The grinding of oats and barley is easy; and there is no difficulty in separating the husks from the meal by the sieve; but the grinding of wheat, and the separation of the flour into the different sorts, is much more difficult; and it is scarcely possible to effect this in a private family so perfectly as it is performed by the skilful miller.

Whether all the popular charges against the millers and bakers, of adulterating flour, are true or false, we do not take upon ourselves to determine; but the main object proposed by the use of domestic mills, namely, to secure an unadulterated material for bread, may unquestionably be obtained, although it will seldom be practicable to do much more than to separate the greatest part of the bran by the sieve, leaving a flour perfectly wholesome, but from which the best sort of brown bread only can be made. The proper grinding and dressing of wheat flour, with the view to obtain that of the whitest kind, will in general be found to fail for want of the necessary experience, which can only be expected from those who are millers by trade. Those domestic mills which act by means of stones are the best; but with the imperfect skill of those who will generally have to perform the operation of grinding, a considerable quantity of flour will always adhere to the bran, which will be lost; and with steel mills, which rather cut than rub down or grind the grain, the loss will be still greater. Upon the whole, therefore, little or nothing is to be expected on the score of economy by grinding at home; more particularly if, as probably will be found necessary, the labour is to be paid for, this not coming within the ordinary duties of domestic servants · nor should the inconvenience of the mill, and the noise it occasions, be left out of the account. Nevertheless, as we have stated, there are certain situations in which a portable mill is extremely valuable.

4122. *Domestic mills have been made nearly upon the same construction as the common corn-mill, fig.* 616, with this difference, that they are worked by the labour of two men, or a horse. We refer the reader to what has been already said on the action of the millstones in grinding. The two stones are seen at *a* and *b*. The upper stone is fixed upon a perpendicular axis called the spindle, and this has on it a trundle, *c*, the upper end of the axis, or spindle, moving in a cross piece. The trundle, and with it the stone, is driven by the cog-wheel *d*, which is worked by a winch, *e*, if the hand be employed. The corn to be ground is put into the funnel *f*, called the hopper, from which it falls into the shoe *g*, and thence into a hole in the top of the millstone, whence it gets between them and is crushed or ground; the meal flies out in all directions from between the two stones, but is stopped by the casing round the stones, and there it accumulates, falls out, and is conveyed away by the spout *h*. As the corn does not come out very readily from the hopper, the spindle is formed in such a manner as to give a slight knock or jerk to the shoe *g*, as it turns round, and this is communicated to the hopper. By a particular contrivance, the two stones can be placed closer or farther apart, for the purpose of grinding finer or coarser. Mills of this kind, where the power is sufficient, grind well; but the wearing away of the stones, and getting them new dressed, is a great inconvenience.

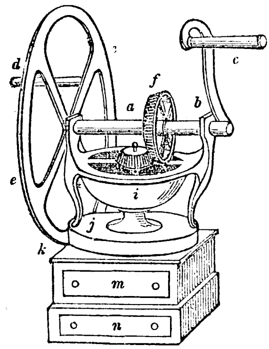
Fig. 616.



4123. *Some small hand-mills* resemble in construction those metallic coffee-grinders which are commonly sold in the shops. These consist interiorly of a solid frustum of a cone, the surface of which is cut spirally into furrows; this revolves within a hollow frustum of a cone a little larger, also furrowed; and the substance to be ground passes between these two. In the little box coffee-mills, the axes of the cones are vertical; but in the largest sort, fixed to the wall or a post, the axis and the cones are horizontal. This kind of mill is not well adapted to the grinding of corn, as they soon clog and make bad flour.

4124. *One of the best flour hand-mills of the latter kind* is that invented lately by Mr. Luke Herbert, and described in the "Mechanic's Magazine." It is made of iron, and not only grinds the corn, but, at the same time, dresses or sifts the meal into flour, pollard, bran, &c. *a*, *fig.* 617, is an axis turned by a winch, *c*, assisted, if required to be worked by two persons, by a handle, *d*, fixed to any one of the arms of the fly-wheel *e e*. The axis, *a*, also carries a bevelled wheel, *f*, which drives a pinion fixed upon a vertical spindle that revolves in the centre of a metallic hopper, *i*, and carries at its lower extremity the upper grinder; to the circumference of the latter are attached brushes that revolve together with it inside the circular case *j*, cast in one piece with the hopper *i*. The lower grinder is fixed in the centre of the flat top, *k*, of the pedestal; and around the lower grinder, in the same place as its upper surface, is a ring of fine wire-gauze, over the area of which the brushes sweep in their revolution, continually scattering every particle of the meal, as the same is constantly projected in minute quantities all around the circumference of the grinders on to the wire-work, causing the flour to fall through into the drawer *m*, below; while the bran and pollard, which cannot pass the wire gauze, are continually being freed from their adhering flour by the action of the brushes, until they are driven through an aperture at the outer circumference of the wire-gauze, on to an inclined screen of coarse wire-work, where the offal separates itself, in the mere act of falling, into pollard and bran, both of which deposite themselves into separate compartments made in the drawer *n*. At *b* is a screw for regulating the admission of the corn; and there is also a contrivance by which the mill can be made to grind finer or coarser for various seeds, as maize, pease, beans, rice, &c., or for crushing malt. This machine is portable, perfectly cleanly, and prevents dust and waste. It is made entirely of iron, and if required to be carried to distant parts of the globe, several spare grinding plates are sold with the mill, in case of any wearing out. Printed directions by the proprietor for using it are sent with the machine. If it be required to convert this into a simple mill for grinding substances that do not require sifting, this is easily done by withdrawing the wire-gauze. With domestic mills, a horse will, in general, grind one bushel an hour; and an average day's work for a man will be about two bushels. Considerable attention is necessary to grind well. The friction produced in the process always occasions a sensible degree of warmth in the meal: the cooler the meal comes from the stones, the better is the flour, and the lighter the bread made of such flour. Meal that has been overheated is technically said to be killed; and it will be more apt to become damp and mouldy, and to be attacked by insects; nor can it be so easily bolted.

Fig. 617.



4125. *Good wheat should look plump, feel heavy in the hand*, and be of a clear, transparent, amber colour; and when masticated some time in the mouth, a considerable portion of a thick, glutinous matter, which is the pure gluten, free from meal, should be left behind. Its taste should be sweetish; and the thinnest skinned yields the most and best flour. We have shown that the part of the grain which produces the finest flour is the heart, or centre. This flour ferments rapidly; but the flour, or meal, produced by that part of the grain immediately under the skin, being softer than the heart, is not so easily reduced to powder, is inferior, and ferments with yeast with difficulty.

SUBSECT. 4.—*Constituents of Wheat Flour, and its various Qualities.*

4126. The nature of bread-making, and particularly that of fermented bread, cannot be properly understood until we are acquainted with the chemical constitution of meal and flour. Wheat flour being the most important, we shall describe this first. If a handful of wheat flour be kneaded into a paste under water, the latter will become milky; and if the water be changed several times, and the kneading be continued long enough, the substance remaining in the hand will no longer tinge the water, and will be found to consist of a grayish, tough, elastic mass, very different from what it was at first; it will be very adhesive, and will draw out in some degree like India rubber. This substance is *gluten*, which has been described in Chap. VII., Sec. III.

4127. *The substance separated from the flour in the operation just mentioned*, and which whitens the water, is *starch*, as may be seen if the whole of the water be suffered to remain some time at rest, when the starch will subside to the bottom. *If the* clear water be poured off and evaporated by boiling, a very small quantity of a *gummy sugar* will remain in the bottom of the evaporating vessel. Starch, gluten, and sugar are, therefore, the principal constituents of wheat flour; and they exist on an average in good wheat in the following proportion, per 100 parts: starch, 68; gluten, 24; sugar, 5; vegetable albumen, 2.

4128. *Gluten is one of the most important principles in wheat flour*, and it is this chiefly which gives it so much superiority over every other substance for bread, as it forms an adhesive paste, and is one of the principles of fermentation. It is not found, except in very small quantity, in any other grain but wheat; and none of them, as barley, oats, or rye, can be made into good fermented bread, except some wheat flour be added: yet it is the starch of the flour, being in greatest quantity, that furnishes the largest proportion of nutritious matter. The gluten is comparatively in a very small quantity; but it is still more nutritious, containing nitrogen (as was shown Chap. VII., Sect. III.), an element constant in the animal kingdom, but rare in the vegetable; and hence gluten has been sometimes called the vegeto-animal principle. The greater the proportion of gluten, as Sir H. Davy has shown, the better is the quality, and the more nutritious the flour. Although starch be less nutritive than gluten, we cannot doubt of its great value as food, when we see how well people are supported upon potatoes alone, which contain abundance of starch, but no gluten. The sugar is in the smallest proportion, but it is important; the fermentation of bread is supposed to commence with this principle, since it is found that if the sugar be washed out of flour, it will not ferment.

Mr. Eldin, who wrote on baking some years ago, separated a pound avoirdupois of wheat into, bran, 3 oz.; starch, 10 oz.; gluten, $\frac{1}{2}$ oz.; sugar, $\frac{1}{8}$ oz.; and 2 oz. loss.

4129. *It is said that good bread cannot be made of flour that is quite new*, and that it is better to keep the flour for two or three months, or even a year; but keeping too long deteriorates it, and sometimes it gets together in lumps so hard that they must actually go to the mill to be ground over again. Such agglutinated flour, however, is not always unfit for bread; if mixed with new flour, it will make very good bread. The bakers generally mix new flour with some that is a year old.

4130. *Although good bread forms one of the most nutritious and wholesome kinds of food, yet bread made of bad flour is one of the worst.* There is little doubt but that many complaints, the origin and nature of which are studied in vain by the physician, might be traceable to the unwholesomeness of provisions, and that of bread among others. In this case, prevention is what we are to look to; cure is often beyond the power of medicine.

In describing rye, we mentioned the dreadful disease which *horned* or *spurred* rye is capable of generating, and that all grain was more or less liable to be infected in the same way. The existence of the diseases in corn called *blight*, *smut*, *mildew*, and *canker* has been long known to the farmer. Blights and mildews are owing to many causes, as cold, frosty winds, which nip and destroy the tender shoots of the young plants and impede their growth; but it has been ascertained that they are frequently caused by the growth of an extremely minute parasitic plant of the fungus tribe, the seeds of which are wafted in countless myriads through the atmosphere, and germinate in places favourable to their development. Smut, which infests wheat, barley, and oats, is one variety of these fungous vegetations; it appears in the form of a black, sooty powder, found in the ear, and more or less offensive to the smell; when examined by the magnifier, it appears as minute globules, each of which is a distinct plant. When this occurs, the farina is totally destroyed. If the injured ear be struck with the finger, the powder will be dispersed like a black smoke. These singular and destructive bodies have been studied by Mr. Bauer, and drawings of them are deposited in the British Museum. There are two varieties, called *Uredo segetum*, or smut, and *Uredo fetida*, or canker; the seeds are supposed to be taken up in the soil by the roots, and carried into the young plant by the sap. The canker is not seen on the exterior, but when the ears are bruised, they have a powerful and fetid odour, and are sometimes threshed along with the sound ears, rendering the whole unfit for food. The smut is more obvious, attacking not only the grain, but the stalks and leaves, which appear as if dusted over with charcoal. These plants are so minute, that Bauer has calculated that it would require 2,560,000 to cover a single square inch; and each of these contains 10,000,000 vegetating granules, or, as they are called by botanists, spores, which are the seeds; the multiplication must therefore be inconceivable. Washing the seed corn in water, particularly lime-water, previously to being sown, is the best preventive known. These diseases in the wheat have not only the effect of lessening or destroying altogether the farina of the grain, but render very unwholesome flour made from corn which has among it any infected grains.

4131. *The mouldiness which appears upon old flour*, or stale bread, is likewise a minute plant that grows upon such substances as are in a certain stage of decomposition. Flour or bread in this state is highly dangerous as food.

4132. *In all cases where corn has been subject to disease*, or the flour has been badly kept, it is the gluten that suffers most, being the part most liable to decomposition; and as we shall show that the raising of the bread depends upon the gluten being uninjured, it is obvious that good bread cannot be made from damaged flour; and though chemical means may be resorted to for assisting the fermentation, yet this can only deceive the public, and enable the bakers to make bread porous and apparently wholesome out of flour of very inferior quality. Instead, therefore, of showing how bread, passable in appearance, may be made out of bad flour, it appears to us much safer to point out the impropriety of using such flour for baking bread: it is best to reject it for this purpose, or employ it in some way where perfect condition is of less importance.

4133. *In wet seasons, corn*, but more particularly barley, from its rapid growth, is liable to sprout or germinate more or less, even in the grain; and it will sometimes throw out young green leaves while still in the ear. The consequence of this germination is, that the corn, when threshed, heats and ferments, and the starch of the grain becomes partially converted into saccharine matter; the grain, in fact, being in some degree malted while yet growing. When this is the case, the gluten as well as the starch is affected, and flour made of such grain will not ferment readily for bread. This germination of the grain can only be stopped by drying it either in a kiln or an oven.

4134. The loss of gluten almost entirely destroys the adhesive power of wheat flour, and it then forms only a sort of pap or soft matter, instead of presenting that consistency and elasticity which distinguish flour of good quality, and which are of such consequence in the making of wheaten bread, as will be shown when we treat of the fermenting of bread.

4135. *When flour is genuine, or of the best kind,* it holds together in a mass when squeezed by the hand, and shows the impressions of the fingers, and even of the marks of the skin, much longer than when it is bad or adulterated; and the dough made with it is very gluey, ductile, and elastic, easy to be kneaded, and which may be elongated, flattened, and drawn in every direction without breaking.

4136. *A method has been pointed out by M. Taddei, an Italian chemist, by which bad flour which has suffered from keeping may be detected.* The gluten which remains in the hand on kneading it in water consists of two principles, both of which are essential to good flour. If some of this gluten be digested in boiling alcohol, or even kneaded by the hand in alcohol, a part will be dissolved, which is the proper gluten, and has been named *gliadine;* what remains undissolved is the vegetable albumen, and has been named *zymome,* from a Greek word signifying ferment. If some of the latter, moistened, be rubbed in a mortar with powder of guaiacum, a beautiful greenish blue colour will appear after a few minutes. As this principle zymome is always present in good flour, the same colour, though less brilliant, will be produced when the flour itself is so treated with guaiacum; but with flour spoiled by keeping, and in which the gluten has suffered spontaneous decomposition, no colour, or very little, will be perceivable. This guaiacum may be made a test of the goodness of flour by the brightness of the colour produced.

4137. *Flour after being ground is put into sacks,* each sack containing five bushels, and weighing two hundred and eighty pounds; this will produce about three hundred and forty-seven pounds of bread.

4138. *The great corn market in London is the Corn Exchange* in Mark-lane, where, on Mondays and Fridays, samples of grain, tied up in small bags, are sent by farmers and corn-merchants, with a label on each, stating the numbers of quarters and the places where they are deposited. To this market the millers, mealmen, and corn-chandlers resort, and the business is transacted by brokers. In most of the country towns the corn is exposed in bulk by the farmer, by which the purchaser is better enabled to judge of the quality.

4139. *The price of flour* ought to be according to the price of wheat; but it is said to be often kept up in London by mismanagement or monopoly. It is considerably cheaper in many parts of the country than in the metropolis.

Subsect. 5.—*Yeast.*

4140. The nature of yeast, called also *barm* in the North, has been fully explained under "Fermentation," and again under "Brewing;" and it is sufficient here to remind the reader that it is the frothy substance that rises to the surface during the fermenting of malt liquors; it contains the fermenting principle, which is the cause of what is called the *rising* of the dough in making bread by the disengagement of carbonic acid gas. Yeast for baking is generally procured from the brewer, if there be one sufficiently near; but it must be from the brewing of ale; that from porter would prove too bitter. Yeast from home-brewed ale is generally excellent.

In large capitals, such as London and Edinburgh, yeast for baking is so much in demand, that it is prepared expressly for the use of the baker, and its manufacture becomes a separate trade. In large baking establishments the bakers prepare it themselves. It is of the first importance in the preparation of bread that the yeast should be of the best kind; and it should not be above twenty-four hours old. It may sometimes happen that yeast cannot be procured from a brewer, and that it is necessary to make it by some process.

The following is the general method; but some more particular receipts will be given in Section VIII.: Proceed with a small quantity of malt as if you were brewing beer; mash, boil with hops, and cool; then add some brewers' yeast to ferment with, and at the same time mix with the wort a quantity of flour. Fermentation will ensue, and a high head of yeast will be obtained; when this begins to fall, it is strained through a sieve, and is fit for use.

4141. *It sometimes happens that the yeast is found to make the bread too bitter.* When this is suspected to be the case, it may be deprived of its bitterness in the following manner: mix it with a considerable quantity of water, and set it by to rest for some hours, when the thickest part will subside to the bottom; pour off the water on the top, and use only the stiff yeast that has settled.

Yeast from the brewer is improved for the purpose of baking by being mixed up with three or four table-spoonfuls of bran to a pint of yeast; water is then added sufficient to make the dough, and the whole is strained through a sieve. The flour of the bran increases the fermentative power of the yeast; and if the latter be rather flat, it may be still farther assisted by using sweetwort to dilute it with instead of water. If no sweet-wort is at hand, a little may be easily prepared thus: Simmer gently over the fire for a quarter of an hour, three or four table-spoonfuls of ground malt in a pint and a half of water, adding a table-spoonful of brown sugar or honey; keep the mixture for a few hours on the hob, and then strain it.

Yeast, when kept for a few hours after skimming, shrinks into one fourth of the space which it occupied at first, and then it is called by bakers *solid yeast,* frequently mentioned in books on this subject. A sack of flour generally requires from three to four pints of solid yeast.

If yeast should happen to be a little sour, which it will sometimes, particularly in country places, there can be no harm in correcting this by carbonate of soda.

Subsect. 6.—*Water.*

4142. *Water in bread-making is made use of not merely to wet the flour*, but also to promote the chemical action of the various principles on each other, which in the dry state would remain passive.

4143. *The increase in the weight of bread* above that of the flour and the other solid ingredients employed is remarkable, and proves that a large portion of water has combined with the principles of the flour, chiefly with the starch; but a part of the water is expelled by the heat of the oven, and another portion is evaporated as the bread becomes stale. A large quantity, however, remains fixed, and we must suppose it to be in a state of chemical combination with other principles in the bread. One hundred weight of flour will make 144 lbs. of bread weighed immediately as it comes out of the oven, and if the flour be very good, 150 lbs.; but in thirty-six hours the same bread will only weigh 139 lbs. The better and older the flour, the more water it will absorb and retain; but fifteen pounds of good wheaten flour ought not to be made to absorb above ten pounds of water in dough, which will produce about twenty pounds of baked bread. In general, one fifth of the weight of bread consists of water and salt.

Subsect. 7.—*Salt.*

4144. *Salt is always used in bread-making*, not only on account of its flavour, to destroy the insipid raw taste of the flour, but it is thought to make the dough rise better.

Salt is used either by mixing it at first with the flour, or by dissolving it in the water. A sack of flour made into bread will require on an average five pounds of salt.

Subsect. 8.—*Assize of Bread.*

4145. Owing to the vast importance of this necessary of life, it has been thought proper in most countries to subject its manufacture to certain regulations. Ever since 1266, in the reign of Henry III., the price at which bread should be sold had been determined from time to time by the magistrates, according to the current price of corn, which was called *setting the assize.* But in 1815 this was abolished by the legislature in London and its environs, and though the power to set an assize in other parts of the country still subsists, it is seldom acted upon, and has fallen into comparative disuse. According to the assize acts, a sack of flour weighing 280 lbs. is supposed to be capable of being baked into eighty quartern loaves; one fifth of each loaf is supposed to consist of water and salt, and four fifths of flour. The number of loaves which may be produced from a sack of flour depends upon its quality; good flour requires more water than bad flour, and old than new; something depends also upon the management of the baker. Sometimes more loaves than eighty, even as far as eighty-six, may be made from a sack of flour, and sometimes the number will fall short of eighty. By the assize acts, bakers were restricted to bake only three kinds of bread, viz., *wheaten*, made of the finest flour; *standard wheaten*, of the whole flour mixed; and *household*, of the coarsest flour. The loaves are the peck loaf, weighing 17 lbs. 6 oz.; the half peck, weighing 8 lbs. 11 oz.; and the quartern, 4 lbs. 5½ oz. avoirdupois.

4146. *The following is an abstract of the last bread act* (5 and 6 William IV., c. 37), entitled "An Act to repeal the several Acts now in force relating to Bread to be sold out of the City of London and the Weekly Bills of Mortality; and for the more effectually preventing the Adulteration of Bread, Meal, and Flour." Bakers may make and sell bread made of wheat, barley, rye, oats, buckwheat, Indian corn, pease, beans, rice, or potatoes, or any of them, along with common salt, pure water, eggs, milk, barm, leaven, and mixed in any proportions they may choose. "Bread may be made of any size and weight. Bread to be sold by weight, and in no other manner (French rolls and fancy bread excepted). Bakers to use avoirdupois weight, of sixteen ounces to the pound, and no other. Penalty for using false weights, £5. Bakers delivering bread by cart, &c., to be provided with scales and weights. Bakers convicted of adulterating bread by using any other ingredient besides those above mentioned, are liable to a penalty of £10, and to have their names and abodes advertised in the newspapers. Penalty for adulterating flour, meal, &c., £20. Bread made of any other grain but wheat to be marked with the letter M. Magistrates and peace-officers, by warrant, may search bakers' premises, and seize and carry away adulterated bread and flour. Penalty for obstructing search, &c., £10. Ingredients for adulterating flour, meal, &c., being found on bakers' premises, subjects the offender to a penalty of £10, and the like sum for every subsequent offence. Offences occasioned by the wilful default of journeymen bakers subjects them to fine or imprisonment. Bakers not to bake bread or rolls on Sundays, or follow any part of their trade, except setting sponge for next day's baking; but bakings may be delivered to customers until half-past one o'clock, and not later, on Sundays, under the penalty of 20*s*. No baker, mealman, or miller to act as a magistrate under this act, under a penalty of £100. One half of each penalty to go to the informer (and 3*s* extra on Sundays for his expenses), and the other moiety to the overseer, or other parochial officer.

CHAPTER III.

THEORY OF BREAD-MAKING; THE VARIOUS KINDS OF BREAD, AND MANNER OF PREPARING THEM.

Sect. I.—UNFERMENTED BREAD.

4147. *Leaven* having been, as we have stated in our "History of Bread," *the original substance by which bread was fermented*, there were at first but two kinds of bread, *unleavened* and *leavened.* Hence the term unfermented was then synonymous with unleavened; at present this is not the case, as bread prepared with yeast is, strictly speaking, also unleavened. Among the Jews, however, the use of the name unleavened is restricted to bread not at all fermented, and this use of the term is not unusual with others.

4148. *When meal or flour and water are kneaded together*, they form a tenacious paste called dough, not easily digestible by the stomach. The action of fire produces a considerable change on the gluten, and likewise in the starch of the flour, rendering the compound more easy to masticate and digest. Forming meal produced from any kind of grain into cakes by moistening it with water, and toasting these before the fire or on the embers, on a hot plate, or baking it in an oven, were the first methods practised of making bread, and these modes are still used extensively in many parts of the world. Milk, butter, eggs, suet, and other substances are occasionally mixed with the flour and water, to make the bread lighter or more agreeable. Unfermented bread may be flaky, but is never porous or spongy.

4149. *The primitive mode of baking bread is still preserved* among the Arabs of the desert, who, as Niebuhr informs us, "lay cakes of dough in hot coals, covering them entirely with the ashes till the bread, in their opinion, is quite done, when they take them from the ashes and eat them warm; but they prefer baking them upon an iron plate, which they carry with them, as cleaner."

Portable ovens are frequent in Eastern countries, and form part of the furniture of travellers in that part of the world. St. Jerome describes an Eastern oven as a round vessel of brass, blackened on the outside by the surrounding fire, which heats it within.

4150. *The bread eaten by the Jews during the Passover* is unleavened; and this usage was introduced in commemoration of their hasty departure from Egypt, when, not having leisure to bake leavened bread, they took the dough before it was fermented, and "baked of it unleavened cakes."

4151. *Unleavened bread is much used*, not only in this kingdom, but in other countries, every kind of grain not affording meal capable of being fermented easily by itself. This is the case with the meal of barley, oats, and maize. The method of making bread of this kind is extremely simple, and has the advantage of requiring the least preparation; although this species of bread is not so light and easily digested by those who have lived long in an artificial state of society, and who are accustomed to very different food, yet a large proportion of robust, healthy peasantry in the northern parts of this island subsist upon it.

4152. *Barley Bread.*—This is much used in Scotland, particularly in the Highlands, as also in Wales, in Devonshire, and some other parts of England. The barley meal is made into bread by kneading it well with water and a little salt; it is then formed immediately either into thick or thin cakes, as may be required. When made stiff, and about three quarters of an inch thick, called *barley bannocks*, they are toasted or baked before a clear, hot fire, by being placed upon the edge, and when nearly done they require to be watched well that they may not burn. It was most likely this sort of cakes that our great Alfred was left to take care of when a goatherd, and the neglect of which brought on the chiding which he experienced. Very thin barley cakes, called *scons*, are much used in the Highlands, particularly at breakfast; they are made by baking them quickly on an iron plate, and, when well made, are much relished; they are generally eaten warm, with butter. Barley bread is also much used in Norway: in short, in those countries which are too cold for the cultivation of other kinds of grain.

4153. *Oat Bread.*—Oatmeal is much used in Scotland, Lancashire, and other northern counties of England, and also in Wales. The mode of forming it into bread is the same as that with barley meal. When made thick, this bread in Scotland is called *bannock*, the term *cakes* being there reserved for the thin sort, which are first baked upon a hot plate, or griddle, till they are stiff enough to stand upon their edges, and then they are toasted before a turf fire, made on the hearth, till they are crisp. In farm-houses they bake a considerable quantity at once, and keep them on a rack fixed to the ceiling: they may be kept for a long time if quite dry.

Perhaps the most ancient mode of using oatmeal in Britain, and which is still kept up in the northern parts of the island, is by making it into *pottage*, or *porridge:* this is stirring meal among boiling water or milk in a pot over the fire with a little salt, till it grows thick or sets. This dish is eaten with milk, butter, or ale. An ancient variety of it is called *brose*, which is made by roasting the oatmeal in a frying pan till it is a little brown, and pouring over it the liquor in which beef has been boiled.

4154. *Sowans* is a species of food little known in England, but much used in Scotland. It is prepared from the husk, or bran, from which the oatmeal has been sifted, much in the same way as starch is from wheat. The husk of the oats (called *sids*) is mixed with water, and suffered to remain until it sours a little. The whole is then thrown upon a sieve, and water passed through. By this all the fine starchy matter is carried down into a tub with water placed beneath, in which it subsides to the bottom; the sour liquor is decanted off, and the sediment, still moist, is put into a vessel for use. To prepare it for food, equal parts of sowans and water are boiled till they thicken into a gelatinous substance, which is very wholesome and nutritive, and when fresh is very agreeable; by keeping it acquires a degree of tartness, but which is still not unpleasant. It is much used as a light supper dish, and is eaten with milk, cream, or butter, sweetened or not with sugar.

4155. *It is a general idea in England that the use of oatmeal bread heats the blood*, and occasions cutaneous eruptions. With respect to the first of these opinions, Sir Humphrey Davy states (*Agric. Chem.*, 138) that he was informed by Sir Joseph Banks "that the Derbyshire miners, in winter, preferred oat cakes to wheaten bread, finding that this kind of nourishment enables them to support their strength and perform their labour better. In summer, they say, oat cakes heat them, and they then consume the finest wheaten bread they can procure." With respect to the supposed effects of oat cakes upon the skin, Mr. Loudon tells us (*Encyclo. of Ag.*) "that the labourers in Angus and Forfarth, who live almost entirely upon oatmeal, are as free from complaints of this kind as they are in other places; and that when these do occur, they are to be ascribed rather to want of cleanliness than to their food."

4156. *Bread of Oatmeal and Pease.*—In some parts of Lancashire, and also in Scotland, they mix oatmeal and pease-meal, and make bread of these in the following manner: A peck of oatmeal and another of pease-meal are mixed well together, by passing them through a sieve; and to these are added three or four ounces of salt; the whole is then kneaded into dough with warm water. The dough is next rolled out into thin cakes, or made into flat rolls, which are baked on a hot plate or in an oven.

4157. *Unfermented bread may be made from any other grain* by a similar process; but as they are not in common use among us, we need not mention them.

4158. *Biscuits* belong to the class of unfermented bread, and are, perhaps, the most wholesome of that class; in cases where fermented bread does not agree, they may be recommended; in many instances they are considered lighter, and less liable to create acidity and flatulence. The name is derived from the French *bis cuit*, "twice baked," because originally that was the mode of entirely depriving them of all moisture, to ensure their keeping; and although that process is no longer employed, the name is retained. The use of this kind of bread on land is pretty general, and some varieties are luxuries; but at sea biscuits are articles of the first necessity.

4159. *Sea, or ship's biscuits*, are made from wheat flour from which only the coarsest bran has been separated. The dough is made up as stiff as it can be worked, and is then formed into shapes and baked in an oven; after which they are exposed in lofts over the oven until perfectly dry, to prevent them from becoming mouldy when stored. One hundred and twelve pounds of flour produce one hundred and two pounds of dry biscuits. The method of preparing them for the use of the navy has long been admired for its simplicity and expedition; and lately, much adulteration having been detected by the contractors, the method has been still farther improved by the application of machinery employed by government. No salt is put into sea biscuits, that they may not attract moisture. The French sea biscuits are made with leaven; they are very brittle, and dissolve very easily.

But as these biscuits are never made in private families, it is unnecessary to describe the mode of their manufacture. A variety of biscuit, called *captain's biscuit*, is made in a similar manner, only of fine flour.

4160. *Abernethy biscuits*, so called from a town in Scotland where they were first made, have a little milk and some caraway seeds, and are more brittle than the last. Both these are now made by every biscuit baker. The mode of making other varieties of biscuits and cakes will be described under the heads of "Pastry" and "Confectionery," Book XV., Chap. I.

Sect. II.—THEORY OF THE FERMENTATION OF BREAD.

4161. *All kinds of meal and flour contain more or less of a peculiar substance* that ferments of itself; but a mixture of flour and water alone will enter into fermentation only very slowly. Four ounces of wheat flour with a pint of water, kept in a temperature of 70°, took four days before it began to ferment.

4162. *By the addition of either leaven or yeast to the dough, the whole mass is made to ferment more rapidly;* and, in consequence, a quantity of fixed air or carbonic acid gas is formed, as in the brewing of beer; but this air being in small quantity, and generated in the midst of the dough, which is very tenacious from the gluten it contains, does not readily escape, but collects in innumerable little vesicles or bubbles in the interior, which causes the dough to swell up and grow bulky, so that when it is cut across it appears to have numerous round cavities of various sizes, which had been filled with air. Baking stops the progress of this fermentation, by the drying up of the moisture that was necessary for its continuance; if permitted, it would go on to the acetous and putrefactive stages. When the bread is sufficiently baked, it retains its porous structure, the whole having a spongy appearance. The fermentation has also produced certain chemical changes in the dough, which render it more agreeable and lighter as food, and it no longer forms a tenacious mass.

4163. *What the chemical changes are, is far from being well understood;* but it is to be observed, that though raw flour contains starch, gluten, and saccharine matter, none of these substances can be found in their true character in baked bread; some chemical combination has therefore taken place, by which a new compound has been formed, and which is fitter for digestion than either of these proximate principles separately.

4164. *The chemical theory of the fermentation* which has been offered, and which is probably very near the truth, is as follows: The fermentative action in the dough is commenced by the saccharine matter and the gluten acting on each other, having been first excited by the yeast; and that the first fermentation is of the vinous kind, is proved by the production of alcohol in a small quantity, as will be afterward shown. The gluten and the sugar being diffused through the whole of the dough, the latter is rendered porous in the manner we have mentioned; and hence the impossibility of preparing bread which shall have those qualities from the farina of oats, barley, rye, or any of the esculent roots, in all of which the quantity of gluten is comparatively very small. During the baking, the starch, which was merely diffused through the mass while in the state of dough, combines, with a portion of water, into a stiff jelly, which renders the bread more digestible, and the gluten wholly disappears. Part of the water, at least, is chemically united to the flour, or fixed and rendered solid; thus increasing the weight of the bread, as has been already stated in p. 747.

That it is the saccharine matter which acts the principal part in the process of fermentation is evident, because, when this is exhausted, the vinous fermentation ceases; and if the fermentation be not checked by the baking, the acetous stage commences. It is also to the semi-transparency of the numerous thin partitions which divide these cells in bread, and which, in fact, constitute all its solidity, that its white colour is due. When bread of wheat flour is baked without being fermented, it forms a solid, dark-coloured, disagreeably-tasted mass, difficult of digestion; qualities which may be obviated by baking it into thin cakes rapidly on a hot iron plate; but these are not comparable to fermented bread.

Thus fermented bread has several advantages over unfermented. It is less compact, more agreeable to the taste, it loses its tenacious and glutinous qualities, and is more salutary and digestible. The cells render it more easy to be broken down in the stomach. It is a chemical compound, in which the gluten and starch have been altered, so as to be no more recognised and separable. It is also less liable to acescence.

4165. *It was at one time supposed that the fermentation of bread was of a peculiar kind, which was called the panary fermentation;* but it is now thought that this fermentation does not differ essentially from that of wine or beer, being only modified by circumstances.

The great objection to the identity of the panary with the vinous fermentation was that no alcohol had been procured from dough, though this might have been expected had the carbonic acid gas been the result of a fermentation of the vinous kind. This difficulty, however, has disappeared, and the question set at rest by an invention which has not only ascertained that alcohol is formed in dough, but by which it may be actually collected.

A company was even formed for obtaining the spirit generated during the fermentation of bread, and which, in the ordinary construction of bakehouses, is lost; but though spirit was obtained, the speculation failed to be profitable.

No doubt this first chemical change in the fermentation of dough is at the expense of the nutritive principles of the flour. It seems, then, to be a point to be attended to that, as soon as the advantage is obtained of having the bread raised, no time should be lost in putting a stop by the oven to the farther fermentation, in order to preserve that sweetness which renders bread agreeable; fermentation beyond that time, though it may produce alcohol, can only do so by decomposing the important principles of the bread; and the result of this will be to render the latter insipid, as well as somewhat less nutritious.

It was said that in the new process only such spirit was collected as formerly absolutely escaped notice, although it is always found in the mode employed by the ordinary baker, the bread losing nothing that it generally possesses; and it was farther said that this bread does not get sour by keeping. It is, no doubt, true that a small quantity of spirit is formed in the usual mode of baking, and which is lost, from there being no method of collecting it; but this quantity is extremely small, and probably not worth the trouble of attempting to preserve. On the contrary, by pushing the fermentation as far as it will go, the whole, or a very considerable portion of the saccharine principle is destroyed, and the bread suffers in its qualities.

4166. It has been remarked, that although sugar is the principal substance decomposed in consequence of the fermentation, yet about three per cent. is still found in bread baked in the usual manner, the flour having had only five per cent. But it is the stopping of the fermentation by the process of baking that has prevented the whole of the sugar from being decomposed, which would have happened had not this been done, or if the fermentation should proceed far enough. It is not improbable that some of the starch of the flour may have been converted into sugar during the baking.

4167. It must be observed, likewise, that this method of collecting alcohol in baking can only be practised in establishments on a very great scale, and adapted for the purpose, the apparatus being of a peculiar structure; it is therefore altogether inapplicable to domestic bread-making, and even to the business of the ordinary baker; and we have said so much, more to illustrate what had been called the panary fermentation than with any practical view.

4168. *There are two general modes of making fermented bread.* The most ancient method was by taking advantage of a spontaneous fermentation, which dough made from flour or meal undergoes when left to itself. The bread so produced is what is called *leavened bread;* and the origin of the name will easily appear from our account of the mode of its preparation. The other method, and that by which our ordinary wheaten bread is now always made, is the bringing on the fermentation of the dough *by the addition of yeast.* We shall first describe leavened bread, which will enable us best to perceive the advantages of the other method.

Sect. III.—Leavened Bread.

4169. *Fermenting bread by means of a leaven is an improvement upon the mere leaving a mass of dough to spontaneous fermentation,* as mentioned above. If dough were left to ferment by itself without any addition, the effect would be unequal, and would vary according to the proportion and condition of the several constituents of the flour. The saccharine part would be disposed to run into the vinous fermentation: the mucilage would have a tendency to become sour, while the gluten would soon verge towards the putrid state. These changes would proceed with greater or less rapidity, as the several parts were on the outside, and exposed to the atmosphere, or whether they were in the interior of the mass. Occasional mixture of the whole would cause these effects to be more uniform; but still, bread made in this manner would be imperfect.

4170. *The great improvement by leavening consists in this:* to produce the desired uniformity of fermentation, a piece of dough is kept in a warm place until it has undergone the fermentation just described; then, if this piece, now called a *leaven*, be well mixed up with a quantity of fresh dough, of which bread is to be made, it will communicate its fermentation to the whole mass, and every part will ferment with greater rapidity, equally, and at the same time, by which a uniformity will be produced that otherwise would not have happened.

4171. *Bread fermented by means of leaven is now rarely used in England, and is confined to rye bread*, or to a mixture of wheat and rye, called *meslin* in the north of England, where these two grains are sown together, and go through all the processes of reaping, threshing, and grinding in this mixed state. In some places of the north, oaten bread is occasionally fermented with leaven; yeast is said not to answer so well for it.

4172. *It is always customary to reserve as a leaven* for the next batch of bread, some of the dough, when it is just in the state fit to be baked; and it is only in case of this being neglected, or that leaven is not to be procured, that recourse is had to making an original fermentation. As it is now the custom for one person always to get leaven from another, it is probable that the original ferment in any country might have been produced centuries ago. In the north of England a pound or more of leaven for the next baking is kept fit for use for weeks, buried in a sack or cask of flour. In Italy it has been kept good in this manner for several months. The French keep it for a week in a warm place between two bowls, adding every day some flour and water; if they wish to keep it longer, they dry it by a gentle heat, and when it is wanted, rub it down to a paste with warm water.

4173. *The producing of new leaven is a tedious process*, and it does not always answer so well as what has been kept from a former baking, being apt to run into putrescence. It is made by working wheat flour with water into dough; this is kept in a temperature of from 70° to 80°: the time of its rising will vary considerably, from a few days to a fortnight. In this process the fermentation is at first of the vinous kind, as mentioned above; it passes, however, very soon into the acetous; and leaven is generally distinguished by a slight acidity, which it gives to the bread. If very skilfully managed, however, bread made in this way is sometimes not inferior to that which is fermented with yeast, and some persons prefer it.

Scarcely two centuries have passed since almost all the bread consumed by the labouring population in England was made of rye flour, either by itself or mixed with wheat. But though rye bread is now little used in Britain, it is still the only kind used among the peasantry in many parts of France, Germany, Norway, and other northern European countries, particularly in the sandy districts near the Baltic, where no other grain than rye can be cultivated. In Sweden it is universally used, wheaten bread being never seen except in the towns. They bake rye cakes only twice a year; and consequently these become at length almost as hard as wood.

4174. To make rye bread, mix wheat and rye flour together with water at a blood heat; add to half of this a small bit of leaven, and after kneading the whole together very well, leave the dough in a warm place, covered up with a woollen cloth. In a few hours or more the dough will rise; next knead up this fermented dough with the other half that was left, adding as much salt as is necessary. Leave this mass for a few hours to ferment farther and swell, and then make it up into loaves for the oven. The time required for baking, and the method of it, are the same as for "Yeast Bread," which see. It requires some experience to be able to determine the exact quantity of leaven necessary; if too little is used, the bread will be heavy; if too much leaven be employed, or if the dough be suffered to lie too long before baking, the bread will have a disagreeable sour taste. Some use milk instead of water to wet the dough. 100 lbs., consisting of equal parts of wheat and rye, will produce from 154 lbs. to 156 lbs. of leavened bread.

Since, with the exception of wheat, rye contains a greater proportion of gluten than any other corn, it is easy to be fermented, and is a strong, hearty, though coarse food.

4175. *Rye bread is also sometimes fermented with yeast*, and then it has not the acid which leavened bread generally has.

SECT. IV.—BREAD FERMENTED WITH YEAST, AND MADE BY PUBLIC BAKERS.

4176. Since it is difficult always to ferment leavened bread so as not to produce more of a sour taste than is agreeable, it was a great improvement to substitute yeast as a ferment, the bread so produced having no unpleasant flavour, and being, at the same time, lighter.

4177. *Method of making Bread by the London Bakers.*—The baker first sifts a sack of flour into the kneading trough; he then dissolves four or five pounds of salt in a pailful of hot water; and when this has cooled down to 84°, from three to four pints of yeast are added, blended well with the water, and passed through a sieve. A hole is now made in a heap consisting of one third of the sack of flour, and the whole gradually worked up in a small trough with the water he has prepared into the consistence of stiff batter, quite free from lumps. The surface of this is made level, some flour is sprinkled over, and it is covered over with sacks or cloths; this is called *setting the sponge.*

In this situation it is left for an hour or two; a fermentation takes place, carbonic acid is disengaged, which, had the mass been semi-liquid, would have risen to the surface in bubbles, that would have broken; but, from the viscidity of the dough, the air, though it forms cells, is confined, and the sponge swells to double its original size. If this was suffered to go on, the air would at last escape, and the sponge fall down. When the baker perceives that the process has advanced sufficiently far, he mixes with the sponge all the rest of his sack of flour, and incorporates the whole together by a laborious course of kneading for upward of an hour, and the mass is then called *dough*.

This setting the sponge is useful by way of precaution, in order to try how the yeast will act in raising the dough, without using up the whole quantity; as any necessary alteration can be more easily made in this stage of the process than after the whole of the flour is mixed up.

If the dough is too thin, the bubbles of gas would all escape, and the raising would subside; and if the baker were to suffer the fermentation to be completed before baking, the bread would pass into the sour state. The baker, therefore, does not carry on the fermentation all at once, but adds the sponge at twice or three times, and also the flour. The perfect kneading is essential, that the fermentation may be equal.

The dough is now left to itself for an hour and a half, with a little flour sprinkled all over it, and it is likewise covered with a woollen cloth; during this time the fermentation continues, and spreads through the whole mass. It is then subjected to a second but less laborious kneading, that the vesicular structure should be equally distributed. The dough is then cut into pieces, each being made, by weighing, of the proper size for loaves, and when shaped into proper forms for the oven, they are set aside in a warm place for some time. They are then put into the oven by a shovel for the purpose, and left in it about two hours and a half or three hours; when taken out, they are turned with their bottoms upward, to prevent them from splitting, and are covered up with a blanket to cool slowly. The loaves, when they come out of the oven, are about twice the size they were when they went in.

4178. *Kneading the dough in some places is performed by machinery*, which is certainly superior to the usual mode of employing the hands, and sometimes the feet of bakers. At Paris and Genoa, mechanism is occasionally employed; and at Geneva, it is said that the bakers are compelled by law to send their dough to be kneaded at a public mill constructed for that purpose. Various dough-making machines have been patented here, of which that by Hebert is one of the best. A kneading machine, simple, cheap, and requiring no art to use it, is employed by many French bakers; and it is desirable, for the sake of cleanliness, that it should be introduced here. It is figured in the "Dictionnaire Technologique."

4179. *Methods of raising the Dough without Fermentation.*—The chief advantage of the process of fermentation in making bread being the production of gas, which forms numerous cells that give that peculiar porous texture seen in the crumb of a loaf, any other process that will produce a similar texture will answer to make good bread. Accordingly, sub-carbonate or bi-carbonate of ammonia being mixed with the dough, the latter will, on baking, become spongy, as if it had been fermented with yeast. The reason is this: the carbonate of ammonia, being very volatile, is, by the heat, converted into a gaseous body, which, after filling the dough with cells, flies off entirely, leaving not a trace behind. This has been occasionally practised by London bakers.

4180. Another method is also used by some bakers, for which a patent has been taken, and the bread produced by it is called *patent unfermented bread*. Instead of the ordinary quantity of common salt put into the dough, carbonate of soda and muriatic acid, in due proportions, are kneaded up with the dough as rapidly as possible, which causes it to rise immediately. The explanation is this: the muriatic acid unites with the soda, and sets free the carbonic acid of the carbonate; this gas then distends the dough, giving it a vesicular character. The muriatic acid and soda, being the ingredients of which salt is formed, remains in the dough as salt, no other salt being necessary. This method is found to answer, and to make excellent bread; by it time and trouble are saved, and all risk of carrying the fermentation too far, as in the common method with yeast, is avoided. By some it is thought that bread made in this manner is particularly suited to invalids.

Sect. V.—Adulteration of Bread.

4181. There is no doubt that both flour and bread have been occasionally adulterated, and sometimes with deleterious substances, though, we believe, such practices are at present not common. It is, however, useful to know what are the substances usually resorted to for sophistication, and likewise how to detect such frauds.

4182. *Flour of bad or indifferent quality, or damaged*, being sold at an inferior price, is perhaps at present what we have most to dread from dishonest bakers, since the means of detecting deleterious substances introduced instead of flour are so simple and well understood, that few will venture to use them. The mere inferiority of flour cannot easily be discovered by chemical tests, and can only be judged of by the general quality of the bread.

It is chiefly to conceal the defects of the flour that alum, and sometimes sub-carbonate of ammonia, are added. When the flour is damaged, the gluten is in part destroyed, and it is difficult to make the bread rise sufficiently without the addition of something.

4183. *Alum has certainly been employed* by some London bakers for the purpose of adulterating bread, since many convictions have taken place of bakers who were found to have alum in their possession for this purpose. We believe, however, that there are many respectable bakers who never employ so deleterious a material. The following will be useful information, in order to put the public upon its guard:

There are several objects for which alum is put into bread: one of them is to enable the baker to make out of imperfect or damaged flour a bread that shall look as if it were made from the best flour; a second motive is, that the bread may absorb more water, and, therefore, weigh more than it ought from a certain quantity of flour; and a third is, to make the loaves part from each other more readily. The first two reasons are positively fraudulent; to the last there would be no objection were the alum perfectly harmless. It is well known that it is impossible to make the whitest kind of bread light and porous, and of the colour and appearance to which the public are now accustomed, of flour alone and unadulterated, except it be of the very best quality; and we have shown that when wheat flour is damaged by any cause that injures its gluten, the bread made from it will not rise properly. The way in which alum acts in covering this defect, as well as that of colour, or what may be termed bleaching the flour, is not well understood; but the fact appears to be, that a small quantity of alum is sufficient to produce a remarkable effect. It has been confidently asserted that many bakers purchase a mixture of flour, alum, and salt, for the purpose of adding it to damaged flour, and that this is known among themselves by the name of *sharp whites;* sometimes it is called *stuff*. By means of this compound, they are enabled to deceive the public, and to make bread composed of bad flour pass for that which can only be manufactured from pure ingredients. Dr. Ure states that he found the proportions of alum in bread to be variable, but that its quantity appeared to be in proportion to the badness of the flour.

4184. It has been said that the small quantity of alum which is employed (an ounce to a sack of flour) cannot be prejudicial to health; others maintain, that the proportion of alum, if used at all, is as much as three or four ounces to a sack of flour, and that less will not have the desired effect. On this subject, however, medical men generally agree that even a small quantity of this astringent substance taken continually cannot fail to injure the constitution. The practice is forbidden by law, and any tampering with the health of the public deserves severe punishment. It is pretty certain that alum is not used by the most respectable bakers; and it is quite certain, that when the best flour is employed, alum is not necessary to make the bread white.

4185. *To detect alum in bread* requires some knowledge of chemistry; and we must recollect that alum consists of sulphuric acid, alumina, and potash. Crumble about two ounces of the bread suspected in half a pint of distilled water; boil the mixture a few minutes, and filter the liquor through unsized paper. Evaporate the fluid to about one fourth of its original bulk; divide it into two parts. Into one of these let fall a solution of muriate of barytes (now called chloride of barium); if a *copious* white precipitate ensue, which does not disappear by the addition of pure nitric acid, the presence of alum may be suspected, as this precipitate indicates sulphuric acid. Into the other half drop a little aqua-ammonia; if alumina be present, the other constituent of alum, a light precipitate will appear, which will be re-dissolved by a few drops of a solution of caustic potash. Bread made without alum produces, when assayed in this manner, merely a very slight precipitate, which originates from a minute portion of sulphate of magnesia, contained in all common salt of commerce; and bread made with salt freed from sulphate of magnesia produces an infusion with water which does not become disturbed by the barytic test. There are more accurate methods than this, by detecting the several constituents of alum, sulphuric acid, alumina, and potash; but as these demand considerable acquaintance with the methods of chemical analysis, they can only be practised by persons conversant with that subject, who will readily find the means of accomplishing this object.

4186. *We have, in the last section, mentioned two methods* which are practised of raising dough without the usual process of fermentation; one by the use of carbonate of ammonia, and another by means of carbonate of soda and muriatic acid. By both of these methods carbonic acid gas is disengaged, which renders the bread porous and light; nor are they in any way hurtful to health, the ammonia, through its volatility, flying off entirely, and the salt formed by the last process being only common salt, such as is always used in bread. But it is to be observed that bakers can by these processes cause dough to rise made of flour spoiled, or, as they call it, *sour flour*, which could not be raised easily by yeast, and therefore bread may thus be made of bad flour to look nearly as well as if made of the best. Occasionally, however, these processes are employed for other purposes than those of sophistication; they are sometimes used with yeast to ensure the rising of the dough in cases of difficulty, or where the bakers are in a hurry.

4187. But although bread baked and raised by these means is vesicular or porous, and nearly similar in appearance to bread made with yeast, yet, when closely examined, the nature of its pores is very different; the pores are generally large, and the mass is seldom spongy, or full of minute pores, and frequently a large cavity is formed in the loaf; it is, besides, difficult to expel the last traces of the ammonia, which sometimes leave an unpleasant taste. Vogel has made some accurate experiments on this subject, and he has shown, in opposition to what has been asserted, that it is impossible to make such good bread by the use of water impregnated with carbonic acid gas, mixtures of carbonate of soda and tartaric acid, or any method of generating gas, as by the employment of yeast.

4188. *Some white substances are said to have been employed by millers and bakers for the purposes of whitening flour and bread* by direct mixture, as chalk, plaster of Paris, bones calcined and ground, which are all very prejudicial. It is very unlikely that these are now often used as adulterating ingredients, however they may have been, since the means of detection are so well known. If any such materials are suspected in bread, it will be sufficient, in order to discover them, to boil some of the bread in a certain quantity of water, when the substances will separate and fall to the bottom as a white powder, which may be examined by a chemist. It is scarcely necessary to say that no powder of this kind can be any part of the flour itself; but if any such occur, it must be the consequence of sophistication. If the powder be chalk, oil of vitriol (called also sulphuric acid and hydrochloric acid), diluted with six times its weight of water, will occasion an effervescence or bubbling when poured upon it.

4189. *The general preference that is given to bread very white has been considered to arise from prejudice*, and it has been said that it is in consequence of this false taste in the public that bakers have been, in some degree, compelled to seek out methods of making their bread as white as possible beyond what their profits will allow. It is very necessary that we should be extremely cautious how we admit of excuses for the adulteration of so important an article of food as bread, and it is highly desirable that we view the subject in its true light. We have already explained that the finest flour is composed of the central part of the grains of wheat, and, when the grain is of the best quality, this part is extremely white. The exterior part of the wheat affords a flour less white. The whiteness of flour, therefore, when it is pure and unadulterated, becomes in some degree a test of its having been produced from the centre of the grain, which gives what is called the finest and best flour. Good wheat likewise affords a flour whiter than damaged wheat, or than the meal of other grains, as barley, oats, pease, and beans. It is no wonder, therefore, that the public should have the impression that the whiteness of flour, and, of course, of the bread made from it, is more likely to be of the first quality rather than what is of a darker colour, since the latter may not only consist of inferior flour, but may be adulterated with some other substance. Bread of the whole of the wheat is, of course, much less white than what is made of fine flour, but it is said to be quite as nutritious, or even more so, and hence the preference of very white bread is called a false taste. But it does not appear to be clearly established that brown bread is more wholesome in general than white, if the latter be pure, and there is a reason why, weight for weight, the white is the most nutritious. The flour of which brown bread is made drinks up more water in making it into dough and baking than the white; hence, in an equal weight of white and brown bread, there is most water, and, of course, less nutritive matter in the former. It is true the brown is also the cheapest, but it is said that the labouring classes find the white, after all, the most satisfying, and therefore, as they suppose, the most economical. This may or may not be so; but if true, their preference of it cannot be called a prejudice, and white bread is more likely to be of good quality than what is worse coloured; for though substances are sometimes used to give artificial whiteness, yet these, being of so easy detection, are probably very seldom made such use of; and if there is no adulteration by the intermixture of other substances, the whitest bread is most likely to be the best, as it ferments most readily, and contains most gluten and starch.

4190. *The most general adulteration of bread, as it is made at present, is the mixing potatoes with the dough*, which has become so frequent a practice, that bakers make no secret of it. Many of them assert that good bread cannot be made without it, and that such bread is more light, palatable, and digestible than that which is manufactured from wheaten flour alone. We must confess that we doubt the truth of this statement in the way in which it is intended to be understood. The addition of potatoes to bread may serve the baker's purpose, since potatoes cost him less than an equal weight of flour; potatoes are not an unwholesome addition, and bread made in this manner may be very palatable; but when we consider the composition of wheat flour and of potatoes, the latter containing no gluten, which is the most nutritive part of wheat flour, it must be obvious that bread mixed with potatoes is less nutritious than an equal weight of what is made solely from wheat. Should this practice be admitted to be fair, and the price of such bread reduced in proportion to that of the ingredients, there might be no reason for complaint; but to put as large a quantity of potatoes into the bread as the flour will allow of, and then to charge as much for this bread as for bread all of wheat flour, is certainly an imposition. With respect to the addition of potatoes being any improvement in bread, it is extremely difficult to decide such a question except accurate experiments were made with the materials, and such experiments can scarcely be expected from the bakers. We have certainly seen bread of the very best quality made in private families without a particle of potato, and until the superiority of potato bread is distinctly proved, we must withhold our belief that it is an improvement upon that where the best flour and other materials are employed.

We are aware that the *flour*, or *starch*, of potatoes is largely manufactured in Paris for the pastry-cook, but this article is dearer than flour, and is therefore used for other purposes than adulteration. Our bakers do not use the starch or flour of the potato to mix with their dough, but rub up with it the whole of the potato, which contains but 30 per cent. of starch.

4191. *Potato starch may be detected in flour* by examination with a microscope; the grains of starch may be seen of a round form, and to possess a glistening appearance, which is not the case with flour. See "Starch," Book VII., Chap. VIII., Sect. II.

4192. *Common salt*, which is essential to bread in a small quantity, is rarely employed in too great proportion as a fraud. Salt has the property of causing the dough to take up more water than it otherwise would, and thus increases the weight of the bread; but as this increase is mere water, the bread gains nothing in nutritious quality. This kind of adulteration, however, is not likely to be carried to any great extent, as the saltness of the bread will be complained of.

4193. *Sand* is sometimes found in bread; but this cannot be supposed to be introduced purposely by the miller or baker. The sand is derived either from grain badly cleaned, or more frequently, perhaps, from the wearing away of bad millstones. In some parts of the country, the millstones being of too soft a material is not unfrequent. This accident is a serious evil, as fine sand is extremely prejudicial.

4194. *On the Continent*, bakers appear to be no less ingenious than in this country in the contrivance of adulterating processes. Some time ago the bakers of Lisle were detected in using sulphate of copper (blue vitriol), a poisonous substance, in bread, to correct the qualities of bad flour.

SECT. VI.—HOME-MADE BREAD.

4195. Hitherto we have treated of the general principles of the art of making bread, which cannot but be desirable to be understood by those who have the management of a family; and we stated in our introduction, Sect. I., that the convenience of having public bakers almost in every village has, in many places, superseded, in a great degree, the necessity for baking at home; nevertheless, domestic baking is very generally practised in the country; and one advantage of this is, that bread can be secured from any adulteration, and may be had of the best quality. It has been said justly that "the evils of adulteration are probably exaggerated;" but, with some persons, the suspicion that they are eating other substances than the produce of wheat is painful enough. In general, good home-made bread is observed to be more full of flavour than that of the baker, to keep better, and to go farther, being more nutritive. In many families, a difficulty occurs respecting the oven; one built of brick is the best; and, where the family is large, a bake-house is found an important requisite; but perfectly good bread may be, by proper management, baked in iron and other ovens on a small scale, and we must refer the reader to the article "Description of Ovens," Sect. IX., Chap. III., where the various kinds will be treated of.

4196. *With respect to the economy or saving in baking bread at home*, some persons consider that it is so little as not to deserve attention except the family be large. This depends much upon opinion, but it is well to see what the cost actually is, in order to determine this question. The following calculation, given in an excellent little work entitled "Cottage Comforts," will place this in a clear light: "The expense of making a bushel of wheat into bread will be as follows: Wheat, 9*s.*; grinding, 9*d.*; yeast and salt, 3*d.*; heating the oven, 1*s.*; in all 11*s.*; but from this you must deduct at least 6*d.*, as the bran and pollard, of which you have 13 lbs., is worth more than ½*d.* per pound. I have also rather overcharged than otherwise on the other things. Salt, now the tax is taken off, is very cheap; yeast, if you have brewed lately, you need not buy, and 1*s.* is perhaps more than ample allowance for heating the oven; perhaps 10*s.* will be about a fair calculation for the baking. From your bushel of wheat you will get from 58 to 59 lbs. of bread, that is, about thirteen loaves and a half of 4 lbs. each, which will cost you, at the baker's, 11*s.* 9¾*d.* Should there be no convenience for grinding, the best white flour may be purchased, of good quality, usually at about 5*s.* 6*d.* per bushel of 56 lbs." From this it is obvious that the saving is not great, and that the baker's profits cannot be considerable, if the materials he uses are of the best kind; but it is also obvious that it is possible to make bread at home, of the very best quality, at least as cheap as it is sold by the baker, with the certainty of its being genuine.

If a certain proportion of potatoes are added to the flour, as is the practice with the bakers, then the bread will be cheaper, weight for weight, but the real saving will be little, as the potatoes contain so much water; added to which, bread into which potatoes enter as an ingredient is decidedly somewhat less nutritive, though very white, and keeps worse, becoming dry and hard in less time.

4197. *To make good Family Bread.*—The general mode of making bread fermented with yeast must be nearly the same in all cases; and we have already described the method as practised by the public baker; but we consider it proper to describe, likewise, the process as it is employed in private families, where the scale is of course less. We will suppose that a bushel of wheat flour is to be baked into bread; if the quantity be less, then all the ingredients must be diminished in proportion, observing that a bushel of flour weighs fifty-six pounds. If the family be large, it may be supposed to consume that quantity weekly; but in a small family of three or four persons, twenty pounds of flour may perhaps be found sufficient for the weekly batch. Put the flour in one heap into a wooden trough that is made for the purpose, or into a smooth tub or pan sufficiently large to hold near twice the quantity, but not too deep. Then mix a pint of good stiff brewer's yeast with a pint of lukewarm water, and a quarter of a pound of salt, and strain it through a sieve; with a spoon, work as much flour into it as will make the whole of the consistence of a thin batter, and stir this together well. Make a large hole in the middle of the heap of flour, and pour this mixture into it; sprinkle some dry flour over this, so as just to cover it. The sponge being thus set, cover the whole over with a cloth, and place it in a warm situation, nearer to, or farther from the fire, according to the state of the weather, whether it is hot or cold.

The sponge will now ferment and swell up, or *rise*, as it is called; and, as it rises, cracks will be seen across the flour that was scattered over it. The whole of the flour is now to be mixed up with the mass in which the fermentation has already taken place; mixing in as much water as is necessary, and taking care to add it a little at a time. The whole must now be very well kneaded together into dough. Much of the goodness of the bread will depend upon the thorough kneading, in order that all the lumps of flour may be completely moistened and broken, and the fermented batter intimately mingled with the dough, so that it may be as uniform as possible.

At first, the mass is very adhesive, and clings to the fingers, but it becomes less so the longer the kneading is continued; and when the fist, on being withdrawn, leaves its perfect impression in the dough, none of it adhering to the fingers, the kneading may be discontinued. The dough is now to be made up into a lump in the middle of the trough, a little flour is dusted over it, and it is placed in a warm situation to ferment, and rise still more. In about half an hour or more, according to circumstances, it will have risen sufficiently; and before it has time to fall back again, it is cut into pieces of the required sizes for loaves, and made up into shape, ready to be put into the oven, and dusted over with flour. No more should be done than is necessary to bring the loaf into shape, since much handling in this stage of the dough is apt to make the bread heavy.

In the mean time, while this was going on the oven should be heated either with wood or by a coal fire, according to its construction, for which see "Oven," Sect IX It is difficult to describe the degree of heat that is proper for the oven; but persons accustomed to bake in a brick oven guess this pretty well by the bricks being red-hot, and the degree of heat which they feel on their faces. The hot embers are now to be drawn out of the oven; if that is of brick, this is done by a long pole with an iron hook; and the bottom is farther cleaned with a mop made of shreds of cloth or sacking. No time should now be lost in putting in the loaves, by means of a proper wooden shovel, called a *peel*, and the oven door should be shut very close; the bread should be looked at when it is supposed to be nearly done, which is generally in about two hours, more or less, according to the size of the loaves. When the loaves are taken from the oven, they should be placed with their bottoms upward, and covered with a thick cloth or flannel, that they may cool gradually.

If the fermentation of bread be too rapid, as it sometimes will be in warm weather, or if too much or too strong yeast has been used, there is a danger of the dough souring by passing into the acetous fermentation. If that should happen, it will become heavy. To check this, it is customary to uncover the dough, and expose it to the air, in order to diminish the temperature of the fermenting mass, or to put it, if possible, in a cooler place. Chaptal proposes to knead a little carbonate of potash with the dough, which will neutralize the excess of acetic acid; magnesia has also been tried for the same purpose; but though these practices may be very proper were bakers scientific, they will frequently fail with our present makers of bread.

4198. *Household*, or *Brown Bread.*—In Sect. II. we described the different kinds of flour prepared from wheat, produced by the mode of dressing it after it was ground; and we showed that the finest and whitest part lay in the centre, or heart of the grains. Originally, the distinction of the kernel and the pollard was neglected by the miller; and, after taking off the bran, the whole was ground together. Future refinements found means to separate the pollard from the kernel, in order to produce a very white flour. There are many persons, however, who consider the *whole flour*, or *grist flour*, as it is called, that is, the pollard and the kernel ground together, as formerly, to be more wholesome than the white flour alone; and this is still extensively used, particularly in the country. Bread made of this is generally known by the name of *household*, or *brown bread.*

Brown bread certainly possesses some qualities peculiar to itself. Its flavour is somewhat sweeter than white bread, and it keeps longer moist, as it absorbs more water; but when it dries it is apt to crumble; it likewise appears to agree better with some constitutions, and on that account it is occasionally preferred.

One of the advantages of grinding our flour at home is, that it may be bolted and separated in any way that may be desired. There is nothing in the baking of brown bread different from that of white; it is now frequently made and sold by the London bakers at a somewhat lower price than white bread.

4199. *Brown Bread with the Bran.*—This is the coarsest sort of brown bread. If a Winchester bushel of wheat is sent to the mill and ground, the meal, including the bran, will weigh fifty-eight or fifty-nine pounds. To make bread of it, mix as much of the meal as is required with water, and add yeast and salt in the usual manner. The dough, before it is put into the oven, will weigh eighty-eight pounds. It may be divided into eighteen loaves, which, when baked, will altogether weigh seventy-four pounds and a half.

4200. *Pan Loaves.*—In many families a preference is given to what are called pan loaves, as being of firmer consistency and better flavour than loaves baked in the ordinary way. The dough is made nearly in the same manner as has been already described, but it is not so stiff as the dough for common bread. After having been suffered to rise for some time, it is divided into portions of the size required, and placed in earthen pans, or in square sheet iron ones tinned. The rising having continued for a short time, the surface of the dough in each mould is pierced with a fork or similar instrument, to prevent inequalities or blisters in the crust. They are then placed in a quick oven, and when nearly done are taken out of the moulds and transferred to flat tins, on which the baking is completed. Iron ovens answer better for these than for the ordinary kind of loaves.

4201. *Rye, and likewise barley, are sometimes made into bread by fermenting them with yeast*, in the same manner as wheat flour; but barley requires the dough to be baked very soon after it is made, as it grows sour almost immediately.

Sect. VII.—FANCY BREAD.

4202. There are many forms of bread which come under this designation; and the bakers seem to vie with each other in producing new varieties. As few of these are made in private families, and as those conversant with the practice of baking will find no difficulty in imitating them, it is not necessary to enumerate them all. We shall describe those kinds that are in general use only.

4203. *Rolls* are made from dough of a less dense consistency than that which is intended for common bread, and when baked they are more porous and lighter than ordinary bread. The London bakers prepare both kinds by the same kneading, and leave the portion intended for the lighter bread in the trough after the loaves have been put into the oven, that the rising may continue a little longer. When the rising is sufficient, the mass is formed into rolls, which are deposited in a warm place, and allowed to expand as much as possible. The baking is effected in twenty or thirty minutes.

4204. *French Bread.*—The French make a great many more varieties of bread than we do; some coarser, and others finer than ours.

To make French bread of a superior kind, put a peck of flour into the kneading trough, and sift it through a wire sieve; then rub in three quarters of a pound of butter, and, when it is intimately incorporated with the flour, mix up with it two quarts of warm milk, a quarter of a pound of salt, and a pint of yeast; in mixing these with the flour, a sufficient quantity of water must be superadded to make a dough; after the kneading, it must stand for two hours to rise; it must then be moulded into loaves, which are to be laid on tins and placed for an hour by the fire, or in a hot closet. They are placed in an oven (a brick oven is best) for twenty minutes, and when drawn are divested of the friable crust by rasping; but some prefer not to rasp them.

4205. *Muffins* are made from a light paste prepared in the following manner: To a quarter of a peck of flour add three quarters of a pint of yeast, four ounces of salt, and as much water or milk, slightly warmed, as will form a dough of rather light consistence. Small portions of this dough are put into holes made in a layer of flour about two inches thick, placed on a board; and the whole is covered up with a blanket, and laid near the fire to promote the rising. When this has been effected, the portions, which are now of a semi-globular form, are removed to a heated iron plate to be baked When the muffins begin to acquire a brown colour on the lower side, they are turned and baked on the other.

4206. *Crumpets* are made thus: The usual ingredients are one pound of flour, three table-spoonfuls of yeast, and a sufficient quantity of milk or water to form a fluid paste. After having been suffered to rise, a portion of the fluid is poured on a heated iron plate, and baked quickly on either side successively, like a pancake.

4207. *Gingerbread* is made from a dough composed of one pound of fine pollard, three quarters of a pound of treacle, half an ounce of the sub-carbonate of potash, half an ounce of butter, with warm water sufficient to make it knead. Several spices are added, as ginger, cinnamon, nutmeg, allspice, Cayenne pepper or black pepper. The dough is kept for several days, sometimes nearly a fortnight, till a rising or fermentation is produced by the action of the acid of the treacle and of the sub-carbonate of potash, by which carbonic acid gas is disengaged very slowly; it is then baked.

4208. Besides the various preparations which we have described, and which go under the general denomination of bread, a great many others are made by the confectioners and biscuit bakers, which are not fermented but are rendered either brittle, or *short*, by the admixture of various substances, as milk, eggs, sugar, butter, and seasoned with seeds, spices, currants, &c. These will be treated of under "Confectionery," Book XV., Chap I.

Sect. VIII.—Receipts for making yeast.

4209. The difficulty of procuring yeast for baking, particularly in country places, at a distance from breweries, constitutes, sometimes, a great inconvenience. Many endeavours have therefore been made to obviate this difficulty by the discovery of an easy mode of forming or of preserving yeast. We shall describe some of the best of these.

4210. *The following method is stated by Mr. Fownes in the "Philosophical Magazine:"* If common wheaten flour be mixed with water to a thick paste, and exposed, slightly covered, to spontaneous change in a moderately warm place, it will, after the third day, begin to emit a little gas, and to exhale an exceedingly disagreeable sour odour, much like that of stale milk; after the lapse of some time this smell disappears, or changes in character; the gas evolved is greatly increased, and is accompanied by a very distinct, and somewhat agreeable vinous odour; this will happen about the sixth or seventh day, and the substance is then in a state to excite fermentation. A quantity of brewer's wort is next to be prepared in the usual manner, by boiling with hops; and when cooled to 90° or 100°, the altered dough above described, after being thoroughly mixed with a little lukewarm water, is added to it, and the temperature kept up by placing the vessel in a warm situation. After the lapse of a few hours active fermentation commences; and when that is complete, and the liquid clear, a large quantity of excellent yeast is found at the bottom, well adapted to all purposes to which that substance is applied.

4211. *Another Method.*—Take sixteen parts of ground malt, and add to it five parts of honey and one of powdered tartar; mix the whole with water warmed to 122°, and place it in the proper temperature for fermentation; yeast will be produced, which must be taken off in the usual manner.

4212. *Method of making Yeast by the late Dr. Henry.*—Boil flour and water to the consistence of treacle, and when the mixture is cold, saturate it with carbonic acid or fixed air. Then pour it into large bottles with narrow mouths, which should be loosely covered with paper, and a weight to keep it down. Place them in the temperature of 70° or 80° for twenty-four hours, stirring it two or three times. At the end of this time it will have fermented so much as to be of the consistence of yeast. Incorporate the dough to be made into bread with this artificial preparation, in the proportion of six pounds of the former to one quart of the latter, and a due quantity of warm water. The whole must now be kneaded together, covered with a cloth, and suffered to stand till it be sufficiently fermented, which, perhaps, may require twelve hours, when it should be formed into loaves and baked. Dr. Henry proposes this as a method that might be useful in making yeast for baking at sea. In order to produce the carbonic acid in this way of making yeast, some have used the common soda powders, and have proceeded in this manner. Some flour and water are boiled into thin paste, and a little of the soda powders (carbonate of soda and tartaric acid) mixed together stirred in; this will produce the carbonic acid gas, and the whole should be well stirred with a whisk, and kept in a warm place. It will soon ferment, and be a strong yeast. It is necessary that the two powders should be in such proportions as to neutralize each other, otherwise the dough will taste acid or alkaline. The salt will give the bread somewhat of an aperient quality, but it will be perfectly wholesome.

4213. *Dr. Lettsom's Method of making Yeast.*—Thicken two quarts of water with four ounces of fine flour; boil it for half an hour, then sweeten it with three ounces of brown sugar; when almost cold, pour it, with four spoonfuls of baker's yeast, into an earthen jug deep enough for the fermentation to go on without running over; place it for a day near the fire, then pour off the thin liquor from the top, shake the remainder, and close it up for use; first strain it through a sieve. To preserve it sweet, set it in a cool cellar, or hang it some depth in a well. Keep always some of this to make the next quantity of yeast that is wanted.

4214. *Yeast from Potatoes.*—Choose some potatoes of the mealy kind that are quite sound, and boil them; skin and mash them very smooth with boiling water; add water till they are of the consistence of common beer yeast, not thicker; then add two ounces of treacle to every pound of potatoes, and while the whole is yet warm, stir in for every pound of potatoes two table-spoonfuls of yeast. Set this before the fire, and it will soon begin to ferment, and in twenty-four hours, perhaps, the fermentation will be at the greatest height, when the yeast will be fit for use. Some add a little honey or other saccharine matter to the mashed potatoes.

4215. *Yeast cakes are made in America for the purpose of baking*, and are thus described by Cobbett in his "Cottage Economy:" "The people of Long Island make a parcel of these cakes once a year, and when they bake, they use them instead of leaven. To make them, they use three ounces of good hops, three pounds and a half of rye flour, seven pounds of Indian corn meal, and one gallon of water. Rub the hops so as to separate them. Put them into the water, which is to be boiling at the time. Let them boil half an hour; *then strain* the liquor through a fine sieve into an earthen vessel. While the liquor is hot put in the rye flour, stirring the liquor well, and quickly, as the rye flour goes into it. The day after, when it is working, put in the Indian meal, stirring it well as it goes in. Before the Indian meal be all in, the mass will be very stiff; and it will, in fact, be *dough*, very much of the consistence of the dough that bread is made of. Take this dough, knead it well, as you would for pie-crust, roll it out with a rolling-pin as you roll out pie-crust, to the thickness of about a third of an inch. When you have it, or a part of it at a time, rolled out, cut it up into cakes with a tumbler glass turned upside down, or with something else that will answer the same purpose. Take a clean board, a *tin* may be better, and put the cakes to dry in the sun. Turn them every day; let them receive no wet, and they will become as hard as ship biscuit; put them into a bag or box, and keep them in a place perfectly free from damp. When you bake, take two cakes of the thickness above mentioned, and about three inches in diameter; put them in hot water over night, having cracked them first. Let the vessel containing them stand near the fire-place all night; they will dissolve by the morning, and then you use them in setting your sponge, as it is called, precisely as you would use the yeast of beer. White pea meal or barley meal will do as well as Indian meal."

4216. *Methods of preserving Yeast.*—For this purpose, it may be pressed in a bag, so as to separate the chief part of the water, and then exposed to a gentle heat on a sieve; by this it will be dried into a hard, granular substance, or coarse powder, which retains all the original properties for a great length of time, if packed into a bottle, jar, or cask, and kept from the air and quite dry. By drying, it is reduced to one third of its weight. This method has been long practised in Holland and Flanders with perfect success, and it is extremely useful; for fluid yeast in warm weather soon becomes sour and putrid, and not only loses its properties, but imparts a most disagreeable flavour to the bread where it is used.

4217. *Another method* by Thenard is as follows: Dip some twigs in yeast, and dry them in the air. This is commonly practised.

4218. *Another Method.*—Work it round with a whisk until it becomes thin; then spread it with a brush over a piece of clean wood, and dry it in the air; when that coat is dry, lay on another, and repeat this till the quantity is an inch or two in thickness; when it is thoroughly dry, put it into close bottles or canisters; or it may be spread and dried on a clean wooden bowl, and a piece cut off as it may be wanted. It should be dissolved in warm water when it is to be used for baking or brewing.

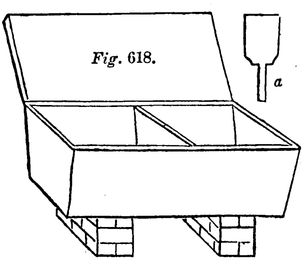
4219. *In Germany* they put the yeast into bags, which they surround with wood-ashes, which will absorb all the moisture from the yeast; then they form it into balls, which they keep in a dry place.

What is called *levure* in France is the yeast and lees of beer put into canvass bags to drain, and some water added to assist in carrying off the bitter flavour of the hops; it is sent from Flanders to Paris for the use of the bakers.

SECT. IX.—ON THE BAKE-HOUSE; CONSTRUCTION OF OVENS FOR BAKING BREAD; AND REMARKS ON THE PROCESS OF BAKING.

4220. In large establishments, where the offices are complete, the bake-house is a distinct apartment, fitted up in a convenient manner. It should have a good light, should contain the ovens, kneading-trough, chests for flour and other materials, a strong table, presses, or cupboards to hold various articles, and should be supplied with water by a pipe. *Fig.* 618 represents the usual form of the kneading trough; and the chests for the flour may be of the same form, and should be placed at one end of the trough, there being a table at the other; and *a* is a wooden scoop to scrape the dough from the sides of the trough.

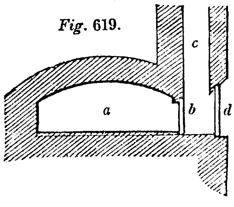
Fig. 618.



4221. *The ovens* employed by the bakers, and likewise in general use by families in the country, where sometimes a considerable quantity of bread is prepared, are built of bricks.

4222. *The common brick oven* is of a circular or oval plan, and is arched over with good sound bricks, the bottom being laid with flat tiles closely jointed. The woodcut, *fig.* 619, represents a vertical section: *a* is the cavity of the oven, arched over where the bread is put. The oven is heated by wood, introduced by the door *d*, laid upon the floor and kindled. When the bricks are sufficiently hot the fire is withdrawn, and the ashes carefully swept out, when the bread is introduced. While the wood is burning the smoke goes up through the flue *c;* but when the bread is put in, the inner door, *b*, is closed, and likewise the outer, *d*, to keep in the heat. The bread is baked merely by the heat of the brick-work, and when it has remained a sufficient time, the doors are opened, and the baked bread is taken out.

Fig. 619.



4223. *Coal is now very generally employed by bakers* in towns for heating the oven, instead of wood, and is found to answer perfectly, at less expense. *Fig.* 620 represents the plan and section of the usual construction of a *London baker's oven heated with coal:* *a* is a *plan* of the body of the oven, of which *s* is a section; *b* the door; *c* the fire-grate and furnace; *d* the flue to carry off the smoke after it has circulated round the oven.

When the bread is taking out there is a great deal of steam and hot air, and these are carried off by another short flue, *e*, over the door, that goes into the flue *d*; this steam flue has a damper to shut it when it is not wanted, represented in the section; and the smoke flue has also a damper, to be shut when the oven is sufficiently heated. A small pan is sometimes put over the fire-place for heating water. In using coal, some management is requisite to burn away the soot which at first adheres to the inside of the oven, and blackens it; but when the fire gets clear this soot is burned away, and the oven is quite clean.

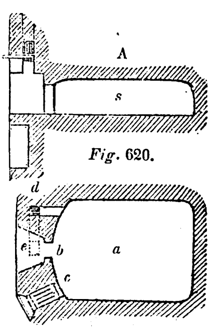
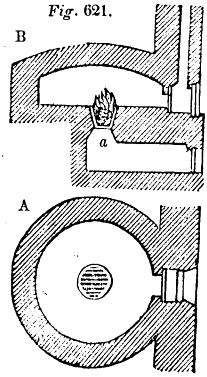


Fig. 620.

4224. *Fig.* 621 *exhibits the plan,* A, *and section,* B, *of another construction of oven to be heated with coal.* In this the fire is made on *a*, a small moveable grate, made in form of a garden pot, placed in a hole in the middle of the floor, supplied with air from beneath. When the oven is heated, this grate is to be lifted out with the fire, and the aperture covered with an iron cover. The situation of the flue is the same as in the last construction. This plan has the advantage of being easily cleaned out.

Fig. 621.


The kind of coal which answers best for heating the oven is that which is called *swift* in burning. Scotch coal is therefore excellent. When *Troone* coal can be procured, it is always to be preferred. The fire-place has double doors, which, of course, are of iron.

4225. *The common brick oven for baking, heated with wood, is the cheapest, simplest, and most durable,* and, consequently, the fittest for cottages or small houses in the country, particularly where there is plenty of wood or fagots to burn. When properly heated, it is superior to any other, and possesses what bakers term a "soaking heat," that is, a uniform, lasting heat, that penetrates the bread perfectly; but in numerous situations, particularly in towns, they are scarcely admissible, and likewise where wood is scarce or expensive.

4226. *Iron ovens are, therefore, frequently more convenient, and even more economical.* There are many persons who imagine that it is quite impossible to bake bread and pastry well in an oven of iron; but this opinion arises from want of experience. It must be observed that much more skill is required in fitting up and managing an iron oven than a brick one; but when the former are fitted up in a proper manner, and persons understand the method of using them, they answer the purpose very well, and have, at the same time, many advantages in baking on a small scale.

The brick oven is a long time in heating, and when used only once or twice a week it is difficult and tedious to bring it to that state which bakers consider to be the right degree; and without that the bread will be imperfectly baked; whereas, iron ovens are soon heated, although the heat is more liable to be unequal, and requires more care in the management of it.

Small iron ovens, very convenient for families, are usually now attached to kitchen ranges, and will be described under "Kitchen Furniture;" though these seldom answer for baking bread: others are made of a portable kind; but the best iron ovens are fixed up separate on purpose for baking bread and pastry. It is essential that the circulation of the smoke and heat should go all round the oven; and when the fire is below, they are apt to be hotter at the bottom than at the top. To defend the bottom from too great heat, it is frequently necessary to put a piece of tile, or fire-stone, or a tray with sand, on the bottom of the oven.

4227. *The simplest kind of oven* is a metal pot or kettle, inverted and covered with live coals. In new settlements, like those in Canada, the most simple contrivances are often the most desirable, as being the most easily put in practice in the infant state of society; and many a valuable hint may be borrowed from the make-shifts which necessity suggests When an oven is not attached to the house, and there is no convenience for constructing one within doors, the oven is sometimes made out of doors, and wholly detached from the dwelling. They are built of clay, somewhat in the form of a large bee-hive, and placed, like it, upon four posts stuck in the earth; and whenever these ovens are not prepared, the bread is baked upon the earth in large iron pots called *bake-kettles*. A flat iron plate, from fifteen inches to two feet in diameter, is first heated by burning fuel on it, or by any other means. It is then swept clean, and a little flour is sprinkled over it, to prevent the bread from adhering. An iron kettle is then placed over this, with its mouth downward, and a fire is kindled upon its bottom, the sides being also surrounded by fire. The heat of this fire striking downward through the kettle, bakes the bread, pastry, meat, or whatever may be required. This mode, like confined ovens, does not admit of any escape of steam; which, in some cases, is an advantage, in others, the contrary. The time necessary for baking can be determined only by experience; but two hours is that which bread usually requires in a common oven.

4228. *Observations on baking meat* and pastry will be given in the description of the processes of cookery.

4229. *To bake properly requires Attention to several Circumstances.*—The heat of the oven must be *just sufficient*, otherwise the bread will not be well baked. If the heat is not enough, the bread will be soft and wet, or pasty; and if the oven be over hot, it will form too hard a crust, which will lock up the water in the bread, or this will be burned. To ascertain when it is heated just enough demands considerable practice. There are, however, several signs which may be observed to assist the operator. Some try the heat by putting in a green vegetable; if this is scorched, the oven is too hot; but the best method is to sprinkle some flour upon the floor of the oven; if this takes fire, or is burned black quickly, the oven is heated too much, and must be suffered to cool; when the heat is proper, the flour should only turn black without taking fire. Every kind of flour is not proper for this test; old flour will burn with a heat that will scarcely blacken new flour, and will therefore lead to an error. The newest flour is the most proper for trying the heat of the oven. Experienced bakers form an opinion of the proper heat of the oven from the appearance of the brick-work in the arched roof; when that is sufficiently hot, it has burned away the soot which lodged upon it when the fire was first kindled, and has become quite clean. Also, if the point of a stick be placed on the heated bricks, it will take fire, and by rubbing the charcoal will make a black mark; but this mark will disappear instantly by being burned off if the bricks are sufficiently hot.

4230. *Experiments have been made to ascertain what is the actual degree of heat in a baker's oven* when fit for baking bread; and it has been stated to be about 270°, which is 58° above the heat of boiling water. The baker's oven has afforded some remarkable facts demonstrative of what the human constitution is capable of enduring, and likewise of one of the properties of air. The German ovens are too deep from the front to the farther end to allow of arranging the loaves conveniently; and it is a common practice in Germany for girls to go into the ovens and stay for a few minutes to arrange the bread. The reason why this great heat is not felt so much as might be supposed, is because the feet are cased in flannel, and also because air does not part with its heat so readily as solid bodies.

4231. *The shapes given to bread are extremely various;* and this is a matter of some importance, as the quality sometimes depends, in a great measure, upon it. The common shape of the loaves made by the baker in England is nearly cubical, but rather a short prism with six unequal sides, a form which is produced by the mode of baking. The dough is first made into the form of two thick cakes, and these are pressed together by the baker's elbow, which is the cause of the deep indent seen on the top of the loaf. The loaf is thus nearly of a globular form; and as they are placed in mutual contact in the oven, by their swelling they press against each other, and produce flattened sides; in consequence, sometimes, they do not separate very readily where they ought, and one of the alleged uses of the alum is to facilitate this separation. One of the reasons for packing the English bread so close together in the oven is that they may take up little room; and another, that they may lose as little in weight as possible, in consequence of which the quantity of crust is small; and this kind of bread is often not sufficiently baked. In the English common loaves, the sides where they are in contact with each other have no crust; and the upper crust differs from the lower from this circumstance: the heat which radiates from the brick-work which forms the top of the oven, and which is conveyed by the hot air from the furnace, is greater than that which is given out by the tiles on which the loaves rest. Several other shapes, however, have been lately introduced by our bakers; and these are baked without being in contact in the oven, by which the crust is increased.

4232. *The imperfect baking which we often see in bakers' bread* is, no doubt, owing to the present law which fixes the weight of the loaf. The loss of weight is variable, according to the quality of the flour. In receiving bread from bakers in a hot state, there is sometimes a loss of five per cent. from evaporation; for this reason parish bakers always send in their bread hot to the work-house when they can. The average loss of weight in baking is about one eighth of the whole. Formerly we had peck loaves weighing 17 lbs. 6 oz.; half pecks, 8 lbs. 11 oz.; quarterns, 4 lbs. 5 oz.; and half quarterns, 2 lbs. 2½ oz. At present the loaf nearest to the old quartern is the 4 lb. loaf; if this proves 1 oz. lighter, the baker is liable to a penalty; hence the baker is tempted to underbake.

4233. *An oven for baking bread, heated by high-pressure steam,* has been made; but this was upon a large scale for a public company, and as it is not applicable to domestic purposes, it is unnecessary for us to describe it.

4234. *Baking by hot water* has also been attempted. To effect this, the hermetically-sealed tubes, filled with water heated to 300° and upward, have been used on the plan of Mr. Perkins; but this mode must likewise be evidently of very limited application.

SECT. X.—BREAD MADE OF THE MIXTURES OF VARIOUS GRAINS.

4235. Though wheat is the most valuable of the varieties of corn, yet it cannot be cultivated in very high latitudes, and demands a rich soil with plenty of manure; whereas some other kinds of grain, as barley, oats, and rye, will grow on comparatively poorer soils, and may be raised at a cheaper rate; these grains will, therefore, necessarily continue to supply the bread of northern nations. But even in many parts of Britain wheat cannot be successfully cultivated; and the crops are liable to fail through bad seasons or other unfavourable circumstances. The employment of other grains also for bread is, therefore, desirable; and many endeavours have been made to combine together the produce of several farinaceous substances, so as to obtain results that cannot be had from any one of them singly. It is important to record some experiments of this kind, as well as the practices of different times; and we shall describe several varieties of bread which have been found useful.

4236. *Bread of Potatoes with Wheat Flour.*—In describing bread made by professed bakers (Sect. IV.), we stated their practice of mixing some potatoes with their flour; but what we are now about to mention is bread made of potatoes with only flour sufficient to produce the necessary fermentation. In describing the composition of potatoes, we showed that their farina consisted almost entirely of starch without any gluten, and since the latter is the chief ferment, the farina of potatoes alone cannot be made into fermented bread. But if a certain portion of wheat flour be added, this mixture, worked into dough, will rise in the usual manner, the fermentation of the flour being communicated to the whole mass. To effect this, however, equal quantities of wheat flour and potatoes are necessary; and it is to be observed, that though the economy may be considerable, and the bread nutritious, yet it is much inferior to that of wheat alone, as it is apt to crack and crumble, and grow clammy when it is stale.

4237. *A sort of cakes may be made of potato flour, without mixing with any other,* as follows: "Its adhesive quality does not admit of baking or kneading unmixed with meal or wheaten flour; but it may be managed in this manner. A small wooden frame, nearly square, is laid on a flat pan like a frying-pan; this frame is grooved, and so constructed that, by means of a presser or lid introduced into the groove, the cake is at once fashioned according to the dimensions of the mould. The frame containing the farina may be almost immediately withdrawn after the mould is formed upon the pan, because, from the consistency imparted to the incipient cake by the heat, it will speedily admit of being safely handled. It must not, however, be fired too hastily, otherwise it is apt to become unpleasantly hard, and unfit for mastication. This precautionary measure being observed, it will be found that, when thoroughly ready, the bread of potato flour, even unaided by any foreign ingredient, will eat very palatably. It might then, from time to time, be soaked for puddings, like the tapioca; or it might be used like the capada cake, which, in appearance, it so much resembles; that is, when well buttered and toasted, it will make an excellent breakfast appendage."—*Quarterly Journal of Agriculture*, vol. ii., p. 69. It is to be observed here that this potato bread is not fermented.

4238. *Potatoes may be prepared to serve the purpose of bread* by simply boiling and cutting them into thin slices, which are dried thoroughly by a gentle and equal heat, for which purpose steam heat answers best. They may be close packed, and carried to any distance, or preserved for any length of time.

M. Parmentier observes that potatoes contain too much mucilage in proportion to their starch, which prevents them from being converted into good bread; but that if starch be collected from ten pounds of raw potatoes by grating them in cold water, and agitating them, and the starch thus produced be mixed with other ten pounds of boiled potatoes, and properly subjected to fermentation, like wheat flour, it will make good bread.

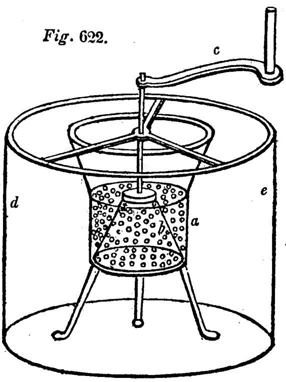
4239. *It has been justly stated, respecting making bread from potatoes*, that though that may be effected by various processes, and more especially by the mixture of different sorts of flour, yet they answer the purpose of food equally well, plain boiled or roasted, without all the trouble of such conversion.

4240. *Potato Flour.*—Sir G. Mackenzie, in the "Transactions of the Highland Society," observes that potato flour, boiled with milk and a little sugar, forms one of the most palatable, wholesome, and cheap dishes of which a labouring man can partake, and cannot be too strongly recommended to cottagers, who ought always to convert a portion of their potato crop into flour, to be used when fresh potatoes cannot be got. In fact, it is potato starch that very nearly resembles arrow-root, though inferior, and, at all events, would be a very desirable thing to have in a cottager's family as a light nourishing food in case of sickness.

4241. *The manufacture of potato flour* is carried on to a considerable extent in the neighbourhood of Paris, and the flour is sold at a price considerably higher than that of wheat, for the use of confectioners, and for bakers who prepare the finer sorts of bread, as it is remarkably white. The potatoes are washed and grated, and the flour, or starch, separated in the usual way of making potato starch; it is dried on shelves in a room heated by a flue, and afterward broken on a floor by passing a cast-iron roller over it; it is then passed through a bolting machine, and put up in sacks for sale. It is stated that 40,000 tons of potatoes are annually manufactured into flour within a circle of eight leagues around that city.—*Gardener's Magazine*, vol. vi.

4242. *A mill for grinding potatoes was invented by M. Beaume.* This mill, *fig.* 622, consists of two graters, made of sheet-iron, punched with holes; an outer one, *a*, cylindrical, and an inner one, *b*, conical; the bars made by punching point towards each other, and grind the potatoes which are put into the hopper above, and fall between the two graters, the inner grater being made to revolve by the handle, *c*. When the potatoes are ground, they fall through at the bottom into water contained in the large vessel, *d e*, in which the graters stand upon three feet. By this contrivance, which is so simple that it might be made by any country smith and carpenter, potatoes may be ground very expeditiously for starch, flour, or any other purpose.

Fig. 622.



4243. *A new species of bread has been made in Paris*, composed of potatoes or potato flour, and a small quantity of the gelatin procured from bones. This is said to be as nutritive as wheaten bread, and much less expensive. Biscuits have also been made upon the same plan. There can be no doubt that it will be nutritive and wholesome; but we would not hazard any opinion upon its comparative merits until it has been more tried. It might certainly, among others, be occasionally a useful resource.

4244. *Potatoes have been made to keep* by converting them into a kind of vermicelli. The potatoes are boiled or steamed, and their pulp forced through a colander fitted with a piston and cylinder; the pulp when it comes out is dried, and may be ground, or used as vermicelli.

4245. *Bread made of barley-meal* is considerably improved by the addition of wheat flour. It is always best to set the sponge with wheat flour altogether, as barley-meal does not ferment readily with yeast, and to add the meal when the dough is about to be made. This bread requires longer time to bake, and a greater heat than wheat bread. It is much used in Yorkshire, and also in Devon, and by the miners in Cornwall.

The following receipt is from the reports of the Board of Agriculture: "Mix two bushels of wheat flour, extracting only a very small quantity of the coarser sort of bran. Add one bushel and three quarters of barley meal. Make this into dough, with salt, yeast, and warm water, and bake for three hours and a half."

4246. *Bread made of Rye and Wheat.*—Equal quanties of wheat and rye flour, made and baked in the usual way, make very good and cheap bread.

4247. *Bread of Wheat and Turnips.*—Mix equal quantities of wheat flour, and turnips boiled, mashed, and having the water well squeezed out. Make the dough in the usual way, and bake it a considerable time. This kind of bread was made in England in a time of scarcity, in 1629, and again in 1693. It has a peculiar taste, by no means disagreeable; it is as light and white as wheaten bread, and should be kept twelve hours before it is cut, when the smell and taste of the turnip will scarcely be perceptible.—*Phil. Trans.* Carrots and parsnips may be treated in a similar manner with turnips. Also, mixtures may be made of wheat with oats, buckwheat, or any other farinaceous substance; all these may be fermented, as wheat flour contains the principles necessary for fermentation.

4248. *Rice Bread.*—In this country rice is rarely made into bread by itself, though it may be by the following process: Let a sufficient quantity of rice flour be put into the kneading trough; at the same time, boil a due proportion of water in a caldron, and throw in a small quantity of ground rice, which must be boiled until the decoction forms a thick viscous substance, which is poured upon the flour, and the mass is kneaded with a mixture of salt and yeast. The dough is then covered with a warm cloth, and left to rise. As the fermentation proceeds, the dough, which at first was firm, becomes almost fluid, and seems totally incapable of being moulded by the hand: to prevent the inconvenience and loss which would ensue from its spreading, a tin box is prepared, with a handle long enough to reach the end of the oven; a little water is poured into it, and it is then filled with dough, over which are laid some cabbage leaves, and a covering of paper. The box is deposited for a short time in the heated oven, and then suddenly reversed, so that the dough retains its place in the mould, and is converted into a loaf of the same form. The bread is of a fine yellow colour, as if it had eggs in it, and is very agreeable to the taste; but it must be eaten while fresh, as it loses much of its flavour on becoming stale. This bread is also useful to put into soups.

4249. *Rice, when made into bread, is more frequently mixed with some other grain.* The following are modes in which it has been so employed with advantage:

1. The Americans make bread with it in this manner. The rice is thoroughly cleansed by pouring water upon it and stirring it, the water being changed occasionally until all impurities are washed away. The water is then drawn off, and the rice, while yet damp, is bruised in a mortar; it is then dried and passed through a hair sieve. The flour thus obtained is generally kneaded with a small quantity of Indian-corn meal, and is boiled until it has acquired a thickish consistence; sometimes boiled potatoes are added. The mass is fermented either with leaven or yeast, and the dough is then baked in pans. The bread thus prepared is reputed to be light, wholesome, and agreeable to the palate.

2. Let a quarter of a pound of rice be boiled until it be quite soft; leave it to drain on the back part of a sieve, and, when cool, mix with it three quarters of a pound of wheat flour, a spoonful of yeast, and two ounces of salt. Let it stand for three hours to ferment, then knead it very thoroughly, and roll it in as much wheaten flour as will give to the exterior sufficient consistency to allow of its being conveniently deposited in the oven. After baking an hour and a quarter it will form a loaf of good white bread, weighing one pound fourteen ounces.

3. To one peck of wheat flour add half a peck of rice flour; let them be mixed and kneaded with salt, yeast, and warm water, in the usual manner. Divide the mass, when fermented and duly risen, into eight loaves, and bake them.

4. Boil a peck of rice until it becomes soft; let it stand all night in a pan, and it will be found greatly distended. Let a peck of potatoes be boiled, skinned, and mashed to a pulp. Knead them while hot with the rice and a peck of wheat flour; then add a sufficient quantity of yeast and salt, and leave the dough to ferment; the mass may be divided into loaves, and baked in the usual manner.

4250. *Bread made of Rice, Potatoes, and Wheat Flour.*—Boil some rice till it is soft, and let it remain some time afterward to swell. Boil an equal quantity of potatoes, peel and mash them, and, while hot, knead them up into dough with the rice, and the same quantity of wheat flour as of rice; add yeast and salt; let the dough rise, and bake in the usual way.

4251. *Although we have already described rice* as one of the materials of which bread is occasionally made, yet, as this is not the mode in which that substance is usually employed as food, its great importance demands a few farther remarks, which are chiefly extracted from the "Household Almanac and Year Book" for 1837. Rice constitutes the principal aliment of millions in India, who are supported by it in health and vigour; and many probably live and die without ever having tasted more substantial food. It is, perhaps, one of the cheapest aliments which can be obtained in this country; and though some persons imagine that it is not sufficiently nutritive, that opinion, upon trial, is found to be erroneous. Some objection is raised to its use on account of its insipidity, but this is easily corrected by the addition of a little spice, milk, suet, or sugar. With milk and sugar it makes excellent puddings. It can be employed as thickening in soups, or may be stewed with meat, bacon, or any other seasoning. In experiments made at the Foundling Hospital, in 1795, it was shown that rice can go much farther than flour for the same price, when made into puddings. Several circumstances, however, require to be attended to in cooking it. It is essential that it should be done till it is quite soft, yet, if brought to table by itself, that not a drop of water be seen with it.

4252. *Bread made of Oatmeal and Wheat.*—The following has been recommended as a good and economical bread: Add a peck of oatmeal to the same quantity of seconds flour, and half a peck of potatoes skinned and washed; knead it up into a dough with yeast, salt, and warm milk; make it up into loaves, and bake as usual. Oatmeal and rice may also be made together into bread.

4253. *Maize, or Indian-corn Bread.*—In North America maize is the principal corn, and bread made from it is extensively eaten in the United States, as well as in many parts of Europe. Meal from maize is made into unfermented cakes in the same manner as those from barley; but the late Mr. William Cobbett, who had considerable experience of its qualities, directs that a mixture should be made of one third maize and two thirds wheat or rye. "Set your sponge," he says, "with the wheat flour only. As soon as you have done that, put the water (warm water in cold weather, and cold in hot weather) to the corn flour, and mix the flour up with the water, and there let it be for the present. When the wheat sponge has risen and has fallen again, take the wetted-up corn flour and work it with the wheat sponge, and with the dry wheat flour that has been round the sponge. Let the whole remain fermenting together for about half an hour, and then make up the loaves and put them in the oven."

4254. *Buckwheat is capable of affording human food very wholesome and nutritious.* In many parts of the Continent it is so employed, as in France and Tuscany, mixed with barley and made into bread; in Germany it is used in puddings. This grain is covered with a hard, black, triangular husk, of which it is deprived by an operation previous to grinding. This is effected by high-drying the grain, either by the sun's rays or by the heat of a kiln, and afterward by running it slightly through the millstones. The husks are then blown away by a winnowing machine, and the grain is ground in the same manner as wheat. To convert it into bread, a gallon of water is boiled, and, by degrees, a peck of buckwheat flour is added, constantly stirring it to prevent lumps from forming, till the whole is formed into the consistence of a thick batter. Some salt is added, and the mass is boiled for an hour and a half. A quantity of this, sufficient for a cake, is then poured into an iron kettle hanging over the fire, in which it is baked, taking care to turn it frequently to prevent burning. An excellent mixed bread is made in England by the addition of a peck of wheat flour to the abovementioned quantity of buckwheat. After the latter has been made into batter and cooled down to blood heat, it may be poured into the trough containing the wheat flour and yeast; being there well kneaded, it should stand two hours to prove, divided into loaves, and baked rather longer in the oven than for wheat bread alone

The Tartars prepare an excellent food from buckwheat in a mode that might be applied upon occasion to other species of grain, where a mill and the other necessary apparatus cannot be had. They first steep the seed well in cold water, and then put it into sacks to drain for ten or twelve hours; after it has been thus swelled, it is well dried over a slow fire in iron pans, when the husks crack and split. The kernel, or flour, is then easily separated from the husks by beating it in a wooden mortar, and sifting separates the fine flour.

SECT. XI.—FARINACEOUS SUBSTANCES WHICH ARE USED IN VARIOUS PARTS OF THE WORLD INSTEAD OF BREAD, TOGETHER WITH OTHERS WHICH MIGHT BE OCCASIONALLY EMPLOYED IN TIMES OF SCARCITY.

4255. It may be useful to know all the plants, either in this country or abroad, which are capable of supplying us with farinaceous matter fit for food, with the view of introducing such of them as we have not noticed, thus increasing our resources against times of scarcity, which, although they rarely occur, are not altogether beyond our experience. It is likewise desirable to be acquainted with the various substitutes for bread which are employed in our colonies and in other parts of the world.

4256. *In many parts of the tropical regions*, the climate or the soil does not admit of the cultivation of corn of any kind; and in those places nature has supplied the inhabitants with other plants which afford a food nearly analogous to bread. Of these, the tribe of palms are some of the most useful of the tropical trees, affording not only an agreeable shade, but also an abundance of nutriment. The stem, or wood, consists of bundles of fibres, interspersed through a pithy substance that, in some species, is highly farinaceous, and which, when extracted by a simple process, constitutes our sago, arrow-root, and similar articles of food.

4257. *In the enumeration of some of the principal vegetables from which nature supplies man with abundance of food* almost ready prepared, in regions deprived of the cerealia, whether from the heat of the climate, or the aridity or rocky nature of the soil, we may perceive the bounty of Providence to the human race before it had extended, probably, to those parts of the earth where the cultivation of our faculties is more demanded. It would indeed be curious, but departing too far from our subject, to consider the numerous natural productions which, in the sultry regions, render effort less necessary, and thus, in fact, deprive man of the motives for progression. Safe under the shade of the banyan-tree, architecture could never have commenced, or if it had, the bamboo and the palm would have rendered the construction of a habitation a matter of little difficulty. Independently of delicious fruits, as the plantain and banana, numerous bread-trees present themselves; in Africa there is an excellent butter-tree, and Humboldt describes the cow-tree of Cumana, which, though growing upon a rock, affords, when its stem is pierced, a flow of delicious vegetable milk, which the natives collect and carry home to their children. Then, for furniture, they have barks to serve as baskets, leaves that fold up for umbrellas, and others that require little to transform them into hats, with numerous fibres ready made for thread and ropes. Little that is essential seems to be wanting for the support of man; yet is all this surpassed among more northern nations where nature has been less bountiful, through industry and art, the result of intellectual improvement.

4258. *Macaroni* is a favourite food in Italy, particularly among the Neapolitans, by whom it may be considered as their staff of life. It is prepared in the following manner, by a very simple process: The best wheat is made into a paste by the smallest quantity of water, and as this is too hard and consistent to be kneaded with the hand, the following contrivance is resorted to: A wooden pole, about fourteen feet long, is fastened at one end by a chain to a strong post fixed in the ground, so as to be moveable up and down like a lever, the paste being placed under one end. Two men take hold of the other end of this pole, and by elevating and depressing it alternately, and moving a little from side to side, they work the paste very thoroughly, the power of the lever being very great when acting in this manner. When the paste is sufficiently worked, it is put into a hollow cylindrical vessel, having its bottom of cast iron, and pierced with holes about the size of a goosequill, or of any size and form required. A piece of wood that exactly fits the inside of the cylinder is forced down upon the paste by means of a screw turned by two men, and in this manner it is forced through the holes in the form of the hollow tubes in which we see it. The macaroni is partially baked as it issues from these holes by a fire that is placed below the cylinder; and as it descends it is drawn away and hung on rods placed across the room, where in a few days it dries fit for use. The manufacture of macaroni appears to be sufficiently simple, and having been usually brought from Genoa and Naples in three different sizes, and also in thin plates, it was formerly sold at so high a price as to be seen only at the tables of the rich; but there appears no reason why it should not be made in this country; and, indeed, we are informed that a manufactory of it, as well as of vermicelli, has existed in White's Row, Spitalfields, ever since 1730. It is generally brought to table dressed with Parmesan cheese; it is likewise used in thickening soups, and in puddings. Since it is very wholesome and nutritive, it appears desirable that it should be brought more into general use.

4259. *Vermicelli* is a preparation very similar, and of Italian origin; it is made in the same way as the last, only to the paste are added cheese, yolk of eggs, sugar, and saffron. The name means little worms, from its form.

4260. *Semolina* is the heart of a kind of Italian wheat, called *grano duro*, remaining in granules, like coarse sand, that resist the action of the millstones, which are soft, blunt, and not set very close. It is imported for making the best vermicelli, and is also used in soups, and may be purchased at some of the Italian shops. It is called also *soojee*; and a still smaller kind, called semoletta, is sifted out of the other.

4261. *The polenta* of the Italians is made from maize, by roasting it when half ripe.

4262. *Fictitious sago*, salep, macaroni, vermicelli, semolina, and tapioca are manufactured from potato starch.

4263. *Rice boiled to a kind of paste*, and drawn out into threads, forms a transparent substance used to thicken soups, and is known by the name of *China lock soy*. There is a kind that is opaque, and which is less esteemed.

4264. *Sago* is the produce of the sago palm (*Sagus farinifera*, Linn.), which grows spontaneously in the East Indies, as well as in the islands of the Indian Ocean; in the latter, it supplies the principal farinaceous food of the inhabitants.

The part which affords the sago is the pith, and, to procure this, the body of the tree, when it is full grown, is sawn into pieces, and the raw sago cut out and put into a trough with water, in which it is well stirred to separate the flour from the filaments. This is now suffered to rest, and the flour, or meal, subsides to the bottom. The water is then poured off, and the wet flour laid upon wicker frames to dry. To form it into the round grains in which we have it, the sago, when moist, is passed through a colander, and rubbed into little balls like small shot, and then thoroughly dried. A single trunk of the tree will furnish 600 pounds of sago; and Mr. Crawfurd has calculated that in one acre of ground, 430 sago-trees can be planted, producing 120,500 pounds of sago. The trees require seven years to be fit to cut down. Our sago has sometimes been stated erroneously to be the produce of the *Cycas circinalis*, or *revoluta*, but that yielded by the cycas is inferior to the other kind. The best sago is of a slightly reddish hue, and readily dissolves in hot water to a jelly, but differs from wheat starch in being likewise soluble in cold water. A superior sort is imported from China which has a pearly lustre. Several other trees yield sago besides the above, but in less quantity.

4265. *Cassava.*—South America is the native region of a plant of this name (belonging to the tribe of Euphorbiaceæ), and the roots of which formerly afforded the chief sustenance to the Indians of that continent; it is still extensively used there, as well as in the West Indies.

There are two varieties of cassava: the *Jatropha Manihot*, or bitter cassava, and the *Jatropha Janipha*, the sweet cassava. They nearly resemble each other, and both are used as food. The first, in its natual state, is so highly poisonous, that the Indians employed its juice for poisoning their arrows; the second is not at all hurtful. The roots of the bitter cassava are nearly of the shape and size of parsnips; and to prepare them they are grated, and the pulp is subjected to pressure, to deprive it of its poisonous juice, which is of a milky colour: by allowing this to rest, a white starch subsides, which is separated from the clear juice, and reserved for use as food. What remains after pressure consists of the same kind of starch, mixed with the woody or fibrous part of the roots; when this is dried by exposure to the heat of a fire, it is pounded and sifted, to separate the fibrous matter from the starch. The latter is made into dough, which is formed into cakes that are afterward baked. It is supposed that what may remain of the poisonous juice in the starch is volatilized by the heat employed. The original inhabitants of America had employed this process for the preparation of cassava; and it is singular that they should have found out the means of separating an excellent food from a substance known to be a malignant poison. The *sweet cassava plant*, of which bread is also made, is free from any noxious property; its stalks are green, whereas those of the bitter cassava are rather of a purplish hue.

4266. Cassava bread, though not relished by those accustomed to wheaten bread, yet is in such repute with some Creole families who have settled in Europe, that they have sometimes been at considerable trouble and expense to procure it.

4267. *Tapioca* is made from the finest part of the farinaceous pith of *Jatropha Manihot*, or cassava-tree, by washing the root and preparing a fecula or starch from it, which, when dried, is sprinkled with a little water, and steamed, so as to form irregular masses, when dried in the sun, or on plates of hot iron; these are afterward broken into the small grains, in which form we have it. A considerable quantity is imported from Brazil, and it is also made in the East Indies. It is extremely nutritious, and forms an excellent food for children, and persons whose powers of digestion are weak.

"No amylaceous substance," Dr. Christison observes, "is so much relished by infants about the time of weaning; and in them it is less apt to become sour during digestion than any other farinaceous food, even arrow-root not excepted."

4268. *Arrow-root* is a well-known, very nutritious fecula, obtained from the roots of the *Maranta arundinacea*, or starch plant, a perennial cultivated in the East and West Indies. Its name is derived from another plant with which it was once confounded, now called Apinia galanga, the root of which the Indians used as an antidote to the poison of arrows. The roots are dug up when they are about a year old; and, after being well washed, they are beaten to a pulp, which is again washed in water to separate all the fibrous part; after being passed through a sieve, the starch is suffered to settle, when the water is drawn off. The white sediment of starch is again washed with water; and, when it is dried by the heat of the sun, it forms the pure arrow-root. The best arrow-root we have is from Antigua, Jamaica, and Bermuda; but a great deal of what is sold in London is adulterated with potato starch, which, though a substance not very different, has not precisely the same properties. Arrow-root, like every kind of starch, boils to a jelly, but it differs from potato starch in this respect: the jelly formed with arrow-root will remain firm for three or four days without turning thin and sour, whereas the jelly from potato flour, in the course of twelve hours, becomes as thin as milk, and acescent; hence it is not so well calculated for food, and particularly for children. It is, therefore, very important to have this useful article genuine when a strengthening food is required: potato flour, though inferior, may, on occasion, form a cheap substitute.

4269. *Salep* is considered to be a very nutritious substance. It consists almost entirely of a peculiar vegetable principle called *bassorin*, with a small quantity of starch and gum. The name of bassorin is derived from gum bassora, in which Vauquelin first discovered this priniciple, which is likewise found in gum tragacanth. Salep is imported from the East Indies, Turkey, Syria, and Persia, where it forms a considerable part of the food of the inhabitants, boiled, or in soup. It is said that an ounce a day is sufficient to sustain a man; hence, from its portability, it is very useful to travellers over desert regions. It is prepared from the roots of different species of orchis, especially the *orchis mascula*, a tropical plant, though some is manufactured in Europe. The bulbous roots of these plants are deprived of their cuticle, and baked in an oven for ten or twelve minutes, which gives them a semi-transparency: they are then dried in a moderate heat.

Salep is brought to this country in oval pieces, of a yellowish-white colour, somewhat clear and pellucid, very hard, and almost horny; of little or no smell, in taste like gum tragacanth. It is not easily pulverized. The powder, dissolved in water, forms a jelly.

4270. *The orchis*, or *salep plant*, grows plentifully wild in moist meadows in some parts of Britain and Ireland, particularly in Gloucestershire, and is also cultivated, but not to any extent. It has been proposed to make salep from it; and it is proper that it should be pointed out, as a resource to the poor in times of distress. The preparation of salep has been described in "Philosophical Transactions," vol. lix. The bulb, or tuberous root, is to be washed in water, and the fine brown skin which covers it is to be separated by means of a small brush, or by dipping the root in hot water, and rubbing it with a coarse linen cloth. The bulbs are then to be dried upon a tin plate, by placing it in an oven for six or ten minutes, in which time they will have lost their milky whiteness, and they will then become transparent like horn. They are afterward dried in the air, which will take several days; or a gentle heat may be used, which will effect the same in a few hours. Reduced into powder, they soften and dissolve, in boiling water, into a kind of mucilage, which may be diluted for use with a large quantity of water or milk, and comes very near to what is made from the salep brought from Turkey.

Dr. Percival, in his "Medical and Experimental Essays," mentions that a mixture of mucilage of salep with flour makes an excellent bread.

4271. *Portland sago* is so called from the Isle of Portland, where the substance is manufactured from the roots of the common wake robin, *arum maculatum*, which grows there in great abundance. These roots are full of farina; but, in their natural state, they are so acrid that, if the juice be applied to the skin, it will raise blisters; it appears to be very analogous to the poison of the cassava root; and, like that, is so volatile that, when heat is applied by roasting or boiling, it is dissipated, and the roots rendered perfectly harmless. When, after this, they are dried and pounded, they afford a starchy matter very much resembling the Indian arrow-root; in consequence of which, it is sometimes called *English arrow-root*.

4272. *Tous les mois* is the French name for a new aliment, prepared from the pith in the roots of the canica coccinea, a plant which flowers every month, whence it has received its appellation. It is stated by Dr. Waterton, of St. Kitt's, to differ in some respects from arrow-root, though extremely analogous to it, and applied to the same uses. It is said not to be apt to sour upon the stomach, and to be well calculated for invalids and children. It is imported into London, and sold in canisters at 2*s*. and 4*s*. each.

4273. *Tacca.*—This is the root of a plant of that name, which, when mashed and prepared, affords food to the natives of the South Sea Islands and the Malays. The roots are something like yams, but in their natural state are bitter and acrid; they are rasped very fine, and steeped in several waters. The farinaceous matter thus prepared is both palatable and nutritious, and is made into cakes and loaves, which some prefer to sago bread. The leaf-stalks boiled are used as food in China.

4274. *Bread Nut* (*Brosimum Alicastrum*).—These nuts abound with farinaceous matter, together with much gummy substance; they form a very nutritious food, and are eaten by the negroes boiled, or roasted with meat instead of bread.

4275. *The celebrated Lotus*, the *Zizyphus Lotus*, is eaten in Barbary and other parts of Africa, and the following account of it occurs in "Burnett's Outlines of Botany." "Dr. Shaw says this fruit is common in the deserts and other parts of Barbary, and is still in great repute, and sold in the markets all over the southern districts, and cattle as well as men are fed upon it. Park states that he found the lotus abundant in all the countries of Africa he traversed, but in the greatest plenty in the kingdoms of Kaarta, Ludamar, and the northern parts of Bambara. The natives, he says, convert the fruit into a sort of bread by exposing it some days to the sun, and afterward pounding it gently in a mortar until the farinaceous part is separated from the stone; this meal is then mixed with a little water and made into cakes, which, when dried in the sun, resemble in colour and flavour the sweetest gingerbread. The stones are afterward put into a vessel of water, and shaken about, so as to separate all the farina that adheres to them. An agreeable taste is thus given to the liquid, which, by the addition of a little pounded millet, is made into a kind of gruel called *fondi*, and this, for several months in the year, forms the common breakfast of the majority of the people in many parts of Ludamar. The fruit, when dried, is laid by for winter use; a sort of wine is also made from it by expression and mixing the juice with water; it is a pleasant drink, but will not keep many days. The people who lived upon the lotus were denominated Lothophagi in the time of Homer."

4276. *Arracacha.*—A farinaceous root about the size of a cow's horn, which grows abundantly on the plains of Bagota, and which has lately been brought to England. A few which are planted near Plymouth are said to thrive well, and may prove in time a valuable addition to our farinaceous vegetables.

4277. *Acorn Bread.*—Take ripe acorns, deprive them of their skins, and beat them into a paste; steep them in water for a night, and then press them dry, which will take out their astringent quality; then dry the mass, and reduce it to powder, to be kept as flour or meal when wanted. Form this into dough, knead it, and make it into thin cakes, which may be baked on an iron plate or the embers. This has been used, but we cannot recommend it.

4278. *The whole of the bran may be used in bread made of wheat.* In the Reports for bettering the Condition of the Poor, we find an account by Sir Thomas Bernard of the use of bran in bread, which was recommended in a time of scarcity: "Take seven pounds of bran and pollard, and fourteen quarts of water; boil the whole very gently over a slow fire; stir it frequently to prevent burning. After two hours boiling it will acquire the consistence of a custard pudding; then put it into a cloth, and twist it till the liquor is squeezed out. Mix a quart of this with three pints of yeast, and set the sponge for twenty-eight pounds of flour. The bran and pollard, which, when the liquor has been squeezed out, is above four times its original weight before it was boiled, is then to be set near the fire, in order that it may be kept warm. In about two hours the sponge will have sufficiently risen, upon which the bran and pollard (then lukewarm, but not hot, and into which is to be sprinkled about half a pound of salt) should be mixed with flour, and the whole kneaded up very well together with a quart of the bran liquor, and it should then be baked for two hours and a quarter in a common oven. The produce, weighed when cold, will be half as much again as the same quantity of flour would produce in the common way without the addition of bran. Most of the objections to the use of bran appear to be founded on a presumption that no mode of preparation will make any difference in the degree of nutriment to be derived from it as a food. Though the subject is yet but little understood, we have gone far enough to ascertain the fact that, in most kinds of grain, some increase of the ordinary nutritive power may be produced by culinary process; the very making of bread affords an example of this increase. In rice it is very great; and in barley meal, particularly when used in soup, its increased power of nutriment may be extended to a surprising degree, as it is now well known that rice, when increased by water to a solid substance of five times its original weight, or, by the addition of milk, to eight times what it originally weighed, is converted from a hard, indigestible grain into a wholesome, nourishing food.

4279. *The fibrous part of potatoes, left after the starch has been separated*, is stated by Sir John Sinclair to be not only a valuable article of food for horses and cattle, but that it may be advantageously employed in bread upon occasion. Mr. Jefcoat, of Gateshead, near Newcastle-upon-Tyne, has proved that 21 lbs. of wheaten flour, kneaded with 12 lbs. of the fibre of potatoes, will produce, when well baked, 38 lbs. 8 oz. of excellent bread, which, allowing that a stone of flour produces at the rate of 18 lbs. of bread, is an increase of 11½ lbs. of bread from 12 lbs. of fibre. His mode of preparing the fibre is as follows: After washing it in two waters, he places it for about an hour upon a sieve to drain; then he adds, without its being boiled, the usual quantity of yeast; and after it has stood for about an hour, he works in the 21 lbs. of wheaten flour. It requires very little addition of water, but rather time to rise, preparatory to its being placed in the oven. The bread thus prepared continues equally good for several days. This potato fibre may also be used with barley or oatmeal, and is an excellent ingredient in a pudding with milk and butter, and either with or without eggs and other ingredients.

4280. *Lichen Islandicus*, or Iceland moss. The lichens form a remarkable class of plants that live in the most barren situations in the most northern parts of the world, where nature refuses any description of corn, growing even on bare rocks. They have no roots, but adhere by a kind of claws, and are nourished by absorption from the atmosphere. The Lichen Islandicus, so named from existing in vast abundance in Iceland, on the northwest coast of which scarcely any other vegetable is to be seen, is now called by botanists *Cetraria* islandicus, and had formerly received the name of *Reindeer moss*, as supplying the only food which these animals can procure in the winter season. The appellation moss is improper, as it is really a lichen.

Notwithstanding its mode of growth, it is an extremely nutritious substance, as may be seen from the following analysis by Berzelius: Starch, 44·6; lignin, 36·6; green wax, 7·0; bitter principle, 3·6; acidulous tartrate of potash and lime, 3·0; extractive, 1·9; traces of gallic acid. With the Icelanders it constitutes a very important article of aliment, and is collected by them during the summer months. The lichen has an outer skin covering a green resinous substance; and the remainder of the plant consists chiefly of fecula, or a kind of gummy, soluble matter, and of a fibrous matter, on which water does not act. The plant has a natural bitterness and astringency; and to take this off, it is scalded two or three times with boiling water, which causes the skin to crack, swell, and peel off. It is then steeped for an hour or two in cold water to extract the bitter principle, and boiled for an hour or two in milk till the liquor acquires a gummy or gelatinous consistence. When cold, this is a jelly like blanc-mange, and it is eaten with milk or cream, with which it makes a very palatable dish. The Icelanders also make it into a kind of bread; or it is powdered or ground, and the meal made into porridge, gruel, or broth, or baked as cakes: these Dr. Henderson describes as not only wholesome and nutritious, but extremely palatable.

This useful plant is not confined to Iceland, but grows all over the north of Europe, and is found on the Pentland hills, the mountain of Ben Lomond, and many other parts of the Highlands of Scotland, but it does not grow to so large a size there as in Iceland. It is also found on many of the lofty mountains of Europe, where the temperature is low, as the Alps, Pyrenees, Jura, &c. From its esculent qualities, its use has been recommended in times of scarcity. If it is boiled for a quarter of an hour after the bitter principle is extracted, it may be dried, and will keep for any length of time.

It is, however, not sufficiently plentiful in this country to be much regarded as an article of food; but it is thought to have some tonic power, and to be proper for convalescents. Dr. A. T. Thomson observes that this quality depends on the bitter principle contained in it; consequently, when employed as a tonic, the bitter should not be wholly removed.

4281. *The starch procured from the horse-chestnut* has been employed successfully in Germany for many of the purposes of flour.

4282. *Bread from the Bark of the Pine.*—From the civilized state in which we now live, we can form but faint ideas of the necessitous situation under which many of the inhabitants of the globe exist, and in comparison of whom our poorest cottagers may be considered in a state of ease. Von Bush informs us that in the rigorous and unfertile climates of Norway and Lapland necessity obliges the inhabitants to make use of the inner bark of the common Scotch fir (*Pinus sylvestris*) for food. In the spring season they cut down the older trees, and, stripping off the bark, collect the soft, white, succulent interior part, which in the early time of the year has a sweet, milky juice in it, and is the new layer of wood in an incipient state. When they have occasion to use it, they dry this at the fire, or bake it in an oven, till it becomes brittle; then beat it and grind it into meal, and after steeping the farinaceous part or flour in warm water to take off the resinous taste, they mix it with a small portion of oats or moss, and make it into thin cakes about an inch thick, which are baked for use. The poor inhabitants are sometimes constrained to live upon this disagreeable food for a great part of the year. We learn from the same authority that "in summer the Laplanders scarcely eat anything but fish from the fresh-water lakes, and drink with great eagerness the water in which the fish has been boiled. In winter they must put up with dried fish and the innermost bark of the fir, which they strip off in summer, divide it in long strips, and hang them in their dwellings to dry for winter stores. When used, these strips of bark are minced in small pieces along with reindeer tallow, and boiled together for several hours with water, till they form a thick broth." Dr. Prout suggests, with respect to this process, that, during the long boiling, the lignin or woody fibre may, perhaps, combine with the water so as to form a kind of starch, which is soluble in the stomach; but the precise nature of the change is not yet understood.

The young shoots of the fir stripped of their leaves just as they begin to appear in the spring are sought for with avidity by the children, and are very wholesome, forming an agreeable salad; these are also stored in winter for the reindeer. In the same countries, also, they dry the root of the water-dragon (*Culla palustris*), grind it to flour, and mix it with the above. The inner bark of the elm and other trees has been employed in the same manner.

4283. *The seeds of the stone pine*, being farinaceous, are eaten in some parts bordering the Mediterranean, and likewise those of the gigantic pine discovered by Douglas in the west part of North America. The inhabitants of Australia likewise bruise and eat the seeds of the screw pine (*Pandanus spiralis*, Brown) and of several cone-bearing pines, but these do not form a very nutritive food.

4284. *The roots of various species of fern* are used as food in different parts of the world. Those of the *Pteris*, the common fern of this country, are ground to powder, mixed with barley meal, and boiled by the poor inhabitants of the Canary Islands; but it is a very coarse food. Another kind, the Cyathea, is much superior, has soft and pulpy roots, and affording a substance not unlike sago, is eaten by the New-Zealanders. The *Pteris esculenta* of Australia, which much resembles the common English fern, has roots which contain a good deal of farinaceous matter; but though these form, in some places, the principal food of the natives, they are very disagreeable, being mixed with much woody matter. A remarkable fern (*Angiopteris erecta*) grows in the Society Islands, the roots of which weigh fourteen pounds, and are used by the natives as food.

4285. *Bread made from Wood.*—Professor Autenrieth, of Tubingen, has shown, by a series of careful experiments, that it is possible to make a palatable and nutritious bread from the dry, ligneous part of wood by proper management. The following is his process, as we find it stated by Dr. Prout in the Philosophical Transactions, 1827: "In the first place, everything that was soluble in water was removed by frequent maceration and boiling. The wood was then reduced to a minute state of division, that is to say, not merely into fine fibres, but actual powder; and after being repeatedly subjected to the heat of an oven, was ground in the manner of corn. Wood thus prepared, according to the author, acquires the taste and smell of corn flour. It is, however, never very white, but always of a yellowish colour. It also agrees with corn flour in this respect, that it does not ferment without the addition of leaven, and in this case some leaven of corn flour is found to answer best. With this it makes a perfectly uniform and spongy bread, and when it is thoroughly baked, and has much crust, it has a much better taste of bread than what is in times of scarcity prepared from the bran and husks of corn. Wood flour, also, boiled in water, forms a thick, tough, trembling jelly, like that of wheat starch, and which is very nutritious."

The following details respecting this extraordinary process are added in the Quarterly Review: "To make wood flour in perfection, according to Professor Autenrieth, the wood, after being thoroughly stripped of its bark, is to be sawed transversely into disks of about an inch in diameter; the sawdust is to be preserved, and the disks are to be beaten to fibres in a pounding-mill. The fibres and sawdust, mixed together, are next to be deprived of everything harsh and bitter which is soluble in water by boiling them where fuel is abundant, or by subjecting them for a longer time to the action of cold water, which is easily done by enclosing them in a strong sack which they only half fill, and beating the sack with a stick or treading with the feet in a rivulet. The whole is then to be completely dried, either in the sun or by the fire, and repeatedly ground in a flour-mill. The ground wood is next baked into small flat cakes, with water rendered slightly mucilaginous by the addition of some decoction of linseed, mallow stalks and leaves, lime-tree bark, or any other such substance. Professor Autenrieth prefers marsh-mallow roots, of which one ounce renders eighteen quarts of water sufficiently mucilaginous, and these serve to form four pounds and a half of wood flour into cakes. These cakes are baked until they are brown on the surface. After this they are broken to pieces and again ground, until the flour pass through a fine bolting-cloth; and upon the fineness of the flour its fitness to make bread depends. The flour of a *hard wood*, such as beech, requires the process of baking and grinding to be repeated. Wood flour does not ferment so readily as wheaten flour, but the professor found fifteen pounds of birch-wood flour, with three pounds of sour wheaten leaven, and two pounds of wheat flour, mixed up with eight measures of new milk, yielded thirty-six pounds of very good bread. Professor Autenrieth tried the nutritive properties of wood flour, in the first instance, upon a young dog; afterward he fed two pigs upon it; and then taking courage from the success of the experiment, he attacked it himself. His family party, he says, ate it in the form of gruels or soup, dumplings, and pancakes, all made with as little of any ingredient as possible, and found them palatable and quite wholesome." This account, were it not so well authenticated, might have the air of a romance, and it still remains to be shown how far the fact may be available for useful purposes in general; in the mean time, it adds to the stock of our knowledge on the subject of food.

BOOK X.

ON THE PRESERVATION OF FOOD.

CHAPTER I.

INTRODUCTION.—GENERAL OBSERVATIONS.

4286. *All animal and vegetable substances being liable to change*, so as to be at least unfit for food, their perishable nature, together with the unavoidable irregularity in their production, has imposed upon mankind the necessity of storing up the superabundance of one time to meet the exigencies of another. It has, therefore, become an object of great importance to ascertain the best method of *preserving* the various substances suitable for food as nearly as possible in their original state, or, at least, in some condition in which their nutritive properties may be, as much as possible, retained. But for the art of preserving food, mankind would at times be subjected to great deprivations; and to mariners, in particular, every method of preserving articles of diet in a wholesome and nutritive state must present itself under a very striking point of view.

When we hear of beef, fruit, milk, and other articles of nutriment eaten quite fresh after having travelled round the globe, and when we consider the simplicity of the means by which this has been effected, we must admit the value of those sciences to which this almost miraculous preservation is owing.

4287. Thus the methods of preserving food for a shorter or a longer period of time are not only deserving of attention in domestic economy, but are highly important in a national point of view. We shall begin by adverting to the chemical history of the substances to be preserved, the nature of which has been already described in Book VII.

4288. *While the living principle exists* in a healthy state in animals and vegetables their elementary constituents cannot separate, and no decomposition can take place; but no sooner is life extinct than an alteration commences, and those elementary substances which we have described as composing the whole animal and vegetable kingdom, and which are held together by the laws of organic life, have a tendency, when deprived of this bond, to separate from each other, and to enter into new combinations. This is a law of nature. Organic bodies come into existence, live their allotted time, and die. If nothing retards the usual course of things, they then pass into other states, and the tangible substances of which they consist are made to form the corporeal part of other living beings. Man, whose present existence demands the use of some portion of matter which is in the act of passing from one state to another, contrives various methods of arresting it in its progress to decay, and rendering it in the mean time subservient to his wants.

4289. *The inevitable change to which dead organic matter is liable is called fermentation*, of which we pointed out, in a former part of this work, that there are several kinds, the vinous, the acetous, and the putrefactive. By the first two, useful products are obtained; but the last is that complete change, termed decomposition, by which the substance is entirely resolved into the inanimate materials of which it had been originally composed, and the greater part of which are finally, if left to themselves, dissipated in the atmosphere in the form of offensive and noxious gases. These changes do not take place precisely in the same manner in animal as in vegetable substances. Although vegetables generally go through more than one of the stages just mentioned, and sometimes through all three, yet the flesh of animals can pass at once into the putrefactive state.

4290. *We have previously stated that animal bodies differ from vegetables in their composition*: the former always have a large quantity of nitrogen as one of their elementary principles, whereas nitrogen enters in a small proportion as a constituent in vegetables.

When animal bodies undergo the putrefactive fermentation, or putrefaction, their elements, oxygen, hydrogen, nitrogen, and carbon, separate from each other, and combine again in the following manner: The carbon absorbs oxygen from the atmosphere, and forms carbonic acid; one portion of the hydrogen forms water with the oxygen; an other portion, uniting with the nitrogen, composes ammonia ; of the rest of the hydrogen some part combines with the carbon, producing carburetted hydrogen gas ; and the remainder unites with some phosphorus and sulphur which animal bodies contain, thus giving rise respectively to phosphuretted and sulphuretted hydrogen gases, which are in part the cause of the nauseous smell evolved by substances that putrefy, although this does not entirely account for the remarkable fetor which is diffused, an effect which is not perfectly understood.

4291. *We observed that vegetable matter*, under favourable circumstances, can go through a series of changes before they arrive at the putrefactive state ; nevertheless, there are some cases where vegetables decompose without experiencing all these. Sometimes they pass into the acetous state without perceptibly going into the vinous, and sometimes the putrefactive alone takes place, as in the case of mushrooms. Vegetables which contain no nitrogen, particularly the ligneous parts, decompose much more slowly than animal matter. The juices which plants contain first enter into the acetous fermentation, and the acid thus generated destroys the cohesion of the ligneous fibre, and reduces the whole to a pulpy state ; but there is very little of that smell so remarkable in animal putrefaction, because the whole of the elementary principles necessary to form the offensive gases seldom exist in vegetables. When vegetables putrefy, their oxygen and part of their hydrogen unite and form water, while another part of their hydrogen combines with carbon, and forms carburetted hydrogen ; but the chief part of the carbon remains in one of the simplest forms of this element, and gives the black colour so prevalent in a rich soil produced chiefly by the decay of plants that have grown there.

4292. *In dead animal bodies*, it is the albumen that first begins the putridity, and serves as a ferment to the rest ; and those plants which contain much vegetable albumen are most apt to become putrid, as mushrooms, cabbages, &c.

4293. The production of ammonia has been generally supposed to distinguish the putrefaction of animal from that of vegetable bodies ; but although this is generally the case, there are exceptions. Such vegetables as contain nitrogen, as the gluten of wheat, also generate ammonia abundantly.

4294. *In the putrefactive fermentation certain conditions are necessary*, as is the case in the vinous and acetous, viz. : 1, a certain degree of heat ; 2, a certain degree of moisture. If we deprive animal and vegetable substances of either of these conditions, no change can take place. 3. The access of air, likewise, though not absolutely necessary, remarkably accelerates it. It is upon these principles that some of the methods of preserving food are founded. The process of putrefaction agrees also with the other stages of fermentation in this respect, that a small quantity of animal substance in this state will inoculate others with which it is in contact, and occasion them also to putrefy ; even their effluvia will sometimes have this effect.

4295. *We shall divide this subject into two parts.* The first will relate to those precautions which are necessary to preserve meat and vegetables for a short time in a perfectly fresh state previous to their being subjected to the culinary art ; and the second will describe the modes of preserving from decay the various species of food which are required to be kept as store for a considerable length of time. But as the difference in the nature of animal and vegetable food demands different modes of treatment, we shall consider each of these classes separately.

CHAPTER II.

PRECAUTIONS TO BE USED IN KEEPING ANIMAL FOOD FOR A SHORT TIME PREVIOUSLY TO ITS BEING COOKED.

4296. *In consequence of the changes to which we have alluded*, it might be supposed desirable that all animal substances used as food should be dressed as soon as life has been destroyed. This, however, is true only of some kinds. The flesh of some animals which have been just killed is at first tough and difficult to digest ; a fact well known to all butchers and cooks, who are not ignorant that the keeping of it for a long or short time, according to circumstances, previously to its being dressed, renders it more tender, palatable, and easy of digestion. Our object is to point out the principle upon which this depends.

The fleshy fibre, or muscular part of living animals, is endued with a property called *irritability*, and this does not cease the instant that life becomes extinct, but continues for a short time after death. The hearts of many animals continue to beat after being separated from the body, and a muscle cut from a living creature trembles and palpitates for some short time afterward. The bodies of animals that are slaughtered cool gradually, and when they are quite cold, and irritability has ceased, *the muscles begin to contract and grow rigid ;* first those of the trunk, and then of the limbs. In whatever attitude the limbs are placed at the commencement of rigidity, they continue, and hence butchers take care to dress the carcasses of animals properly while they are in a supple state.

4297. *While this rigidity continues, meat is tough*, and can scarcely be made tender by any process of cookery, except by being long stewed, or being made into soup, for which it is quite proper; but if boiled or roasted in this tough state, it resists in a considerable degree the action of the gastric juice, or, in other words, it is hard to digest. If meat be kept for a few days or less, according to the weather and climate, this rigidity ceases, the flesh becomes softer, and, before long, those changes commence, which, if suffered to go on, would terminate in putrefaction. Now the moment when the meat is in the fittest state to be dressed, as being the most tender, is just *before* the last change commences; for it is the nature of the decomposing or putrefactive process to loosen the fibres, and dispose the muscular part to be easily acted upon by the digestive organs. It is upon this principle that animals killed by electricity and cooked immediately are found to be tender, because the electric fluid has destroyed entirely the irritability of the nervous system.

4298. *But the length of time that meat ought to be kept* after it is killed depends upon the climate, the season of the year, the weather, and the temperature, moisture, and ventilation of the place where it is kept, as likewise the particular kind of animal. In very warm climates, meat will not keep above four or five hours, and is therefore used in a more recent state than in cold countries. With us it is sooner ready in summer than in winter; and in some animals, as in venison and game, this change is permitted to show stronger symptoms than in other kinds of meat before it is considered as fit for the spit. But although it is proper to hang up meat for some time in the air till its fibres have lost some degree of their rigidity, yet it must be clearly understood that if it be kept so long as to lose its natural sweetness, and to exhibit symptoms of putrescence, it becomes as detrimental to health as it is disagreeable to the smell and taste. Much experience and attention to various circumstances are necessary to determine exactly how long any particular joints ought to hang up in order that they may be ready against a certain day; and much of the success of the cook will depend upon hitting this point with precision, by using the necessary precautions. In warm weather, the change from the rigid state towards putrefaction proceeds often too rapidly, and then it requires to be checked. But a moderate reduction of temperature may be all that is required.

Meat should, accordingly, be always kept in the most cool and shaded places, as a degree of temperature very little below that of the atmosphere, even 10°, is of great use in warm weather.

In summer it is difficult to get meat that is not either tough or tainted, as the butcher runs great risk in keeping it sufficiently long, and is therefore glad to sell it as soon as he can. The best mode, therefore, is to buy joints as fresh as possible, and to hang them up in the larder, where the manner of proceeding must be founded upon the principles which have been alluded to.

The due degree of *itineration*, or tenderness of meat, may be partly ascertained by the way in which it yields to the pressure of the finger, and by its opposing little resistance in attempting to bend the joint; fortunately, the slightest degree of change beyond that can be detected by the odour.

4299. *Where a regular larder is desired, its construction should be carefully attended to.* It should be cool and dry, should have good ventilation by windows on opposite sides, which ought to be covered with wire cloth to admit the air, but not the flies, which lay their eggs in the meat, and occasion it to be what the cooks call *fly-blown;* and from these eggs, if suffered to remain, maggots will be produced. Meat should be carefully examined every day in summer, wiped dry, and such bits as are beginning or seem liable to taint, particularly kernels, should be removed. It may be kept for several days more in hot weather than it otherwise would, by wrapping round it a linen cloth moistened with vinegar, or equal parts of vinegar and water; the acid vapour keeps off the flies, and the moisture occasions cold by evaporation. The wood vinegar, or pure pyroligneous acid, may be used for this purpose. Charcoal bruised to powder has also the property of preventing meat from spoiling for some time, and, in some cases, is useful; it is important that it should be fresh made, or at least heated red hot and cooled again, and spread entirely over the meat. So strong is the antiseptic power of charcoal, that meat, when but slightly tainted, may be recovered by boiling it for some minutes with some pieces of this material fresh burned.

4300. *To preserve fish quite fresh for a short time* requires even more care than meat. They should be kept in a very cool place, an ice-house if possible; but if that cannot be had, they should be laid upon a stone floor or shelf, and dipped in cold salt and water every night and morning. If it is necessary to keep them a few days longer, this may be done by immersing them in a pickle composed of equal quantities of common vinegar, small beer, and water.

4301. *Succulent or soft vegetables*, such as cabbages, when just gathered, quickly lose their natural juices by evaporation from the leaves, which soon become flaccid, and in his state they are not only disagreeable to the eye, but deteriorated with respect to their nutritious properties. Every care should, therefore, be taken to preserve them in their full and plump state previous to their being dressed. As heat is the cause of the loss of their juices, a cool, shady, and damp place is proper to keep them in. A cool cellar, with the floor paved with stone, is the most proper place, except there be an ice-house or a room attached to it, which is still better.

They should not be kept in water, as that dissolves and destroys some of their juices, and injures their flavour; and the best method of refreshing them is to cut off a portion of the stem, and set the cut part in water, of which the vegetable will then absorb a good deal to supply the leaves and make up for the evaporation. They should not be laid together in heaps, since this is apt to generate heat and fermentation, as is often the case with vegetables brought up from the country to market, when they are seen to steam and sweat, as it is called, in which state they are far from being wholesome. In the "Practical Directions to the Cook," Book XII., farther particulars relating to the business of the larder will be found.

CHAPTER III.

PRESERVATION OF ANIMAL FOOD FOR A LONG TIME.

4302. *The various modes of preserving animal food as store* for a considerable period of time may be reduced to the following: 1. Preserving by drying; 2, by cold; 3, by salting, and by sugar; 4, by smoking; 5, by vinegar; 6, by M. Appert's method of parboiling and excluding the air; 7, by potting; 8, by alcohol. Sometimes one of these methods is employed singly, and sometimes several in conjunction.

4303. *Substances that prevent the putrefaction* of animal and vegetable bodies are termed *antiseptics;* the principal of which are, common salt, nitre, vinegar, spices, and sugar. These operate partly by inducing a change in the fibres, and partly by rendering the aqueous constituents unsusceptible of decomposition.

SECT. I.—PRESERVATION OF ANIMAL FOOD BY DRYING.

4304. *Moisture being one of the essential conditions of the decomposition of animal substances,* their complete desiccation is one of the means of preventing their decay, and is employed as a mode of preserving them as food for a long period. Every one knows that common glue will dry quite hard, and will keep in this manner for any length of time; the same is the case with white of egg if it be spread thin, one layer being dried upon another. Now, both these substances, consisting the one of gelatin and the other of albumen, are constituents of flesh; and fibrin, or the fleshy fibre, dries equally well, and in that state is not liable to putrefaction. Gelatin, after being hardened by drying, is easily softened again, and brought into the gelatinous state by hot water; but if albumen be thoroughly coagulated by boiling water, it cannot be softened again; nevertheless, albumen can be dried without coagulating in a heat of 140°, and may then be redissolved in cold water with its valuable properties unaltered. Meat dried to be preserved for cooking must not, therefore, be exposed to too high a degree of heat, other wise it would become insoluble.

4305. *Remarkable instances of the power which drying has in preserving* flesh may be observed in those parts of the earth where there are sandy deserts, and where rain seldom falls; the air that blows over these is rendered dry, and possessing a great affinity for moisture, greedily attracts it from all substances with which it comes into contact. Buried in these deserts, the bodies of travellers and of camels that have been arrested and overwhelmed by the drifting sand have been found preserved from time immemorial, the flesh having been totally deprived of all moisture, and perfectly dried. While they continue in that state they are not liable to change. Such effects are never known in Britain, the winds being well saturated with moisture before they can reach our shores.

4306. *The North American Indians, in the fur countries, prepare the flesh* of the bison, buffalo, and deer merely by drying, according to the account given by Mr. Hearne, in his "Journal to the Northern Ocean," who found it to be excellent food. This preparation is called "pemmican." It is stated to be quite essential to travellers in those countries, and is thus described by Captain Back, who travelled with Sir John Franklin:

"While meat remains in a thick piece, it is impossible to get the middle dried before putrefaction commences; but if the meat be cut into slices, its desiccation may be easily effected. The fleshy parts of the hind quarters are cut into very thin slices, dried in the sun or before the fire, and pounded. Two parts of the pounded meat are then mixed with one of melted fat, and packed into a bag formed of the hide of the animal. A bag weighing ninety pounds is called a *taureau* by the Canadian voyageurs; and, in fact, only one bag of pemmican is generally made from each bison cow. Two pounds of this kind of food are sufficient for the daily support of a labouring man, though, when the voyageurs first commence upon pemmican, they will each consume three pounds, or more. In the spring, they generally boil the young shoots of the *Epilobium angustifolium* along with it; and some Scotchmen in the service of the Hudson's Bay Company add flour or oatmeal, thus rendering it more palatable. The best pemmican is made of finely-pounded meat, mixed with marrow, and farther improved by the addition of dried berries or currants. If kept from the air, it may be preserved sound for several years, and being very portable, it might be used with great advantage in provisioning troops that have to make forced marches. It may be eaten raw, or mixed with a little water, and boiled; and although not much rel wished by those who taste it for the first time, the *voyageur*, with a single addition of the luxury of tea, requires nothing else for breakfast, dinner, or supper."—*Back's Journal.*

4307. *The Moors of Africa preserve meat in the following manner:* They cut into thin slices beef, mutton, or camel's flesh, and after salting them well, suffer them to lie in the pickle twenty-four hours. The meat is then removed from the tubs or jars, and put into others filled with fresh water; and when it has remained there a night, it is taken out, and hung on ropes to dry in the sun and air. When thoroughly dried and hard, it is cut into pieces two or three inches long, and thrown into a pan, or caldron, which is kept ready with boiled oil and suet sufficient to cover it; thus it is boiled, till it be very clear and red on cutting it, when it is again taken out and set to drain. After having undergone this process, it stands to cool, while the jars are getting ready for storing it; at the same time, the liquor in which it was fried is poured upon it, and as soon as it is thoroughly cold the vessels are closely stopped. Preserved in this manner, it will remain hard, and keep two years; indeed, the hardest is considered the best and most palatable. It is brought to table sometimes fried with eggs and garlic, or stewed with a little lemon juice poured on it.

4308. *Jerked beef* is a name given to a method of curing beef in the West Indies and South America. It is there difficult to preserve beef by pickling; but they cut the meat into slices, dip it into sea-water, or brine, and dry it in the sun. In this manner they preserve the flesh of the wild cattle at Buenos Ayres, from whence a great deal is exported to Brazil and Havana for the slaves, and is found to be excellent food. Sometimes, also, they pound this dried meat in a mortar into a uniform paste, which is pressed into jars; and if required for travelling, they beat it up with maize-meal and press it into leather bags; prepared in this way, it is eaten without farther dressing by fire. Captain Owen, in his late "Survey of the East Coast of Africa," mentions American ships bound for India being supplied with jerked beef at Madagascar.

4309. *Some kinds of fish are dried*, when they are below a certain size, merely by slitting them, and by exposure to the air, so as to evaporate their moisture; these will preserve fresh perfectly well if kept from damp. Small cod and haddock are often treated in this manner, and the stock-fish of the north of Europe. In the large kinds of fish, however, the desiccation seldom proceeds with sufficient rapidity, and the addition of salt is found necessary to prevent putrefaction taking place before they can be sufficiently dried in the air.

4310. *By drying meat from air alone*, a great part of the nutritive juices are dissipated, and its flavour considerably impaired, which forms a great objection to this mode of preserving.

4311. *Portable soup* comes into this class of substances preserved as food by drying. The principle upon which it is made is the same with that of manufacturing glue. The gelatin of meat is dissolved by boiling water; and the water being afterward evaporated, the gelatin is left in a solid state. Any fresh lean meat will answer for this purpose, but the fat should be cut away. Portable soup, made in large quantities, forms a valuable acquisition to the traveller, and to those engaged in naval and military duties.

4312. *Dr. Kitchener* endeavoured to ascertain by careful investigation the best and cheapest mode of making this soup. The legs and shins of beef he found to answer better than other meat, both in regard to quantity and flavour. If expense is not a principal object, the addition of other meat, and the trimmings of poultry and game, together with lean ham, in the proportion of one pound to eight of beef, will greatly improve the flavour. Made without ham, the price of this essence in the shops is from 10*s.* to 12*s.* the pound; made in a private kitchen, Dr. K. estimates the expense to be scarcely more than 3*s.* 6*d.* per pound. One ounce of this (2½*d.*) will make a pint of broth; double that quantity with the addition of either thickening or flavouring ingredients, the same quantity of soup.

4313. *To make portable Soup.*—Take a leg or shin of beef weighing about ten pounds; have it from a bullock recently killed; break the bones, and put it into your soup pot; just cover it with water, and set it on the fire to heat gradually till it nearly boils. It should boil for nearly an hour. When scum rises it should be carefully skimmed off, and a little cold water be poured in once or twice, which will cause more scum to rise on the surface, which must be again removed. When the scum has ceased rising, let it boil for eight or nine hours, and then strain it through a hair sieve into a stone jar, and place it where it will quickly cool. The next day, after removing every particle of fat, pour it quite through a very fine sieve, or tamis, into a stew-pan, taking care that none of the settlings at the bottom go into the stew-pan. After adding a quarter of an ounce of black peppercorns, let it boil briskly, the pan uncovered, until it begins to thicken, and is reduced to about a quart. All scum that rises must be removed, as in the preceding process, but without adding water to it. When it begins to thicken, withdraw it from the brisk fire, and place it where it can continue to boil gently until it becomes a very thick sirup. Great care must be taken to prevent it burning, which would in one instant destroy the whole. Pour out a little in a spoon, to ascertain if it will jelly. If it does not, then boil it longer, and at length pour it into a little potting jar, about an inch and a half in depth and perfectly dry. These pots Dr. Kitchener recommends, if the soup is intended for home consumption, and is sufficiently concentrated to keep for six months. If to be longer preserved, it may be put into bladders such as are used for the German sausages; or it may be dried in the form of cakes, by pouring it at first into a dish until cooled. When cold enough to turn out, weigh the cake, and divide it into pieces of an ounce or half an ounce each; place them in a warm room, and turn them twice a day for a week or ten days, by which time they will be thoroughly dried. If kept in a dry place, they may be preserved for years.

4314. Portable soup, besides being very serviceable to travellers, is also very convenient in country places, where it is difficult to have a supply of fresh meat, for making extempore broths, sauces and gravies for hashed or stewed meat, &c. When they are to be used, half an ounce is put into a vessel with half a pint of boiling water, which is to be covered and set upon hot ashes, or put into a water-bath for a quarter of an hour, until the whole is dissolved. If seasoning of roots or herbs is required, they may be added. Boil an onion, with or without a bit of parsley and sweet herbs, and a few corns of allspice, or other spice, in the water you melt the soup in, which may be flavoured with mushroom catsup, essence of sweet herbs, or of celery, or anything else that is customary.

As this portable soup is easily made, and is not only convenient in a family, but economical, since no more need be dissolved than is wanted, it is recommended that it be made at home, as affording the only certainty of the goodness of the materials; it may thus be made for less than half the price of that at which it is sold.

4315. *A preparation is made in France, called "Gelatin brut fin,"* from bones; the ends being cut off and the bones cut down the middle to remove the fat, they are steeped in diluted muriatic acid for about ten days, which dissolves the solid part and leaves the gelatin. The acid being poured off, they are soaked afresh in weak acid for a day and a night, and then steeped in water some hours, renewing it five or six times until all the acid is washed out, and finally they are steeped in a very weak solution of sub-carbonate of soda to neutralize what acid may yet remain. 100 lbs. of bones yield about 25 lbs. of gelatin. The gelatin is then dried and cut in the form of dice, and is used for making soup, for which it keeps better than the cakes of portable soup. This kind of prepared gelatin is made in England, and may be had in the London shops; but we wish our readers to observe that we merely mention the fact, without recommending the substance.

SECT. II.—PRESERVATION OF FOOD BY COLD.

4316. If animal and vegetable substances be exposed to a degree of cold below the freezing point of water, the juices are congealed and converted into ice, and during this state they cannot undergo any change whatever; hence freezing becomes a very simple and effectual mode of preserving food in many cases. The inhabitants of northern countries are thus enabled to lay up a sufficient store of provisions for their winter consumption, and to receive supplies from a great distance. Meat frozen at Archangel is sent to Petersburgh and Moscow; and the markets of these places present the extraordinary appearance of immense numbers of hogs, sheep, fish, &c., built up in stacks, in a complete state of rigidity, and as firm as so many statues or stuffed figures. About the end of October, the Russians pack their meat in tubs, with layers of snow between, and preserve it in this way, using it afterward as occasion requires. Veal frozen in this manner, and sent from a distance, is esteemed the finest they have in Petersburgh; and, when properly thawed, it is said that it cannot be distinguished from that which has been recently killed, being equally juicy. The same practice is followed in Canada, Hudson's Bay, and in all countries where the frost is sufficiently steady. All that is necessary is to hang it out of doors till it be frozen as hard as a board.

4317. *But the most extraordinary proof of the power of extreme cold in preserving animal bodies* is in the account given by Pallas of a species of elephant discovered in a frozen state in a mass of ice that was driven on shore on the coast of Siberia, about thirty-five years ago, and which is supposed to have been preserved in that state as long since as the time of the Mosaic deluge; and yet so fresh was the flesh when the animal fell out of the iceberg, that it was fed upon by the bears of the country. The skeleton and great part of the skin are now to be seen entire in the Museum of Petersburgh. The proofs of the great antiquity of this carcass depend upon geological reasoning, which we cannot here enter into; but whatever difference of opinion there may be with respect to its exact age, all agree that it must have been at least thousands of years old, since the climate of Siberia has long been such that no elephants could live there; nor could the carcass have floated from a warm climate, since it must have undergone decomposition during its passage. We can put no limit, therefore, to the period during which organic substances may be preserved when enclosed in ice.

4318. *In our variable climate, this mode of preserving butcher's meat is not so applicable;* but ice is employed with great advantage in the transportation of fish to London. Salmon is brought by this means to the metropolis from all the northern rivers that flow to the eastern coasts of Britain. The practice is said to have been first recommended by a public-spirited gentleman in Scotland, Mr. Dempster, of Dunichar. Every salmon fishery is now provided with an ice-house, and a stock of ice is laid in during the winter; the salmon are packed in large oblong wooden boxes, with pounded ice interposed between them; and in this manner they are conveyed to the London markets as fresh as when they were taken out of the water, but it is to be observed that they are not actually frozen. Almost all fishmongers have either ice-houses or ice-cellars for the preservation of their fish in tubs of ice. But whenever meat, fish, or vegetables are frozen, it is of the utmost importance to attend to the manner in which heat is subsequently restored; if thawed too rapidly by putting them before the fire, or into hot water, putrefaction is soon induced; and though it may be cooked before that time, yet the flavour is destroyed, and it becomes hard. It is necessary, in order to have the frozen substances unimpaired, to thaw them by immersion in *cold* water. A crust of ice will then be seen gathering round them on the water, owing to their abstraction of heat from that fluid.

4319. But although meat and fish are perfectly preserved by ice, it is doubtful whether the flavour does not suffer in some degree, at least in this country. Some are of opinion that when they have once been frozen, they never completely regain their fine flavour. Taking advantage, however, of the usual cold of our winter, and exposing animal food of any kind to a temperature not quite so low as freezing, so that the juices are not converted into ice, does not produce any injurious effect upon the flavour, but, on the contrary, renders the meat more tender, while all the sapid qualities are perfectly preserved.

4320. *The most complete mode of employing ice in this country for the preservation of food is by a well-contrived ice-house;* but where this cannot be had, many methods more economical may be employed. See "Ice-house," Book VIII., Chap. VII.

SECT. III.—PRESERVING ANIMAL FOOD BY SALT.

4321. *The power which salt possesses of preserving animal food* from decomposition has been known from time immemorial. In the early periods in this country, before markets were so well supplied as they now are with fresh meat, the barons and other wealthy persons laid in an immense store of salted provisions against the winter; for so wretched was the state of husbandry, that they often had not subsistence for their cattle during the winter months, and they killed some of them for this reason, to preserve the flesh in salt. Thus Hume informs us that when the insurgent barons ravaged the estates of the elder Spencer, in the reign of Edward II., he had in his larder the enormous quantity of 600 bacons, 80 carcasses of beef, and 600 muttons; the latter as well as beef being at that time salted. Nor do things appear to have been any better in 1512; for, from the "Northumberland Household Book," we learn that during the winter months the family lived on salted meat. The scurvy was then one of the most common diseases in this island, owing, no doubt, to the great use of this kind of food and the scarcity of vegetables.

In later times, it was usual for families in the country to lay in a stock of salted meat in October and November, which served for their consumption during the winter and spring; but in consequence of the universal establishment of markets, butchers' shops, and travelling butchers, this is less necessary, and fresh meat may at present be had in most places almost every day. Large quantities of meat, chiefly beef and pork, are, however, salted for the use of the navy, and for exportation to the East and West Indies, of which Ireland supplies a large proportion. The property which salt possesses of preserving animal substances from putrefaction is of the greatest importance to the empire in general, and to the remote grazing districts in particular. It enables the latter to dispose of their live stock, and distant navigation is wholly dependant upon it, as long voyages could not be undertaken without the usual stock of salt provisions.

4322. *Animal food is rendered harder and less digestible by being salted* for preservation; and the quantity of salt with which it is thus incorporated is greater than is beneficial to health. Hence it is that those who feed much upon salted provisions are liable to peculiar complaints, as was the case with sailors, who in long voyages were often attacked with scorbutic diseases, before the method of preventing them was so well understood as at present, when great care is taken to have supplies of food preserved fresh, and likewise of lemon juice or citric acid.

Salting is at present the most general process by which meat is preserved in the British Isles; and as, in describing the methods of salting provisions, mention is often made of different kinds of salt and their various qualities, we propose to explain the nature of this substance and the modes of preparing it.

Of the various Kinds of Culinary Salt.

4323. *Common or culinary salt is obtained from two sources.* It is found in great abundance in the waters of the ocean, sea-water containing about three per cent. on an average. This substance is also found in the solid form, composing rocks in various parts of the world; this is called *rock salt*, of which there are mines in Cheshire, from which most of our salt is derived. There are likewise many springs of water issuing from the earth so highly impregnated with salt, that they are called *brine springs;* these are supposed to owe their origin to water passing through rock salt below ground, in consequence of which it dissolves a portion of this mineral substance; on evaporating the water of these springs, or sea-water by boiling, salt is procured. From whichever of these sources salt is obtained, it is never quite pure, being at first contaminated with earthy substances, or with other salts; and it has to be purified or refined before it is fit for all domestic purposes. These salts are sulphate of magnesia, or Epsom salt; sulphate of soda, or Glauber's salt; muriate of lime, and sulphate of lime; they are nearly all separated in the process of refining the salt, by chemical processes not necessary to describe in this place. Common salt is generally a little deliquescent, that is, attracts water and becomes damp, which is owing to its not being entirely freed from the muriates of lime and magnesia. Salt should be preserved for immediate use in a salt-box with a close lid, and be kept in a warm, dry place.

4324. *Common salt*, when perfectly pure, was formerly said to consist of muriatic acid and soda, consequently to be *muriate of soda:* at present, chemists consider it as formed of chlorine and sodium, consequently it is *chloride of sodium;* but it frequently retains its former name. It is white, transparent, without smell, with a taste strictly saline, and free from bitterness. When thrown upon a heated metallic plate, or on the fire, it decrepitates; in a greater heat, or red heat, it melts; and in a white heat it is volatilized in white vapour, but is not altered. Water can only dissolve a certain quantity; when it cannot take up any more, the solution is said to be *saturated;* and this is the strongest brine that can be made. Boiling water dissolves more salt than cold; but when the hot solution is suffered to cool, all the salt falls down in a solid state above what the cold water can hold in solution. Hot brine, therefore, can be made stronger than cold, but will remain so only as long as it is in the hot state. To make brine completely saturated, it is best to boil it, and when the solution is cold, it is certain to be as strong as possible.

4325. *Culinary salt may be divided into two kinds:* 1. Bay salt and Fishery salt; 2. White, or fine-grained salt.

4326. *Bay salt* is obtained from the sea-water by evaporating it in large shallow reservoirs by the heat of the sun only. None is made strictly by this method in Britain, the climate being scarcely warm enough; but large quantities are manufactured on the southern coasts of Europe, as France, Spain, and Portugal, and from thence it is imported into this country. It is very large or coarse-grained, in consequence of the slowness of the evaporation, and more or less impure, being brownish, gray, or reddish, according to the colour of the clay which formed the bottom of the pans in which it was made. The bay salt of different countries differs considerably in purity and colour, according to the mode in which it has been manufactured. The more slowly the water has been evaporated, the larger are the crystals of salt, and the more perfect and pure they are. Bay salt is generally considered to be stronger than white salt; but this opinion is erroneous: its superior operation is rather by dissolving slower on account of the large size of its crystals; and hence it is more useful in salting sea stores. It is cheaper than white salt; and although fitter for the same purposes in curing fish and meat, is much less fit for ordinary purposes from its containing much impurity. Little actual bay salt is now imported, as a coarse salt equally useful is manufactured in this country.

4327. *Cheshire fishery salt* is the coarsest grained of all, and is made by evaporating the brine from dissolving rock salt, or natural brine from the springs, by a temperature of 100° to 110°, by which slow evaporation the crystals become large, and better adapted to the use of the fisheries. It is sometimes called British bay salt.

4328. *White salt* is made either by boiling sea-water in places where fuel is cheap, as at Newcastle; or by partly evaporating sea-water by the heat of the sun, and thus reducing it to a brine, which is afterward boiled to salt, as at Lymington in Hampshire; or by boiling the brine of salt springs, as in Worcestershire and Cheshire; or, lastly, by dissolving and boiling rock salt, as in Cheshire. The different states in which salt is prepared for sale have given it various appellations, as *stored* or *lump salt*, *common salt*, *basket salt*, and *Sunday salt*. In making the stored salt, the brine, whether from the natural brine springs, or from the rock salt, is evaporated in wrought iron pans by a heat of 226°, or 14° above the boiling point, a temperature which brine can sustain, although fresh water cannot; as the liquid boils, a scum is taken off, consisting of carbonate of lime, with which the salt was mixed in the earth; when the brine is sufficiently concentrated, the salt crystallizes, while the other salts, the Epsom salt and the Glauber's salt, do not crystallize so soon, and are poured off in the liquid state; these are called the *bittern*, which are crystallized afterward. The salt now purified is put in baskets and drained, and afterward dried upon a stove; this is often called *basket salt;* it is very fine grained, in consequence of the great heat, and is the best salt used for the table.

4329. *The common salt is made by the same process*, but the evaporation is slower, the temperature being only 160° to 170°, and it is not stoved after draining.

Lymington common salt is made by evaporating salt water by means of the sun and air in shallow ponds, till five parts out of six have disappeared, and quick boiling the remainder to dryness.

In Scotch common salt, the sea-water is boiled very quick, and the crystals, or grains, are small, approaching stoved salt.

Salt upon salt is made from bay salt dissolved in brine and recrystallized.

The following table, by Dr. Henry, gives the components in 1000 parts of foreign and British varieties of salt:

Kind of Salt.		Insoluble Matter.	Muriate of Lime.	Muriate of Magnesia.	Total Earthy Muriates	Sulphate of Lime.	Sulphate of Magnesia.	Total Sulphates.	Total Impurities.	Pure Muriate of Soda.
Bay salt	St. Ube's contain of	9	a trace	3	3	23½	4½	28	40	960
	St. Martin's . . .	12	. .	3½	3½	19	6	25	40½	959½
	Oleron	10	. .	2	2	19½	4¼	23¾	35¾	964¼
British salt from salt water	Scotch common .	4	. .	28 or +	28 or +	15	17½	32½	64½	935½
	Do. Sunday .	1	. .	11½	11½	12	4½	16½	29	971
	Lymington common	2	. .	11 or +	11 or +	15	35	50	63	937
	Do. cut .	1	. .	5	5	1	5	6	12	988
Cheshire	Crushed rock salt	10	0.1-16	0.3-16	0¼	6½	. .	6½	16¾	983¼
	Fishery	1	0¼	0¾	1	11¼	. .	11¼	13½	986¾
	Common	1	0¼	0¾	1	14½	. .	14½	16½	983½
	Stoved	1	0¼	0¼	1	15½	. .	15½	17½	982½

4330. *Common or culinary salt is not only important as a preserver, but as a seasoner of food.* No other condiment is in equal request; and it is considered by medical men to be not only a useful, but a necessary stimulant, and that its valuable properties contribute much to health, when used in moderation. Mankind in all ages appear to have had a relish for salt: "Can that which is unsavoury be eaten without salt? or is there any taste in the white of an egg?"—*Job*, vi., 6. In countries where salt is scarce it fetches a good price, and long journeys across deserts are undertaken to procure it. Although salt is known to be a powerful antiseptic, yet, according to the experiments of Sir John Pringle, it, like sugar, is only so in large quantities; this physician found that a small quantity, so far from preventing, promoted putrefaction; and from this fact he concluded that, as we use salt at table in small quantity only, it helps digestion by softening and dissolving our animal food. Its utility is strikingly exemplified in the avidity with which animals in a wild state, guided by natural instinct, seek for the salt pans of Africa and America, and in the difficulties they will encounter to reach them. The great desire that cattle and sheep have for salt is remarkable, and well known to farmers. Lord Somerville attributed the great health of his merinoes to the salt with which they were supplied; in Spain the merinoes have a ton annually to every 100 sheep.

In the interior countries of Africa, the greatest of all luxuries is salt. A child there, according to Parkes, will suck a piece of rock salt as if it were sugar. The poorer class of the inhabitants are, however, so very rarely indulged with this precious article, that to say a man eats salt with his victuals is the same as saying he is a rich man. The long use of vegetable food creates so painful a longing for salt that no words can sufficiently describe it.

Salt among the ancients was the emblem of friendship and fidelity; also of the inviolability of compacts; hence it was used in all their sacrifices and covenants. At this day the Bedouin Arabs consider it in the same light; they have a great respect for bread and salt, and are accustomed to affirm or deny anything by these substances. Hostile as they generally are towards strangers, yet, if they have eaten salt with any one, it would be accounted the greatest of all crimes to rob him, or even to take the smallest article of his baggage. They never break any engagement made with the ceremony of exchanging bread and salt. If a stranger can contrive to oppose this alliance to their rapacity, he is safe among them even in the middle of the desert; the Arab with whom he has tasted them regards him as one of his own tribe. This feeling extends also to India; no natives will ever fight against those whose salt they have eaten.

Considering the utility of salt to be thus established, it may excite surprise why the long-continued use of salted provisions should give rise, as is well known, to diseases.

But it has been observed by Dr. Paris that the salt, when it has combined with animal fibre, in the case of salt meat, is no longer to be considered as the condiment we have mentioned; and although chemistry cannot explain the cause of the difference, yet it is certain that flesh, when salted, is not so digestible as it was before salting.

4331. *In the process of salting, besides common salt, several other antiseptics are frequently employed* to improve the meat; as saltpetre, sugar, vinegar, and spices.

4332. *Saltpetre*, called also *nitre*, is a salt which consists of nitric acid and potash; hence the chemical term is *nitrate of potash.*

It is a natural production, and is found crystallized on the surface of the soil in certain countries and places, particularly among old walls and spots that have been uninhabited. The surface of the ground is swept off frequently, and the saltpetre contained in it is procured by mixing the whole in water; when the salt dissolves, and the impurities have subsided, the former is obtained by evaporation. What is used in England comes from Bengal in a very impure state; it is purified here; that which is of the best quality is in long transparent crystals. Its taste is sharp, bitterish, and cooling; it is possessed of a greater degree of antiseptic power than common salt. Sir John Pringle found that it exceeded the latter four times; hence it is always an ingredient in making strong brines where the saline taste is to be avoided. When common salt alone is used, it is apt to give a greenish tinge to the meat; and those who are desirous of having the beef of a fine red colour, add a little saltpetre, which has the property of giving this colour; but as this salt has also the effect of hardening the meat, and communicating a harsh taste, to correct these defects, some sugar or molasses is likewise added. Those who are desirous of the red colour without using saltpetre, may give it by a little cochineal, which is perfectly harmless.

4333. *Sal prunella*, mentioned in receipts, is the same salt as saltpetre, only it has been melted over a fire, poured out, and made up into cakes.

4334. *The theory of the preservation of meat by means of alkaline salts* does not appear to have been clearly explained. We know that they attract water, and that the existence of this fluid in meat accelerates its decomposition. When applied to meat, the water in the juices unites with them, and they become dissolved, which facilitates their entrance into the pores of the animal substance. The albumen of the meat being thus deprived of its water, is concentrated, and is less apt to putrefy; hence salted meat may be more readily dried in the air than fresh meat.

It is generally understood that salting greatly impairs the nutritiousness of meat. There can be little doubt that the action of long-continued salt is to corrugate and harden the fibrin, rendering it somewhat less easily digestible; but by *a few days' salting only*, probably its nutritive properties are scarcely, if at all diminished; and although certainly in the process some of the juices of the meat are lost, yet these appear to consist chiefly of water tinged with blood. Meat that has been kept very long in salt becomes strongly and disagreeably saline; and it is difficult by soaking in water to expel the salt, for the meat retains it with great obstinacy, even in boiling. Over-salting appears to have no remedy; for if the meat be kept so long in water as to bring the salt from the middle of the mass, the outside will be totally deprived of it; and cutting it in pieces is well known to injure the quality of the meat.

4335. *Salting meat is performed in two ways*, by dry salting, and pickling.

4336. *Dry salting* is performed by packing the meat in dry salt, and sometimes rubbing the surface of it all over with the salt. Packed in salt, the meat will keep longer, but it is made more salt, and is more altered in its nutritious properties than when it is simply cured by pickling. Dry salting is necessary where beef or pork is intended for exportation and keeping in a hot climate. In general, the pieces of the animal best fitted for being salted are those which contain fewest large blood-vessels, and are most solid. Very little salt penetrates except through the cut surfaces, to which it should therefore be chiefly applied, and all holes, whether natural or artificial, should be particularly attended to. For each twenty-five pounds of meat, about two pounds of coarse-grained salt should be allowed; some employ the following mixture: a pound of black pepper, a quarter of a pound of Cayenne pepper, and a pound of saltpetre, all ground very fine, and mixed well with three quarts of fine salt; this mixture is sufficient for eight hundred weight of beef. The pieces should be first sprinkled with the spices, and then the salt and spice should be well rubbed into every part, moulding and turning the meat very often to open the grain. The meat is then to be put into tubs, with a layer of large-grained salt between each piece; the juices of the meat dissolve the salt, and cause it to form a strong brine. In about a week, or rather sooner, some take out the meat, and re-pack it in smaller vessels with more coarse-grained salt; and some add a little spirit of salt in this re-packing to improve the flavour. Cutting out the bones of meat salted in this manner is advantageous. The meat requires to be kept a month in salt before it is fit to use for sea or winter store.

4337. *If the salting is performed immediately after the animal has been slaughtered*, and is still warm, and before the fluids are coagulated, the salt penetrates rapidly by means of the blood-vessels through the whole substance of the meat; and this is the practice in Ireland in the provision trade. In warm climates, it is important to perform the operation of curing meat very quickly, to prevent putrefaction, and Mr. Jackson, in his "Reflections on the Trade in the Mediterranean," informs us that this operation is admirably performed at Tunis, where the heat is 110° in the shade. There a good-sized bullock, of six or seven hundred weight, is killed and salted in three hours. They use a good deal of pepper.

4338. *The recipe given by Admiral Knowles for salting meat* is as follows: "As soon as the ox is killed, let it be skinned and cut up into pieces fit for use, as quick as possible, and salted while the meat is hot; for which purpose have a sufficient quantity of bay salt and saltpetre pounded together, and made hot in an oven, of each equal parts; with this sprinkle the meat at the rate of about two ounces in the pound; then lay the pieces on shelving boards to drain for twenty-four hours; turn them and repeat the operation, and let them lie for twenty-four hours longer; by this time the salt will be all melted, and will have penetrated the meat, and the pieces may then be drained off. Each piece must then be wiped with clean dry cloths, and a sufficient quantity of common salt, made hot likewise in an oven, and mixed, when taken out, with about one third of brown sugar; the casks being ready, rub each piece well with the mixture, and pack them well down, allowing about half a pound of the salt and sugar to each pound of meat, and it will keep good for several years, and eat well. It is best to proportion the casks or barrels to the quantity consumed at a time, as the seldomer it is exposed to the air the better. The same process does for pork, only a smaller quantity of sugar and more salt will answer; but the preservation of both depends equally on the meat being hot when first salted."

4339. *In directions for salting meat and other provisions, we often find bay salt recom-*

mended as preferable to any other; and it will be useful to consider how far this opinion is well founded.

Dr. Henry has shown, by careful analyses, that the Cheshire salt contains less impurities altogether than the foreign or bay salt, and therefore that the latter cannot be stronger; but the bay salt has not so much of the muriate of lime (now called chloride of calcium) and muriate of magnesia, and therefore it is less disposed to dissolve in the air; and bay salt, from the slow way in which the water is evaporated, is crystallized in larger crystals, or is what is called larger grained. Dr. Holland, who seems to have attended much to this subject, is of opinion, that although the different sorts of salts may differ little in their purity, yet from the different way in which they are made, they possess a difference of form, as well as of compactness, which may fit them for various applications, especially in the preservation of animal flesh and provisions. But in every case, the more pure the salt is, and the more free from any admixture of alkaline or earthy saline matter, the more effectual it will be for the purpose of salting. The small-grained salt is better suited for table, the salting of butter and cheese, because it dissolves more readily and incorporates more easily and intimately with these substances; on the same account, it is the most proper for preserving the different kinds of vegetables. For the like reason, of the smallness of its grain, as well as from its consequent readiness of solution, the same sort of salt is best adapted for making the pickle for meat, and for rubbing on and into its substance; salting by it is sooner performed. But it is not so well calculated for *packing* meat, fish, or provision of any kind, as the bay salt, or the common large-grained fishery salt. This is not from any want of purity or strength, but merely from the smallness of the grain, by which it runs more readily into brine, which, by being forced out from between the layers of flesh or fish, by the pressure of these on each other, the different portions of the animal matter are allowed to come into close contact, without having any salt interposed. Whereas, on the contrary, when salt of a larger and firmer grain is employed, a considerable part of it remains a long time undissolved, separating the different layers or portion of meat; admitting, in some degree, the brine to flow and insinuate itself between them, and admitting also a constant new supply of saturated brine, from the gradual solution of the salt in the fluids exuding from the animal matter to every part of the packed provisions. It does not appear, from all these considerations, that the bay salt, which is a foreign commodity, has any real advantage over the salt made in this country of as large a grain, either by sea-water or from the rock salt, and therefore it is desirable that the prejudice in favour of foreign bay salt should be removed, as injurious to our home manufacture. This fact is well illustrated by the practice of the victualling department of Government at Deptford; there, for several years, the large-grained salt manufactured in this country from natural salt brine springs has been the only salt used for packing provisions, after they have been first cured with common salt, or that which is prepared by a heat of 180°. And though these provisions have been carried to the hottest climates, the strength and purity of the salt employed in preserving them have never been called in question; and the provisions are considered equal in every respect to that packed with the bay salt of St. Ube's or any other place. Indeed, what is now sold in the metropolis as bay salt is almost wholly the large-grained salt of home manufacture from natural brine springs. Such salt, however, though it may be equal in quality, should not be charged at the same price as foreign salt. It is said that strongly rooted prejudices in favour of bay salt exist in Ireland and Scotland; but as salt of equal quality can be made in England, it is very desirable that the large sums paid for bay salt may be saved to the country.

4340. *In domestic economy, salting is sometimes performed only by rubbing in salt;* but this is less efficacious than pickling in brine, or packing in dry salt, and frequently fails when it is wished to keep the meat long; it answers very well where the meat is to be used in a short time.

It is desirable to avoid salting meat in hot weather, if it is to be kept for any length of time; and, in particular, it is improper for the butcher to send meat to any distance in the heat of the day if it is intended for salting; if the meat has been heated, it will not take the salt well. Autumn is the most favourable season for this purpose. If salting in warm weather be necessary, it should be done as soon as possible after the animal is killed; for if it hangs a single day, it runs the risk of being fly-blown, or being tainted in some part, and, if once tainted, it will not take the salt. If the weather be cold, and it cannot be salted immediately on being killed, it will be better for hanging two or three days to become tender, as this change does not take place after it has received the salt; but the first must be guarded against.

For salting, wooden troughs are generally used; some line them with lead, but this is better omitted, as this metal may prove injurious. Glazed salting pans are purposely made of Welsh ware, or Nottingham stone-ware, which answer very well; but common red earthen-ware pans are liable to have the glaze destroyed. The first operation is to clear away any blood or slimy matter that may appear on the meat, and to remove any kernels. It should be then slightly sprinkled with salt, and laid on sloping boards for a day or two for the blood to drain off; and the brine that runs out must be thrown away, as unfit to use again, if the weather be warm, for the blood and other juices that are extracted are apt to putrefy; but if the weather be cold, the brine may be saved to be used over again, if necessary, after boiling. The meat should then be wiped with clean cloths. Dry some common salt in an oven, and bruise it by rolling; some add to this brown sugar, in the proportion of three ounces of salt to one of sugar, which will assist in preserving the meat, and also render it more juicy and mellow. The salt should now be well rubbed into every part of the meat; after which the meat should remain in the trough for a day, and then be turned and rubbed again for several days successively. If it be required to have the meat look read, add half an ounce of saltpetre to the salt; but it is to be observed that this rather tends to harden it. As to the time required for salting, that will depend partly upon the size of the joints, the manner in which the salt has been rubbed in, and the length of time it is required to be preserved. Meat requires, in general, from four or five days to a fortnight, according to the size. Much salt injures its nutritive properties, and makes it tough; but when slightly salted, or *corned*, as it is called, it is still juicy and tender, easily digested, and sufficiently nourishing. Rubbing in salt cannot be applied to fish, on account of their tenderness not bearing the necessary rubbing.

Salt meat is flavoured sometimes by adding to the salt some sweet herbs, onions, &c., pounded, and likewise a little spice.

4341. *Salting meat by pickle* is keeping meat immersed in a pickle, which is a brine composed of common salt dissolved in water. This mode of application does not render the meat so salt as dry rubbing, but is not calculated for keeping it so well for a great length of time, being chiefly limited to small pieces; it is thought, however, to be less injurious to the nutritious quality of the meat.

4342. *A pickle for domestic purposes* is by some recommended to consist of six or seven pounds of salt, and four ounces of saltpetre, to four gallons of water, boiled together, carefully skimmed, and then suffered to get cold before the meat is put in; to this some add a pound or two of sugar, which assists in preserving, without making the meat so salt, and corrects the hardness given by the saltpetre. It is essential that the meat should be kept wholly immersed in the pickle, by laying some weight upon it. Meat preserved in pickle gains in weight. Messrs. Donkins and Gamble found in one experiment a gain of three per cent.; in another two and a half. It should always be kept in mind that the true art of preserving meat by salting is to do with the smallest quantity of salt that can answer the purpose.

4343. *When meat is to be preserved a long time, the brine should consist of a saturated solution of salt.* A common direction in books is, that the brine should be so strong that an egg will float in it; but this is a very imperfect test of its strength, for an egg will not only float in a saturated solution, but in one that has double its measure of common water added to it; and from observing this imperfect direction, and making their brine too weak, some persons have failed in preserving their meat. Indeed, it would be advisable that the brine should not only be as strong as it can be made, but that a little more salt should be added than can be dissolved; because, as the meat is constantly giving out its juices up to a certain period, these juices will lower the strength of the brine below the preserving point; but if there is an excess of salt present, it will dissolve in the juices given out, and thus the strength of the brine will be kept up. A saturated solution of salt is made by dissolving seven ounces and a half of salt in an imperial pint of water at 60°. When the meat has lain sufficiently in the brine, it is to be taken out and packed in casks with dry salt between each layer of meat. *A strong brine or pickle* for preserving meat a long time, or for sea voyages, is made by boiling down the solution; and the rule is, that the water should be evaporated till the salt begins to crystallize, which is known by a thin film of salt beginning to form on the surface when the liquid is on the fire; the water is then completely saturated.

4344. *The same pickle may be used repeatedly*, provided it be boiled up occasionally, with additional salt to preserve its strength, as this is diminished by the combination of part of the salt with the meat, and by the dilution of the pickle by the juice extracted. In consequence of boiling, the albumen, which would cause the pickle to spoil by changing very soon, is coagulated, and rises to the surface in the form of a scum, which must be carefully removed.

4345. Notwithstanding the antiseptic power of the salt, the brine that has been used is very liable to putrefaction; for the blood and all the liquid parts of an animal are more putrescent than the flesh. Mr. Ramsay, of Glasgow, has given an economical process for recovering it: "Dilute the brine with water until its specific gravity is 1·16; then pour it into a clean boiler—cast iron is best; and, to two gallons and a half, add an egg previously beaten up along with two thirds of an ounce of finely-powdered charcoal; boil and skim off the impurities which will then collect. The liquid, on cooling, will be as colourless as water. Any fish or meat to be preserved by this recovered brine must be sprinkled with salt. Different sorts of meat should never be put into the same brine."

4346. *Pickled Pork.*—Pork does not keep long without being salted, not so long as other meat. Great part of what is used for domestic purposes is slightly salted, or, as it is called, *pickled;* this, as is well known, is generally eaten with fresh meat of some kind, as poultry, veal, &c. The method of pickling it is the following: Cut the pork into pieces of a suitable size; rub them well with salt; put them into a pan with a sprinkling of salt between each piece; as the salt melts on the top, strew on more. Lay a coarse cloth over the pan, a board over that, and a weight on the board to keep the pork down in the brine.

4347. *In most farm-houses* where pork is to be kept it is treated thus: When well salted and cut into pieces, it is put into kits; after which it is directed to be covered with brine made sufficiently strong to swim an egg, and simmered over a gentle fire until the impurities which rise are skimmed off; this, when cold, is poured upon the meat, which sometimes remains in that state so long as two or three years before it is used; at which age, it is said, the fat is more firm, of better flavour, and wastes less when boiled than with less keeping.

4348. *All kinds of animal substances may be preserved by salt*, but beef and pork are the only kinds of meat usually cured in Britain as staple articles; and the former is by far the most used in domestic life. Neither of these it is now found necessary to salt to a great degree for home consumption; it is for sea stores chiefly that it is requisite to salt them completely. For distant sea voyages, pork is preferred, for several reasons, which it may be useful to point out. Pork can be preserved by a smaller quantity of salt than beef; it takes up less salt, and is, consequently, less salt to the taste. A piece of pork and a piece of beef were salted as nearly as possible in the same manner; at the end of three months the pork was of a proper degree of saltness, but the beef was so salt as scarcely to be eatable. Every one must have observed that the fat of salted meat is less salt than the lean; and, as pork contains much fat, this may be one cause of the effect mentioned. The fat of fresh pork is too luscious to be relished; but, when salted, it becomes firmer, not so disagreeable to the palate, and is more digestible. Fat, in general, has a less tendency to putrefaction than the lean of meat, as may be observed in oil, tallow, lard, &c.

It is scarcely necessary to observe that too great care cannot be taken that the provisions for the navy should be of the best quality, when we consider the importance of health to sea-faring people, and that they are for a long time deprived of the power of changing their provisions.

Bacon.

4349. *Bacon* is made from the sides and belly of the hog, salted and dried. Each side is called a *flitch* of bacon. This is a very ancient mode of preserving the flesh of the hog; and bacon has long been, and still continues a favourite food among the labouring classes in England, but is scarcely at all used by the same class in Scotland. It is extremely useful in the compositions of the cook. Smoke is generally employed in the drying of bacon, which is effected by hanging it in the wide chimneys of farm-houses. But some persons dislike the flavour communicated by much smoke; and bacon is sometimes cured entirely, or almost entirely without it.

4350. *The general process of curing bacon without smoking* is as follows: It is recommended that the hair should be burned off the hog, after it has been killed, by singing it with kindled straw laid over it, and that the skin should not be scalded, or wetted with water. A large wooden trough, or tray, being provided for the salting, with a gutter round its edges to drain off the brine, the flitches are to be sprinkled over with salt, and left for twenty-four hours in the trough, or on sloping boards, for the blood to drain away thoroughly. They are then to be taken out and wiped dry; the drainings are to be thrown away. Both sides of the flitches, but particularly the inside, or fleshy side, are to be well rubbed with either common salt alone, or, what some prefer, with a mixture in the proportion of three or four pounds of common salt, half a pound of saltpetre, and one pound of coarse sugar or treacle. The salt should be previously well dried in a frying-pan over the fire. When the rubbing is finished, the flitches are placed in the trough upon each other, the skin side lowermost, and next day they should be salted again. They are then to be left in the trough for a month or six weeks, according to the size of the flitches and the state of the weather, rubbing them over with salt four or five times in that time. After this they are dried by hanging them up over the fire, but not in the smoke, and afterward laying them upon a rack hung up to the ceiling in the kitchen, or in some very dry but not too warm a place, nor in the sun, as either of these will cause the bacon to turn rusty. There are some slight variations of this process, as practised in different parts of the kingdom; and it is in Yorkshire and Somersetshire chiefly that bacon is cured without smoking.

A great deal of bacon is cured in Ireland, and imported from thence; but it is not so well fed or cured as the English bacon, and is lower priced.

4351. *Hams are cured* in a similar manner; but this varies in different parts of the country. In Yorkshire they are cured without smoke as follows:

Mix and pound together a peck of common salt, five pounds of bay salt, of saltpetre and sal prunel two ounces each; sprinkle the ham with salt, and lay it down for twenty-four hours; rub it well with the above mixture, and let it remain for three days; then take out the meat, and boil the pickle in two gallons of water, adding salt sufficient to make the brine strong enough to float an egg; when this is cold, pour it over the ham, and suffer it to lie for a fortnight or three weeks; then dry it without smoke, having tied it up in paper to keep away the flies, &c. Some, for the same purpose, whitewash the hams over while they are drying.

See the finishing of bacon and hams by smoking under "Preservation of Meat by Smoking," Sect. V.

Salting Fish.

4352. *In preserving fish, salt is usually more or less employed.* Fish, according to the modes of preserving it, is distinguished into *dry*, *salt*, *green*, and *pickled*. The method by drying alone has been already mentioned; it is used only in the smaller kinds. Pickling fish will be described, Chap. VI.

4353. *Large quantities of cod are salted and dried* in the Newfoundland and Shetland fisheries; these are little esteemed in England, and they are chiefly sent to the Mediterranean, where they fetch a good price, as in the Catholic countries there is a prodigious consumption of fish in Lent. At Newfoundland, the fish, after being gutted and split, are laid in a pile on the shore with a layer of coarse-grained salt, called fishery salt, between each layer of fish; when they have taken the salt sufficiently, they are placed upon stages of wattle-work supported by poles, and exposed to the sun till they are quite dry, when they are packed up and put on board the ships. This mode of preparing the fish is called *curing*.

4354. *Green cod* is the kind most generally used in England. These, instead of being split quite open, like the dry fish, are only opened down to the navel; they are then salted and laid in brine or strong pickle, and put in this manner into casks, without any drying. The finest we have is cured at the Dogger Bank, and is generally brought to the London market two or three weeks after it is caught; the fish sometimes weigh from fifteen to twenty pounds, and are known even to measure from four to five feet in length. But by far the greatest quantity is prepared at Newfoundland; these and the Irish cod-fish are of an inferior quality.

4355. *Haddock, cod, or ling, are cured* by splitting the fish and removing the bone, they are then salted for two or three days with equal parts of salt and sugar, or with salt alone; afterward they are stretched on sticks, and laid on the beach to dry in the sun, or on stages, or within the influence of a kiln or stove.

4356. *Herrings are preserved* by being salted, pickled, or smoked. The Dutch have always been famous for curing herrings, and it has been supposed that they first began the herring fishery; but there is evidence to show that the Scotch had preceded them.

4357. The people of Yarmouth have been long celebrated for salting and barrelling herrings, and for their method of preparing red herrings. They have greatly the advantage over the Dutch in being nearer to the herring shoals.

4358. *To salt herrings*, as soon as they are taken out of the sea they are cut open, and everything is taken out except the milt and the roes; then, after washing them in fresh water, they are left in a tub of strong brine for twelve or fifteen hours. They are drained, and afterward packed up in barrels, disposing them evenly in rows, pressing them well down, and strewing a layer of salt between each row, and another at top and bottom. Mackerel are sometimes cured in the same manner; also pilchards, of which vast numbers are taken off Cornwall, and exported to the Mediterranean.

The same objection that is made to salted meat applies likewise to herrings and other fish; but they are much used by the poor, and are rendered less injurious by a plentiful addition of potatoes; indeed, the best way of using salted herrings is by merely employing them to give a relish to that excellent vegetable.

Sect. IV.—Preserving meat and fish by sugar.

4359. The preservative power of sugar is well known; and though it is not a common practice to preserve meat and fish by it alone, yet this has been done occasionally. Meat has been preserved fresh for months by being immersed in molasses.

4360. To preserve fish by sugar, open them and rub the sugar in, in the same manner as salt, leaving it then for a few days. If the fish be intended for long keeping, dry it after this, taking care to expose new surfaces to the air frequently, to prevent mouldiness. Fish preserved in this manner, it is said, will be found, when dressed, much superior to what has been cured by salt or smoke. For a salmon of six pounds' weight, a table-spoonful of brown sugar is sufficient; and if hardness be required, a tea-spoonful of saltpetre may be added.

Sect. V.—Preservation of meat by smoking, or smoke-drying.

4361. It has been long known that the smoke of burning wood has the property of preserving the flesh of animals from putrefaction. We find from Horace that the making of hams in this manner was practised by the Romans:

"Fumosæ cum pede pernæ."—Sat. ii., 2.

But it is only of late that chemistry has taught us the rationale of the process. A certain portion of salt is almost always employed; but much less is necessary than when no smoke is used, and the smoke imparts a peculiar flavour that is much relished by many persons; the juices of the meat are likewise more perfectly preserved than when it is only salted and dried, by which it is apt to become hard if long kept.

4362. *The usual method of smoking meat in England* is to hang it, after being salted to a certain degree, in those large and wide chimneys which were universally built formerly in our farm-houses, in which they were exposed to the ascending smoke; latterly it has been the custom to erect rooms or houses for the express purpose of hanging meat in to be smoked. The smoke from every kind of fuel is not effectual for this purpose; that from coal does not answer; the smoke of wood and of peat only are fit: nor is every kind of wood equally proper; the quality of the wood has an influence upon the flavour of the meat; beech and oak are preferable to fir or larch. Smoke from the twigs of juniper, rosemary, peppermint, &c., impart to the meat something of their aromatic flavour. Westphalia hams are smoked by juniper; slow smoking is preferable to a more rapid one, as this penetrates more completely into the interior of the meat.

4363. *With respect to the theory of preserving by smoke*, it is now known that in the smoke of wood there is an acid vapour which rises with it, and is the cause of the preservation of the meat. Every one must have remarked how much more pungent for the eyes is the smoke of wood and turf than that of coal; this is owing to the acid just mentioned, which can be procured in a separate state; and as this was at first thought to be one of a peculiar kind, distinct from all other acids, it received the name of *pyroligneous acid*, or acid of wood. But subsequent observations have shown that it is not a peculiar acid, but the same as the acetic, which forms the sour principle *in vinegar*: an opinion which is confirmed by the manufacture of actual vinegar in the distillation of wood. The liquid that comes over first in this distillation is of a dark brownish colour, and consists of acetic acid mixed with tar and water, from which good vinegar is afterward prepared by rectification. The crude liquor still goes by the name of the pyroligneous acid, and is now successfully applied to the preservation of animal substances by simply washing them with it, which is, in fact, making use of the active principle in wood smoke; and this substance might, without much impropriety, be familiarly styled the *essence of smoke*.

4364. *It appears that the first application of pyroligneous acid* to the preservation of meat was made by Mr. Sockett in 1820, from having reflected upon the antiseptic property of wood smoke, and having the opportunity of making some experiments with this acid, made in a manufactory near him. By adding some of it to the pickle for making hams, he found that a much smaller quantity of salt was sufficient; and he even succeeded by brushing over the ham with the acid without employing the pickle. He likewise tried it with success on salmon and herrings.

It should be observed that, after meat or fish have been smoked by the liquid pyroligneous acid, it is necessary to expose it a few days to the air, to take off a peculiar smell.

This opinion respecting the antiseptic property of pyroligneous acid has been completely confirmed by various experiments. Fish simply dipped in it and dried in the shade are perfectly preserved. If haddocks are cleaned, split, and slightly sprinkled with salt for six hours, then drained, and dipped for about three seconds in the acid, and afterward hung in the shade for eight days, they are found to be equal to the highly esteemed *Finnan* haddock. Herrings cured in the same way, and dried in the shade for two months, are equal in quality and flavour to the best red herrings, the fish retaining the shining and fresh appearance which they had when taken out of the sea. A piece of beef was dipped for one minute in pyroligneous acid, in July, 1819; on March 4, 1820, it was as free from taint as when first immersed; no salt was used.

4365. Acetic acid, or pure vinegar, appears to have likewise considerable antiseptic power. Beef and fish dipped in it were found free from taint several months afterward, but when cooked had an insipid taste. The empyreumatic oil, or tar of the pyroligneous acid, is useful in giving that peculiar flavour so much relished in smoked meat. Mr. Donovan observes that pyroligneous acid is, perhaps, more generally made use of in the curing of fish and flesh, as a substitute for wood or turf smoke, than the public are aware of, and that perhaps it acts to the full as well, if not better, for communicating flavour, while it is also an antiseptic. Hams intended for smoke-drying are usually cured with a less quantity of salt than when they are not smoked; even one half the quantity is often sufficient.

4366. Hitherto we have spoken of the pyroligneous acid as possessing the property of preserving meat from putrefaction; and it is sufficient for most practical purposes to take this view of it. But we may now state that late discoveries in chemistry have shown that there *is a peculiar principle in the acid of wood which produces this effect.* A kind of oily substance has been extracted from this acid by Reichenbach, and also from coal tar, to which they have given the name of *creasote.* This oil is transparent, colourless, peculiarly volatile, has a pungent odour, and possesses a very remarkable power of coagulating albumen. That it is this principle in wood smoke and the pyroligneous acid which is effective in preserving flesh is evident from the following facts: If to a solution of albumen in a large quantity of water, a single drop of creasote be added, the albumen is immediately coagulated. When fresh meat is put into a solution of creasote, allowed to remain for half an hour or an hour, then withdrawn, and afterward dried, it may be exposed to the heat of the sun without putrefying, and in the space of eight days it becomes hard, the colour changes to a reddish brown, and the flavour is that of good smoked beef. Fish may be preserved by it in the same manner. M. Reichenbach has ascertained that creasote does not act upon pure fibrin, which by itself is said not to be susceptible of putrefaction. Its action upon living animals is highly deleterious. It is not to be understood from this that pure creasote is to be preferred for this purpose to the pyroligneous acid; it would be much too powerful; and what we have said is merely intended to show that it is really this substance that is the effective agent in wood smoke and pyroligneous acid.

Bacon.

4367. *Bacon is smoked* after it is salted, in many parts of England, particularly in Wiltshire. The treatment is at first nearly the same as has been already described in preparing salted bacon; after which the flitches are hung up in the smoke. Smoked bacon is by some considered as superior to what is salted and dried only; as it is less salt, and thus acquires a flavour relished by some persons. The smoke may be not only from wood, but from straw; but the wood of fir or deal is improper. The best way is to dry the flitches slowly over smoke made by sawdust of oak or beech; the fire may be kept burning in a smothering manner by sawdust, and should be kept up night and day. In some parts of the country, drying and smoking bacon and hams is a separate trade; they charge fourpence or sixpence each for hams, and one shilling for each flitch of bacon; and it saves much trouble to send the flitches to those persons who practice smoking as a business. The flitches should be hung up sufficiently high from the fire, and they should hang till quite dry, but not so long as to get hard and cause the rind to separate. It is not prudent to rub the flitches with bran, as is sometimes done, since this often harbours insects; and great care must be taken to preserve bacon and hams from flies, which lay their eggs there and produce maggots. It is better to put them into coarse calico bags than in paper, as the latter is liable to break and tear.

When large quantities of bacon are to be smoked, it is generally performed in a *smo-*

king-house, prepared on purpose. This is generally a hut about twelve feet square, and the walls seven feet high, with a hole in the roof; joists are laid across in the inside to hang the flitches upon, and the floor is covered five or six inches deep with sawdust, which is kindled, and causes a great deal of smoke, with scarcely any flame.

4368. *What is called rusty bacon* is, in fact, bacon more or less advanced in the process of decay or putrefaction; and though this may be swallowed with impunity in small quantities by strong ploughmen, yet it will prove extremely unwholesome to more delicate stomachs. Bacon, as an article of food for the labouring classes, has many inconveniences, as well as its advantages of convenience and cheapness. It creates thirst, which must be quenched sometimes with beer, and too often leads to ardent spirits.

Hams.

4369. *Hams consist* of a leg or thigh of the hog, salted, seasoned, dried, and sometimes smoked to give it an agreeable flavour. They are cured according to various modes in different places, but it does not appear that the best method has been determined by any well-conducted set of experiments, though the methods are nearly similar to what we have described in the curing of bacon. In those districts which are the most celebrated for the making of good hams, they are first rubbed very hard with salt, and some let them remain for a time upon a stone bench, in order that the brine may drain away; others, on the contrary, cover them up quite close. But whatever method has been followed, after the lapse of a few days they are again rubbed as hard as before, with the same kind of salt, mixed with saltpetre in the proportion of about half an ounce to each ham; and some add sugar. Ude recommends equal parts of sugar and salt. They are then continued about a week longer on the bench, or in the salting tub among the brine, when they are supposed to be ready to hang up to dry. The drying is performed in different modes, according as it is wished to have the hams smoked or not. If they are to be smoked, they are usually hung up in large, wide chimneys where they burn wood or peat, as in Westmoreland, or in smoke-houses. The smoke of peat gives a peculiar flavour. These smoking-houses sometimes consist of two or three stories, the fire being made in the lower one, generally a sunk story, where the previous salting is performed. The meat is hung in the story above, and it is desirable that they shall be at some distance from the fire, that the smoke may arrive at them cool; the principal part of the soot being deposited in the flues of the lower story. From this story the smoke ascends through holes in the ceiling into another placed above, in which sausages and fish are also smoked. It requires about six weeks to smoke meat sufficiently, if it is five or six inches thick; if thinner, less time will do. The smoke penetrates quicker and better in cold weather than in warm; and on this account the process is seldom carried on in the summer season.

4370. Several places on the Continent, Westphalia in particular, are famous for the delicacy and flavour of their smoked hams and other meat; and the manner of smoking them is nearly the same as that just described. In Westphalia, it is said they use juniper wood for the smoking.

4371. In many countries, various kinds of animal food are preserved by smoke-drying besides bacon, pork, and hams. In the north of England, and in Dumfriesshire, mutton and beef hams are smoked. In Germany, venison, geese, and ducks are cured in this manner. The Orkneys were formerly celebrated for smoked geese, and sillocks, a small salt-water fish. The Highlands of Scotland are famous for smoked salmon.

4372. *To prepare hung Beef.*—This is preserved by salting and drying, either without or with smoke. Hang up the beef three or four days, till it becomes tender, but take care it does not begin to spoil; then salt it in the usual way, either by dry salting, or by brine with bay salt, brown sugar, and saltpetre, with a little pepper and allspice; afterward roll it tight in a cloth, and hang it up in a warm, but not in a hot place, for a fortnight, or more, till it is sufficiently hard. If required to have a little of the smoky flavour, it may be hung for some time in a chimney corner, or smoked in any other way: it will keep a long time.

4373. *To make hung Beef in the Dutch Way.*—Take a lean piece of beef; rub it well with treacle or coarse sugar, and let it remain for three days, turning it frequently; after that, wipe it dry, and salt it well with common salt and saltpetre, well dried and beaten fine; turn it every day for a fortnight; roll it quite tight in a coarse cloth, and put it into a cheese press, or under a heavy weight for a day; hang it then to dry in the smoke of wood or turf, but turn it upside down every day.

4374. *The tongues of various animals are preserved by salting and smoking. Neats' tongues* are sometimes pickled only; but they are more commonly salted, dried, and smoked. *Reindeers' tongues* smoked come to us from Norway as a great delicacy.

4375. *Tar vinegar has been used for giving the smoky flavour* to meat. Pour half a pound of the best pickling vinegar over an equal quantity of common tar; stir them together, and let them remain for an hour; then pour off the vinegar. Cut slices from a ham that has been cured with salt, but which is deficient in the smoky flavour, and dip them into this tar vinegar. Broil them, and they will be found to be much improved.

4376. *Curing with smoke is applied very successfully to fish of various kinds. Red herrings* derive their appellation from the brownish red colour given to them by smoke after they have been salted. Yarmouth has been celebrated for many centuries for the preparation of red herrings, and it still stands unrivalled in Great Britain, and is, perhaps, not excelled anywhere. The best kind prepared there are known by the name of "*Yarmouth bloaters.*" The Yarmouth are first salted, and then smoked with wood smoke; but the Dutch use turf, and sometimes straw, for smoking.

4377. *Herrings may be easily smoked* thus: Wipe them clean, and lay them in equal parts of salt and sugar, and a little saltpetre for twenty-four hours; then hang them on a stick by passing it through the eyes. Put some oak sawdust into a cask, and place in the sawdust an iron heated red hot. Fix the stick across the cask, letting the herrings hang within; cover the whole with a cloth, and let it remain for twenty-four hours.

The best way of dressing red herrings, we are told in "Sir John Cochran's Seamen's Guide," is to soak them in water until they become pretty fresh, and hang them up in the sun and wind; then boil or broil them as wanted. In this way they eat extremely tender. Red herrings, though by no means a wholesome food if eaten too frequently, and particularly if the salt be not taken out, yet, from their high flavour, they may be made extremely useful, as a cheap addition to other varieties of food that would be insipid by themselves; and they have the advantage of being easily kept for a very long time.

4378. *Smoked salmon*, called "kippered salmon," is a favourite article of diet in Scotland for breakfast. After taking out the inside of the salmon, scale and split it; then rub it with common salt and Jamaica pepper, and let it drain for twenty-four hours. Mix together salt, coarse sugar, and a little saltpetre, and rub the fish well once or twice with this, and leave it in a tray to pickle for a couple of days; wipe and dry it, stretch it on sticks, and hang it up in the smoke of a turf or wood fire to dry. If less smoking is wished, dry it partly by the heat of a fire or the sun. Kippered salmon is eaten boiled and just warmed through.

4379. *Finnan haddocks* are cured at Findhorn (pronounced Finnan), a fishing village near to Aberdeen famous for this fish, which are considered very delicate, and are much used at breakfast in that part of Scotland; they are split, dried for a day or two in the sun, and hung up for a few days on wooden spits on a wide chimney filled with smoke from a fire made of peat and sea-weed, so as to receive a very slight flavour. These may be had at Billingsgate in London; but great care must be employed in getting them genuine. *An imitation of the Finnan haddock* is commonly made by salting them for a few hours, splitting and wetting the fish with pyroligneous acid, and hanging them to dry.

4380. *Buccaning meat* is a mode of preserving it practised in some parts of the West Indies, and which was employed by the Caribs before their conquest by the Europeans. A number of hunters and pirates, existing in the West Indies about 1630, received the name of "Buccaneers" from their practising this mode of preserving meat.

The flesh was cut into pieces of the length of the arm and salted. Next day the pieces were laid upon a grating, or hurdle, made of sticks, called a buccan, and placed at some height above the ground. A fire of wood was then made below, and a thick smoke produced; the meat was thus partly roasted, partly dried, and also smoked. Large quantities used to be cured in this manner by the hunters, and the meat is said to have a particularly agreeable flavour.

SECT. VI.—PRESERVATION OF ANIMAL FOOD BY VINEGAR.

4381. *The antiseptic property of vinegar* has been long known; but the acid nature of vinegar renders it improper for the preservation of food in general, and it is only employed, combined with salt and spices, in some substances that may be considered among the luxuries rather than the necessaries of life. It is not used for preserving any kind of butchers' meat; and only a few kinds of fish are preserved by it. Its chief employment is in pickling certain fruits, roots, and leaves of vegetables employed as condiments to improve the relish of several kinds of food.

4382. The principle by which acids preserve animal and vegetable substances is the property which they have of coagulating the albumen of the vegetable or animal substance, this principle being peculiarly susceptible of putrefaction.

4383. *Salmon is pickled with vinegar* in the following manner: The fish ought to be perfectly fresh, and in good condition. It must be cut into pieces of convenient size, but the scales are not to be taken off. Make a strong brine, and boil the fish in just so much as will cover it, with some whole pepper and allspice, but take care not to over-boil. When sufficiently done, lay the fish on a slope to drain off the superfluous liquor. When quite cold, pack it up close in kitts, a kind of small, shallow casks, and pour over them some of the brine, together with some good vinegar; let this stand for a day; and then, to make them lie close, strike the sides of the kitt with a mallet, and pack them down as close as possible; then head the kitts. Some boil in the liquor bay leaves, fennel, and tarragon. The kitts should not be opened till wanted for use; the fish will keep after that about a fortnight. The goodness of pickled salmon is known by the brightness of the scales, and their adhering fast to the skin, the firmness of the flesh, and its fine rose colour. If stale, or beginning to spoil, it is extremely unwholesome, and altogether unfit for food.

4384. *To make Caveach, or Pickled Mackerel.*—Take the heads off the fish, open them, and take out the inside, preserving the roes and livers; then divide the fish into quarters. Prepare a seasoning by mixing together a quarter of a pound of salt with two ounces of pepper, half a drachm of mace, a drachm of allspice, and some nutmeg grated; rub well this into the fish, and then fry them of a fine brown with olive oil; drain them dry on a hair sieve, and then put them close into a stone jar, which must be filled up with vinegar; put a little olive oil on the top, and secure the whole with bladder. Mackerel may also be pickled in the same way as salmon.

4385. *To pickle Oysters.*—Put the oysters into a stew-pan, with their liquor, over the fire; do not let them boil, but take them off when they are white and firm; remove the beards; strain the liquor, and put it with twice its quantity of good vinegar into a stone jar; to this may be added some mushroom ketchup, some bay leaves, tarragon, and shallots. Stew the whole in an oven for three hours; when cold, put them into a jar, strewing in with them a little pounded sugar, some pepper-corns, allspice, and bay leaves. Fill up the jar with vinegar, and cork and secure it with bladder.

4386. *Mussels and Cockles* may be pickled in the same manner, and the spices may be varied according to taste.

SECT. VII.—M. APPERT'S METHOD OF PRESERVING FOOD.

4387. *A work was published in Paris in* 1810 *by M. Appert*, entitled "The Art of preserving all Kinds of Animal and Vegetable Substances." The methods employed by the author for this purpose had been in some degree anticipated by Mr. Boyle many years ago, and have, to a certain extent, even been practised by our housewives in this country, at least with respect to vegetables; yet M. Appert does not appear to have been acquainted with any of the former experiments, which had never been followed out and reduced to practical rules: he is therefore entitled to the merit of the invention, which has proved of great utility, and has afforded the most complete mode of preserving meat in the best condition, which has been of late eminently useful in long voyages by sea.

4388. M. Appert received a reward of 12,000 francs from the French government, and he observes, "That before that time two principal methods had been employed for preserving food; that of drying, and that of mingling, in greater or less quantities, some other substance for the purpose of impeding fermentation or putrefaction. By the first of these methods we obtain smoked and hung meat, dried fish, fruits, and vegetables; by the latter, we have fruits and other vegetable substances preserved in sugar, pickles, salted meat, and vegetables. But each of these modes has its peculiar inconveniences. Drying takes away the odour, changes the taste of the juices, and hardens the fibrous or pulpy matter. Sugar, again, from the strength of its own flavour, in a great measure conceals or destroys other flavours, particularly where we wish to preserve the agreeable acidity of certain fruits: it is also very expensive. Salt communicates an unpleasant acerbity to substances, hardens the animal fibre, and renders it difficult of digestion. Vinegar can seldom be made use of, except in certain articles for seasoning."

4389. *To describe the principles of M. Appert's method*, we must observe that animal substances are more liable to decompose, or *spoil* (to use the language of the kitchen), than vegetables, and hence are more difficult to preserve. Many of the latter can be kept quite fresh for a great length of time in their raw state, merely by sealing them in a close vessel, and filling the interstices with some loose substances that will exclude nearly all the air. But meat cannot be preserved raw in the same manner. If raw meat should be treated in this way, its complete change would be much retarded, but it would not be preserved long in a condition fit for food. When meat has been boiled, there is a remarkable difference; the albumen has been coagulated, and, as this is the principle where the putrefaction first commences, cooked meat keeps longer than raw; but it does not by this alone keep any great length of time, except the air be *thoroughly* excluded. Air is essential to the process of putrefaction, and if animal or vegetable substances could be kept wholly out of contact with it, no change could take place. But it is not sufficient that the air is kept from the external part of these substances; that in the interior parts is sufficient to begin the fermentation. Boiling drives out this internal air, and after that, if the substances be placed in a vessel entirely emptied of air, their preservation will be secured. M. Appert's method, accordingly, consists in applying heat to the substances to be preserved so as to coagulate their fermentable juices, and likewise in placing them in such a situation that they shall be deprived of the contact of air. Fabroni and Thenard had previously observed that heat destroyed the fermenting principle in grape juice and fruits, and showed that they might thus be preserved for a long time. It is quite essential that the vessels into which the meat is put should be plunged for some time into boiling water, in order completely to drive out the air; for Gay Lussac ascertained that, though putrefaction cannot take place if air be *thoroughly* excluded, yet the smallest quantity of oxygen gas present is sufficient to produce a commencement of putrefaction, and after the process has commenced, it goes on, whether air be present or not.

4390. M. Appert says, with justice, of his method, "That the great advantage of it consists principally in its application to the service of the navy. It will supply fresh and wholesome provisions for vessels on long voyages, with a saving of more than fifty per cent. Mariners will, in case of illness, be furnished with broth, various and cooling beverages, vegetables, and fruits: in a word, they will be able to partake of a number of alimentary and medicinal substances, which will alone be sufficient to prevent or cure some of the diseases contracted at sea, more especially the worst of them all, the scurvy."

4391. *The preserved substances first presented by M. Appert to the Council of Administration of France* were "Pot-au-feu," a well-known standing French dish of boiled meat, fowls, &c., consommé, milk, whey, green pease, small Windsor beans, cherries, apricots, currant juice, and raspberries. Each of these articles was contained in an earthern vessel hermetically sealed, the cork being fastened with iron wire, and pitched. They had been preserved above eight months. On examination, the pot-au-feu was found to consist of a tolerably rich jelly, with a piece of beef and two pieces of fowl in the middle. When the whole was warmed with care, the soup was found good, and the meat was very tender, and of an agreeable flavour. The consommé was excellent, and quite fresh, though prepared fifteen months. The milk was found to be of a yellowish colour, resembling that of beestings; thicker, as well as sweeter, and more savoury than ordinary milk, a superiority it derived from the concentration it had undergone. Milk prepared in this way was considered nearly equal to the cream sold in Paris; and it did not appear to suffer from uncorking and being put into another bottle. The whey had all the transparency of whey recently prepared, and, though transferred into another bottle, did not begin to lose its transparency till the end of a fortnight. The green pease and beans were as fresh as if just gathered, and the currant and raspberry juice had preserved their aromatic flavour. The reports of French naval officers completely confirmed the expectations which M. Appert had formed respecting the success of this method of preserving provisions.

4392. *Soon after this publication, a patent was taken out in this country* for M. Appert's discovery by Messrs. Donkin and Co., and they succeeded equally in accomplishing the same object. Their method, which is nearly the same as that of M. Appert, is the following:

The meat to be preserved is first parboiled or somewhat more, and freed from the bones. It is then put, together with vegetables, if required, into tin cases or canisters, which are filled quite up with a rich gravy. A tin cover, with a small aperture, is then carefully fixed on by solder; and, while the vessel is perfectly full, it is placed in boiling water, and undergoes the remainder of the cooking. The small hole in the cover is completely closed up while the whole is yet hot. The canister with its ingredients is now allowed to cool, in consequence of which these contract, and the sides of the vessel are slightly forced inward by the pressure of the atmosphere, and become a little concave. The vessel being thus hermetically sealed, and all access of air prevented, it may be sent into any climate without fear of putrefaction, and the most delicate food of one country be thus eaten in its original perfection in a distant region, many months, or even years, after its preparation.

In this manner may all kinds of alimentary substances be preserved: beef, mutton, veal, and poultry; fish and game; soups, broths, and vegetables; creams and custards. Of a quantity taken by Captain Nash to India, not one canister was spoiled, and one which he brought back contained, after two years, beef in the highest state of perfection and preservation, and after having been carried upward of 35,000 miles in the warmest climates. This method has been adopted by the commissioners for victualling the navy, who, having examined some meat so preserved for four years during voyages in the Mediterranean and to America, found it as sound, sweet, and fresh, as if it had been boiled only the day before.

4393. Captain Hall gives his testimony as follows: "I can answer for the perfect preservation of a great number of cases which were in my possession during the voyage to China. I had £88 worth, and not one failure. At that time milk was preserved in bottles corked; but tin cases have been substituted with very great effect. It is really astonishing how excellent the milk is; and, indeed, everything preserved in this way is good. You must, on examining the list of prices, bear in mind that meat thus preserved *eats* nothing, nor drinks; it is not apt to get the rot or to die; does not tumble overboard, nor get its legs broken, or its flesh torn off its bones by knocking about on the decks of a ship in bad weather; it takes no care in the keeping; it is always ready; may be eaten hot or cold; and enables you to toss into the boat, in a minute, as many days' cooked provisions as you choose; it is not exposed to the vicissitudes of markets; nor is it scourged up to a monstrous price (as at St. Helena) because there is no alternative. Besides these advantages, it enables one to indulge in a number of luxuries which no care or expense could procure."

4394. *Considering the great superiority of M. Appert's method* of preserving food to all others before his time, and likewise that there may be many occasions in which it may be practised with great advantage, we shall here give the principal directions which he has published, taken from the original work, in which there are many useful practical hints connected with the details of his process. The use of tin canisters is an improvement by Messrs. Donkin; M. Appert has employed glass and earthen-ware vessels. Messrs. Donkin also have taken care to exclude the air from the interior of the vessels as much as possible, by leaving a small aperture in the lid of the canister, through which the expanded air escapes during the last boiling, rendering the inside nearly a vacuum, a circumstance which does not appear to have occurred to M. Appert. As his methods, however, have rather more simplicity, and though less perfect, yet appear to have answered in general, requiring no tin canisters, which cannot always be so easily procured as bottles and jars, an account of his processes should be generally known.

4395. *M. Appert's Method of preserving boiled Beef, Mutton, or other Meat.*—The meat is first put into a pot to boil in the ordinary way; when three quarters done, half the meat is taken out, and the other half is boiled into a strong broth, which is strained, and part put into a bottle to be preserved. The other half of the meat is put into another bottle, which is struck against a cushion on a table, to shake down the materials, and the bottle is filled up with some of the broth that had been made. Both bottles are then securely corked, and luted in the manner that will be afterward described, and they are placed in a boiler which is filled up with cold water as far as the rims of the bottles or jars. A lid is now put on the boiler, and fire being applied, the water is made to boil, and is kept up at that heat as long as the particular substances require to be thoroughly done, when the fire is put out; in half an hour the water is drawn off by a cock; in another half an hour the lid of the boiler is to be removed; and in one or two hours more, the bottles or jars may be taken out, and placed upon shelves in a cool place.

4396. We shall now describe the methods which he employed to secure his bottles so as to be air-tight previously to their being placed in the boiling water, as mentioned above. As the complete exclusion of the external air from his bottles is essential to the success of the process, his first care is to have the bottles or jars quite sound, and as wide mouthed as the corks would allow. He employed no corks but those of the very first quality, and when he had bottles made on purpose, he had a projecting ring formed on the inside of the neck, more effectually to compress the cork and make it tight. The corking was very carefully performed; the bottles were then enclosed in coarse linen or canvass bags to preserve them from being broken. When he employed jars, he was obliged to join several pieces of cork together to make a stopper large enough; and as his method was ingenious, we shall notice it. He joined together several pieces of cork with isinglass glue made as follows: Having dissolved four drachms of well-beaten isinglass in eight ounces of water over the fire, he filtered the solution through linen, and again put it on the fire to reduce it to one third of the quantity. He then added an ounce of full proof brandy, and left the whole on the fire till it was reduced to three ounces. When he wanted to use this glue, he put some in a little pot over live coals, warmed the pieces of cork, and applied the glue to the surfaces with a brush; he then bound the pieces together with string, and let them dry in the sun or in a gentle heat for a fortnight, when he cut them to the size of his jars. Having corked his jars or bottles, he then covered the corks and edge of the vessel with a lute made of quicklime slacked in the air, and beat up with skimmed milk cheese to the thickness of paste; this hardens very rapidly, and withstands the heat of boiling water. Lastly, he applied strips of linen to this paste, and bound the whole down with two wires crossing each other. If the bottles were to be sent to a distance, he enclosed them in canvass bags, pitched if necessary

4397. In this manner a great variety of dishes are preserved, so as to be sent to distant places, as round of beef, mutton, fowls roasted and fricasseed, young partridges roasted, eels, carp, pike, sweetbread, mushrooms, onions, butter, anchovies. In short, the result of these experiments shows that in this manner all animal productions may be preserved for one, or even two years. But some substances, as broth, jellies, &c., will bear much boiling; other substances will be spoiled by being boiled too long.

4398. *Gravies are preserved* in a manner nearly similar. M. Appert directs that gravy should be made in the proportion of two pounds of good meat and poultry to one quart of water; and the best pieces are to be taken out when one quarter dressed. The gravy is then to be strained and suffered to cool, after which it is to be bottled, corked, luted, and tied as directed above, and placed in the boiler. The boiling should be continued for two hours before the bottles with gravy are properly prepared. The meat and poultry that was taken out may be prepared in other bottles in the manner described above for meat.

4399. *Blood may be preserved* for the use of refiners, or for any other purpose, by putting it into bottles with very narrow mouths without boiling; they must be filled to within an inch of the top, and then have a small quantity of olive oil poured in to the depth of an inch, and then corked thoroughly to exclude the air. Blood has been kept in this manner fresh for two years. M. Appert's method of preserving vegetables will be described in Chap. IV., Sect. III.

4400. *M. Appert's Method of preserving Eggs.*—The eggs are put into a jar with raspings of bread, or bran, to prevent breaking; the jar, corked and luted, is put into a suitable vessel with water heated to 200° Fahr., or 12° under boiling. The vessel with water being taken off the fire, the water is allowed to cool till the finger can be borne in it. The eggs are then taken out, and they will keep fresh for six months.

4401. *M. Appert's Method of preserving Milk.*—Fresh milk was reduced by boiling to one half, and beaten up with the yolks of eggs in the proportion of eight eggs to every ten and a half quarts of milk. The whole is then again placed upon the fire for half an hour, during which time it is to be skimmed frequently; it is then to be strained, bottled, and treated in the water-bath for two hours. This milk kept for two years, and if churned, would afford good butter. *Cream is preserved* by boiling it down from five measures to four; it is then cooled and skimmed, put into bottles, corked, luted, and treated in the water-bath boiling for an hour. This cream will keep two years.

4402. *Many articles of provisions prepared in M. Appert's manner may now be had* in London. These may be carried fresh to the East and West Indies, and are extremely convenient for pleasure yachts, cabin stores, &c. Turtle soup may be had in London preserved in this way, in quarts, three pints, half gallon, and gallon canisters, at the price of 12*s.* 6*d.* per quart, which is found more convenient on some occasions than purchasing the turtle. We subjoin a list with the usual prices, which include the tin cases:

List of Provisions preserved by M. Appert's Method, to be purchased in London.

	s.	d.
Meats.		
Soups and boulli . . per lb.	1	9
Round of beef . . . "	1	9
Roasted beef . . . "	2	0
Boiled beef . . . . "	1	3
A-la-mode beef . . . "	1	6
Mutton, roasted . . "	2	0
" boiled . . . "	1	9
" and green pease "	2	0
Meat in small Cases		
Soup and bouilli for quarts, per doz.	24	0
A-la-mode beef . . . per lb.	24	0
Ragout of mutton . . "	27	0
" " veal . . . "	27	0
Mock turtle . . . . "	27	0
Poultry.		
Ragout of fowls . . per lb.	2	0
" " turkey . . "	2	0
" " goose . . "	2	0
Fish.		
Fresh salmon . . . per lb.	2	3
Stewed eels, per lb. . . .	2	0
Oysters, half pints, per case	1	9
" pints . . "	3	0
Lobsters for fish sauce, quarter pints	1	0
Ditto, half pints	2	0
Vegetables.		
Carrots, plain . per lb. .	0	8
Carrots and gravy " . .	1	0
Parsnips . . . " . .	1	0
Beet root . . . " . .	1	0
Vegetables for table service .	1	0
Green pease and gravy, pints	2	0
" " " " quarts	3	0
Sage and onion with gravy, per doz.	12	0
do. for ducks and pork " .	24	0
Soups.		
Vegetable soups, pints, per doz.	20	0
quarts " "	36	0
Carrot soups, pints, per doz.	20	0
quarts " "	36	0
Concentrated gravy, pints, per doz.	10	0
quarts " "	20	0
Ox-tail soup	1	9
Portable soup, beef, per case	4	0
Ditto, beef and mutton "	4	6
Ditto, beef and veal "	5	0
Turtle soup	10	0
Mock turtle do.	2	0
Portable soup and beef-tea in skins for immediate use	3	0
Milk.		
Half pints, per doz. . . .	8	0
Pints . . " "	12	0
Cream, half pints	14	0
" pints	26	0
Custards, half pints . . .	14	0
" pints	26	0

4403. *With respect to the mode of finally cooking the various substances so preserved*, there is little to be said: the different dishes of meat and soups, being already cooked, require only to be warmed up; and a variety of jellies and similar preparations that may be preserved in this way will be exceedingly convenient to the cook for sauces and making up dishes. The milk and cream may be used for desserts.

Sect. VIII.—Preservation of Meat by Potting.

4404. *What is termed potted meat consists* of cooked animal substances reduced to a pulp by beating them in a mortar, and having some salt and spices incorporated with them. This pulp is afterward put into jars, and preserved from the air by having a thick coat of melted butter or lard poured over it. Lean meat is best for this purpose. Potted meat is used more as an agreeable and occasional refreshment than as ordinary food.

4405. *The following is the usual method of potting beef*: Take three or four pounds, or any smaller quantity, of lean beef, free from sinews, and rub them well with a mixture made of a handful of salt, one ounce of saltpetre, and one ounce of coarse sugar; let the meat lie in the salt for two days, turning and rubbing it twice a day. Put it into a stone jar, with a little beef gravy, and cover it with a paste to keep it close. Bake it for several hours in a very slow oven till the meat is tender; then pour off the gravy, which should be in very small quantity, or the juice of the meat will be lost; pound the meat, when cold, in a marble mortar till it is reduced to a smooth paste, adding, by degrees, a little fresh butter melted. Season it, as you proceed, with pepper, allspice, nutmeg, pounded mace and cloves, or such of these spices as are thought agreeable. Some flavour with anchovy, ham, shallots, mustard, wine, flavoured vinegar, ragout powder, curry powder, &c., according to taste. When it is thoroughly beaten and mingled together, press it closely into small shallow pots, nearly full, and fill them up with a layer a quarter of an inch thick, of clarified butter, and tie them over with a bladder, or shee India rubber. They should be kept in a cool place.

Any other meat may be potted in a similar way, as ham, veal, game, or poultry of any kind; fish also; char is often potted; also quails; shell-fish, as lobsters, shrimps, prawns, or crabs, may be preserved by the same process. It is essential that fish should be potted perfectly fresh, or as soon as they have been boiled, otherwise they lose their flavour. When made for sale, they have usually too much seasoning; this is done that they may keep till sold; but it overpowers and destroys their flavour.

Some persons prefer, instead of salting the beef as directed above, which as apt to make it hard and less digestible, pounding it when raw with an equal quantity of fat bacon, adding the herbs and spices, together with a few grains of saltpetre. It is then pressed into pots and baked, and, when cold, covered with clarified butter.

4406. *Beef potted to taste like Venison.*—This is made of the flank of beef, the inside skin of which must be pulled off, and the meat slashed across, especially in the thickest parts. It must lie for six hours in pump-water. It must then be salted with saltpetre of the bulk of an egg, mixed with two pounds of common salt. White wine vinegar is to be sprinkled upon it, and it must lie for three or four days, turning it once a day. The brine is then to be washed away with claret. The seasoning must consist of cloves, mace, nutmeg, white and Jamaica pepper; a quarter of an ounce of each, beaten together with savory, thyme, sage, and the rind of a lemon, shredded together, and then well rubbed into the cuts, slashes, and insides. It must be afterward bound with tape, the claret poured over it, the skins laid upon it, and baked in a long pot.

4407. *Potted veal may be prepared* as follows: Take cold fillet of veal; cut off the outside, and pound it with fresh butter, and a little mace and white pepper; then pot it, and cover the surface with clarified butter.

Or, take one pound of undressed lean veal, and put it into a stew-pan with two ounces of butter, the juice of a lemon, and a small quantity of the grated peel, with some mace, salt, pepper, mushroom powder, and some parsley, thyme, savory, and two shallots. Stew these together for ten minutes or a quarter of an hour; have ready a pound of the mellow part of a boiled pickled tongue and half a pound of fresh butter; cut the tongue and veal small, and pound them together; then mix the whole more completely together with the yolks of two eggs well beaten. Press the mass into shallow pots; paper them and bake them in a moderate oven for twenty minutes; when cold, pour over the surface clarified butter.

4408. *Potted Birds.*—Larks, wheatears, or partridges may be potted; and in this state they will keep a considerable time. Take any of these birds that are perfectly fresh, as the least taint will spoil all the materials. When they are emptied, season them inside with allspice powdered, black pepper, and some salt. Press them flat, and stew them for half an hour in a liquor composed of two ounces of fresh butter, a gill of sherry, a table-spoonful of essence of anchovy, with powdered cloves, mace, nutmeg, allspice, and black pepper. After they have been stewed, let them be put in a slow oven to dry; when their moisture is sufficiently exhaled, put them into pots and press them down; fill up the vacuities, and cover them with clarified butter. The liquor in which they have been stewed may be employed for the following preparation.

4409. *Potted Lobster.*—Boil a couple of hen lobsters for a quarter of an hour with plenty of salt; take out the meat from the shell, but do not employ the soft part of the body, and reserve the spawn; stew the meat for half an hour with a large glassful of white wine, a table-spoonful of essence of anchovies, some powdered spices, as cloves, mace, nutmeg, and black pepper. When done, take out the pieces of lobster, which pound with the spawn in a mortar, and let the liquor in which it has been stewed be reduced to a third; to this add a quarter of a pound of fresh butter previously oiled, and mix them well together. Pour this to the pounded lobster, and, when properly incorporated, press it into shallow preserving pots, and cover it with clarified butter. This is an excellent substitute for lobster sauce; in the same manner, you may pot shrimp and cray-fish, or prawns.

4410. *Potted Shrimps.*—When boiled and shelled, season them with salt, pepper, mace, and a small portion of cloves; press them down in a jar, and bake them in a slow oven for ten minutes; when cold, cover them with clarified butter.

4411. *Sausages* are made as a convenient method of preserving many kinds of meat that it would be difficult to keep long in any other mode. The principle of making all sausages is simply chopping fine or pounding the particular kind of meat employed, seasoning it with spices, and herbs of various kinds, bread crumbs and eggs, salt, or mustard, or any of them, mixed in such proportions as are agreeable; then the whole is enclosed in portions of the prepared intestines of a hog, sheep, or calf, very well washed and scraped till thoroughly clean. The herbs employed are some of the following: onions, shallots, sage, thyme, leek, garlic, marjoram, parsley, &c. For some kinds of sausages, besides meat, anchovies, oysters, and red herrings are added. The blood of various animals, as the ox, hog, goose, &c., are used in this way, mixed with oatmeal, crumbs of bread, and seasonings of various kinds. The Germans are famous for their preparation of sausages, in which smoked meat is generally used.

Machinery is now employed for the preparation of sausage-meat on a large scale; but as, in the case of manufactured sausages, the consumer has no method of ascertaining the quality of the ingredients, he should be cautious in their use, as it is well known that meat very improper as food can be used in this way.

4412. *The following preserved meats are to be had in the London shops:*

York, Westmoreland, Westphalia, and Bayonne hams.	Gorgona anchovies and anchovy paste.	Marinate herrings.
Mutton hams.	Hambrough smoked hung beef.	Pâté au Diable, for making grills, &c.
Russia ox and reindeer tongues.	Strasbourg bacon.	Russian caviare.
Neat, smoked, and pickled tongues.	Potted beef.	Bologna sausages.
Welsh dried salmon.	Potted ham.	Modena sausages.
Scotch kippered salmon.	Potted game.	German sausages.
Findhorn haddocks.	Potted shrimps.	Saucissons d'Arles.
Dutch herrings and Yarmouth bloaters.	Potted red herrings.	Saucissons de Lyons.
	Potted char.	

SECT. IX.—PRESERVATION OF BUTTER.

4413. Butter, like the other mild and fat oils, is liable to the change called *rancidity*, which, from the experiments of Parmentier, appears to proceed from the coagulable albuminous or cheesy matter that is mixed with it; and probably the water, which is seldom quite separated from it, assists in the change. Butter not well freed from the milk becomes rancid more readily than that which has been completely deprived of it. By the application of salt, the rancidity of butter is, in a great degree, prevented for some time; but if the butter be melted and deprived of its albuminous part, it may be kept much longer.

The common method of preserving butter is by salting it more or less. Salt, in the proportion of one or two ounces to the pound, according as it is required to be kept for a shorter or longer time, is worked up into the butter till they are thoroughly incorporated.

4414. *Dr. Anderson, in his "Recreations," has recommended another method of curing butter*, by which, he says, with proper care, it may be kept for years in this climate, or carried to the East Indies, if packed so as not to melt.

"Mix two parts of the best salt, one of sugar, and one of saltpetre, and beat them into a fine powder; one ounce of this preparation is sufficient for a pound of butter. This should be thoroughly mixed with the butter as soon as it is separated from the whey, and it should then be put into a clean cask. It should be packed very well down, to exclude the air thoroughly; the top should be covered with a sprinkling of salt, and melted butter poured over it, to fill up every crevice before the cover is fixed down. Butter cured in this manner does not taste well till it has stood at least a fortnight after being salted; but after that time it has a rich, marrowy taste that no other butter ever acquires, and tastes so little salt that one would imagine it would not keep." Dr. Anderson has seen it perfectly sound and sweet, when two years old, in this climate.

4415. *When butter is to be exposed to the heat of a warm climate*, it requires, in order to make it keep, to be clarified before it is salted and packed up. To do this, put it into an iron vessel, and suspend that in another iron vessel, containing water in the manner that chemists make a water-bath, or like a cabinet-maker's glue-pot. Put the whole over the fire till the butter is melted. By continuing the heat some time about 196°, the albumen or cheesy matter will coagulate and settle to the bottom, leaving the butter pure and transparent like oil. When it is nearly cold, take the pure butter off from the dregs that have settled; let it get cold and solid, and salt and pack it up in the same manner as ordinary butter. The use of the double vessel is to prevent the butter from burning, which would give it a disagreeable empyreumatic taste. This purified butter will be somewhat paler than before, and of a firmer consistence; if put into close vessels, and in a cool place, it will keep for some months without salt.

This, according to M. Thenard, is also the method employed by the Tartars to preserve their butter; and he states that if, when used, it be beaten up with one sixth of cheese, it will have much the flavour of *fresh butter*. The bad flavour of rancid butter may, according to this chemist, be removed almost entirely by similar meltings and coolings.

4416. *When a barrel of salt butter is opened*, and consumed slowly, the surface of the butter should be kept covered with strong brine.

4417. *Butter may be preserved without salt*, by incorporating it with honey in the proportion of an ounce to a pound of butter. This has an agreeable taste, will keep for years, and might be useful on long voyages; but as the proportion of honey is considerable, it may not agree with some constitutions.

4418. *The salt butter of Holland* is superior to that of every other country. It forms about three fourths of all the foreign butter we import: *Keil* butter, when it can be had genuine, is excellent.

Irish butter is inferior to that of Britain; chiefly, it is said, owing to want of care in its manufacture.

SECT. X.—PRESERVATION OF EGGS.

4419. However compact and close the shell of an egg may appear, it is nevertheless perforated with a multitude of small pores, too minute to be seen by the unassisted eye. The effect of these, however, is evident, by the daily decrease of the moisture of the egg, through evaporation, and the air taking its place, which operates in effecting its alteration. From the time of its being laid, when the egg is quite full, a fluid is constantly perspiring through the perforations of the shell, which occasions its decay; and this proceeds more rapidly in warm than in cold weather. Although an egg quite fresh is proverbially "full," yet in all stale eggs there is some vacancy, which is in proportion to the loss they have sustained through evaporation. If the end of a fresh egg be applied to the tongue, it feels cold; but that of a stale egg feels warm, because the white of the former being in contact with the shell, abstracts the heat from the tongue more rapidly than the air bubble in the latter.

4420. *To preserve eggs completely fresh*, therefore, this transpiration must be stopped, and the eggs kept full. Any kind of varnish will answer this purpose, but the most convenient substance is mutton suet, or a mixture of that and beef suet. This is rubbed over the eggs; the most effectual method is to dip the eggs into this, melted in a pipkin; olive oil will also answer. They should be afterward wiped, to take off the superfluous fat or oil, which might become rancid, for all that is wanted is to stop up the pores. After this anointing, the eggs should be set on end, with the small end uppermost, wedged close together, one layer over another, in bran, the containing box being closely covered up. Laid upon the side, the yolk will adhere to the shell. They thus come into use, at the end of a considerable time, in a state almost equal to new-laid eggs. They should be done over with the suet as soon as possible after they are laid. Some cover them with a solution of gum Arabic, which is preferable to fat. Eggs are sometimes packed in bran, meal of any kind, wood ashes, salt, or charcoal powder; but these substances are not nearly so effectual alone as when the eggs are first done over with the above mentioned substances, as they can have but a slight influence in preventing the transpiration we have mentioned. Eggs should never be suffered to continue in the nest above a day, since the warmth which they receive in it from the hen is inimical to their keeping. It should be observed, that on the third day after the hen begins to sit on her eggs to hatch them, they are rendered unfit for use.

4421. *From an experiment of Reaumur*, it appears that cutting off the access of air to the embryo in the egg does not kill, or prevent it being hatched, but, on the contrary, preserves it alive for a much longer period than if it had not been treated in this manner. He covered eggs over with spirit varnish, and found them capable of producing chickens after two years, when the varnish was carefully removed.

4422. *It is said that the dealers in eggs* immerse them for a moment in oil of vitriol diluted with water, as a means of preservation. This is not improbable, for the acid would dissolve a little of the calcareous matter of the shell, forming with it a sulphate of lime, which would be deposited and fill up the pores.

Another mode of preserving eggs is to plunge them for five minutes in water heated to 140°; they are then taken out, oiled or rubbed with suet, and packed in sawdust or charcoal powder; they will keep thus for a year or two. Some boil them for one minute, which preserves them a long time, probably by coagulating the portion of the albumen next to the shell. If boiled hard, they will keep many weeks without other preparation.

Eggs are very liable to absorb the flavour of any substance they are kept in contact with, and therefore care should be taken not to pack them in anything that might communicate a flavour; mahogany shavings will impart to them a peculiarly disagreeable taste; and musty straw will likewise give them an unpleasant flavour.

SECT. XI.—PRESERVATION OF MILK.

The changes to which milk is liable have been described in Book VII., Chap. IV. It is well known that it will not remain fresh for many hours in warm weather; the principal care must therefore be to keep it in as cool a place as possible; stone shelves are preferable to wood; and a room connected with an ice-house is particularly convenient The milkmen of Paris, to prevent their milk from turning sour, sometimes use a little subcarbonate of soda, which unites with the acid as it forms; provided too much soda is not employed, this will have no injurious effect; a little calcined magnesia will answer the same purpose.

Milk boiled with sugar will keep some time.

4423. *Cream may be preserved* for several weeks, or even months, in the following manner: Dissolve in water an equal weight of white sugar with cream you wish to preserve, using only so much water as just to melt the sugar and make a rich sirup. Boil this, and while hot, add the cream, stirring them well together. When cold, put this into a bottle and cork it well.

4424. *M. Appert's method*, already described, appears to be a perfect and simple method of preserving milk and cream without sugar, and that even in long voyages.

4425. *A method of preserving milk* for use for any length of time has been invented by M. Dirchoff, a Russian chemist. New milk is slowly evaporated over the fire until it is reduced to a solid substance; this is powdered and put into a bottle, which is accurately sealed with wax. When it is required to use it as milk, some of the powder is put in a proper quantity of water, and it has then all the properties, as well as the taste of milk.

CHAPTER XIII.

PRESERVATION OF FRUIT AND VEGETABLES.

4426. *General Remarks.*—From the nature of vegetable substances, and chiefly from their not passing so rapidly into the putrefactive state as animal bodies, the mode of preserving them is somewhat different, although the general principles are the same. All the means of preservation are put in practice occasionally for fruits and the various parts of vegetables, according to the nature of the species, the climate, the uses to which they are applied, &c. Some are dried, as nuts, raisins, sweet herbs, &c.; others are preserved by means of sugar, such as many fruits whose delicate juices would be lost by drying; some are preserved by means of vinegar, chiefly used as condiments or pickles; a few also by salting, as French beans; and others are preserved in spirits. We shall treat of these various modes separately.

In the summer season, during hot weather, various kinds of vegetables, as pease, kidney beans, cucumbers, &c., can be kept in the ice-cold room attached to the ice-house for several days. Fruits gathered in the morning, which is the most proper time, may be there kept cool, and with all their freshness and flavour, until required for the dessert in the afternoon. It is to be observed that the cold should not be so great as to freeze the vegetables.

SECT. I.—USUAL METHODS OF PRESERVING OUR ORDINARY FRUITS, ROOTS, AND VEGETABLES, WITHOUT SUGAR, FOR WINTER'S STORE.

4427. It had long been a desideratum to preserve fruits by some cheap method, yet such as would keep them fit for the various culinary purposes, as making tarts and other similar dishes. The expense of preserving them with sugar is a serious objection; for, except the sugar is in considerable quantity, the success is very uncertain. Sugar also overpowers and destroys the sub-acid taste so desirable in many fruits: those which are preserved in this manner are chiefly intended for the dessert.

4428. *In gathering fruit for winter store*, great care should be taken not to bruise it, nor to break the skin; the injured parts soon rot and spoil the sound fruit in contact with it. To prevent this, gardeners even have instruments for gathering the most valuable kinds of fruit from the trees, without touching it with the hand. Fruit intended to be stored should never be beat off the trees, or by shaking the branches till it drops, if this can be avoided. They are best gathered on a fine day, when they are most likely to be dry; or if this be done on a wet day, they should be dried in the sun, if possible; the more delicate kinds do not bear to be wiped, as this rubs off their bloom, which, when allowed to dry on some fruits, constitutes a natural varnish, closing up the pores, and preventing the evaporation of the juices.

4429. *The usual mode with apples and pears* has been to lay them first in heaps for a fortnight or more, covered with mats or straw, to *sweat*, as it is called; that is, by a very slight fermentation to discharge some of their juice, after which the skin contracts in a slight degree; but this is now generally disapproved of, and it is thought best to carry them at once to the fruit room, where they are laid upon shelves covered with paper, after wiping gently each fruit. The fruit room should be dry and well aired, but should not admit the sun. The finer and larger kinds should not be allowed to touch each other, but should be kept separate; for this purpose, a number of shallow trays should be provided, supported above each other on racks or stands. There should be the means of warming the room in very cold, frosty weather.

Some kinds of apples and pears are gathered before they are quite ripe, and the ripening is completed after they are gathered; this is termed the *maturation* of the fruit, and it appears to be a curious and interesting natural process. This subject has been well examined by M. Couverchel in a paper inserted in the "Annales de Chimie." He conceived that the acid and mucilaginous matters of fruit nearly ripe are converted into sugar by a process which is perhaps chemical, and which has been called the saccharine fermentation. Had such fruit remained on the tree until it was quite ripe, this fermentation would soon have passed into the putrefactive stage, and then the fruit could not be preserved without extraordinary means, such as extreme cold, sugar, &c.

In general, the apples and pears of autumn should be gathered eight days before they are ripe, and maturated in this way; in fact, there are some fruits that are never fit for eating except they are treated in this manner. The principle of life remains in vegetables very differently from what it does in animals; for a branch cut from a tree does not die immediately, but will grow, on being planted, into a new tree. Flowers that have been cut off when only buds blow on being placed in water; and the head of a carrot cut off a little below the top of the root, if placed in a shallow basin of water, will put out leaves, and become a handsome ornament. Mr. Knight is of opinion that, in the case of the maturation of fruit, it still continues to be in a living state though taken from the tree, and that the saccharine matter is formed in the same manner as it would if growing. Pears kept for maturation may be packed carefully with dry moss, bran, or sand dried in an oven, in baskets lined with stout paper; straw is apt to communicate a mouldy taste. They will keep in this way through the winter.

Choice apples and pears are sometimes wrapped singly in paper, and put into glazed jars with covers. When there is no fruit room, a cold cellar may be used, or they may be kept in baskets packed in dry straw, and kept in a dry, cool room.

4430. *Pineapples may be kept* a considerable time by twisting out their crowns, which, being very ornamental, are generally suffered to remain; but in time they will destroy all the juice of the fruit by living upon it.

4431. *Oranges and lemons* may be preserved a long time wrapped up singly in paper, packed in dry sand or jars, and kept in an equal temperature.

4432. *The free access of the atmosphere being one of the circumstances* essential to the decomposition of animal and vegetable matter, it is obvious that the exclusion of it must prevent this effect from taking place, and that, consequently, if such substances are completely kept from the contact of air, they cannot change, or, at least, in a very considerable degree. At a certain depth below the surface of the earth the temperature does not vary, summer nor winter, and it is never so cold there as to freeze. This fact has been taken advantage of in the preservation of provisions. In many parts of Europe, vegetables, such as potatoes, turnips, carrots, onions, &c., are preserved for one or more years by burying them in deep pits in a clay soil, which they burn hard before using, or even in a dry, sandy soil. Caves form excellent cellars, on account of the equality of their temperature.

4433. *Receipts have been often given* for preserving fruit and vegetables throughout the winter upon this principle, such as apples, pears, cherries, gooseberries, currants, green pease, cranberries, &c.

Some apples that had been preserved in pits in the ground were sent to the Horticultural Society on February 14, 1828, in as fresh a state as if newly gathered from the tree. The apples should be of the hardy or keeping sorts, and not more than four or five bushels should be put into one heap. It is requisite to place dry straw at the bottom and sides of the pit, and also to cover the top with straw, before the earth is put over them.

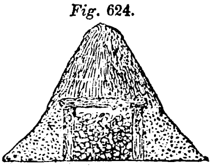
4434. *The undried grapes imported from Spain and Portugal* furnish us with a fine example of a simple mode of preserving fruit. They come in large jars, having sawdust poured in among the fruit to fill up the jars, and the lids are cemented on to prevent access of air.

4435. *To preserve green gooseberries, currants, or green pease* in this manner, let the fruit be gathered in dry weather, or if not, let them be dried in the sun; cut them from the stalks with scissors, and take care that they are not in the least wounded, and that no spoiled or bruised ones are mixed with the rest. Drop them gently into dry, wide-mouthed bottles. Cork the bottles, and rosin over the corks. Make a trench in the garden, at least two or three feet deep, and bury the bottles in it, placing the corks downward, to keep them from the frost. Should the frost in winter be severe, a quantity of litter from the stable should be laid over the place where they have been put. If the bottles are placed in a very cool cellar, the fruit will keep tolerably well. By plunging the bottles, after they are corked, for a few minutes in hot water berries will keep better.

4436. *It is sometimes safer to take up certain vegetables before hard frosts set in*, where the cold is severe, as they may be preserved by artificial means, even by laying on a floor inaccessible to the frost; whereas if left in the ground they would have been frozen and lost. This, in some situations, is the case with cabbages, lettuce, greens, endive, leeks, cauliflowers, &c. They should be carefully removed in dry weather, without injuring the roots too much. Vegetables only a little touched by the frost may be recovered by soaking in cold water.

4437. *Potatoes* are difficult to preserve for many years, and hence they are considered less to be depended upon than wheat against years of scarcity; but as they are seldom required to be kept longer than during the winter and spring seasons, with proper precautions this is not difficult.

Fig. 624.



When preserved in considerable quantities by the farmers, several methods are put in practice in different districts; but the principle appears to be merely to keep them dry, and so protected that the frost cannot reach them. A very effectual method was employed by Mr. Young. He constructed a house capable of holding seven hundred bushels of potatoes, and formed it of fir posts, *a*, *a*, *fig*. 624, having the interstices filled in with watling; against the sides of this he laid straw, and against that, exteriorly, he put earth, rammed tight, six feet thick at the bottom, and eighteen inches at the top. The roof was flat, and he placed on it a stack of beans. The beans kept out the weather, and yet admitted any steam that rose from the potatoes, and which, if it did not escape, would have rotted them. A roof of thatch would have answered. In some parts of the country they are kept during the winter in pits in the ground, where the soil is dry and light, to the depth of three or four feet, lining this with straw, covering them with earth to protect them from the frost, and the whole thatched. Roots, as potatoes, turnips, carrots, &c., should never be divested of the earth adhering to them when taken out of the ground, as it tends to preserve them fresh, the little fibres by which it is retained continuing still to draw some nutriment from it; and if these are broken, the juices escape through the broken surfaces. They should be wounded as little as possible.

4438. *Where the quantity is not considerable*, potatoes may be kept in a cellar underground, where the temperature is pretty equal and never very low, and covered with straw or mats; but in the spring they should be frequently examined and turned over; those which are decayed should be removed, and the shoots broken off closely, if any of them have sprouted.

4439. *Frost appears to have the singular property of converting the starch of potatoes into sugar;* accordingly, when they are affected by frost, or are, as it is called, frost-bitten, they become sweet, and in this state are no longer fit to be eaten, but are generally given to cattle, or are employed for the distillation of spirits, or the making of beer, for which they are even fitter than when fresh. If only slightly injured by the frost, they may be partially restored by thawing them in cold water.

4440. *Carrots and turnips* may be preserved through the winter by taking them up and keeping them in pits, or in a dry cellar in sand, secure from frost. The heads and roots should not be cut off.

4441. *Onions*, when pulled up, should be laid thinly on a gravel walk, and turned every day to dry. When thoroughly dried, they are usually strung together by the tails and hung up in a dry, well-aired place, till wanted for use.

Cabbages are in some places preserved all winter by burying them in the ground, out of the reach of the frost.

4442. *Walnuts, filberts, and chestnuts* are preserved by drying them; then packing them in jars, boxes, or casks, with fine clean sand that has been well dried before the fire, or they may be buried in a pit in the ground, lined with straw.

SECT. II.—PRESERVING FRUIT AND VEGETABLES BY SCALDING, AND BY M. APPERT'S METHODS.

4443. *Scalding fruit* has been employed with success to render their keeping more certain, and is therefore very useful in preparing them for house or sea store.

In 1808, the Society of Arts gave a premium to Thomas Saddington for communicating the following process for preserving fruit without sugar: Fill some stone wide-mouthed bottles with the fruit picked carefully, and set them in a copper or large kettle; then fill the kettle with cold water nearly up to the mouths of the bottles. Corks should be prepared to fit the bottles, and a cloth should be put under the bottoms of the bottles to prevent their breaking with the heat. Light the fire under the kettle, and heat the water to 160° or 170°. This heat should be continued for about half an hour, when the fruit will be sufficiently scalded. After that, fill up the bottles with boiling water to within an inch of the cork, and cork them tight. The bottles should now be laid on their sides, where they are to be kept. During the first month or two it will be necessary to turn the bottles round once or twice a week, and occasionally afterward, to prevent the fermentation that will take place with some fruits from forming into a mouldy crust. Fruit preserved in this manner will keep at sea, even in hot climates. The fruits that may be preserved in this way are apricots, gooseberries, currants, raspberries, cherries, plums, Orleans, egg, or damson, greengages, and also rhubarb cut into small, square pieces. But the most juicy fruits, such as currants, mulberries, strawberries, and raspberries, are not so well calculated for this purpose. In this process the heat seems to act by coagulating and rendering insoluble and inactive a kind of gluten, which is a principal agent in the commencement of fermentation. In the old process, we are sometimes directed not to cork or tie up the vessels till they are quite cool, by which it now appears a very great advantage was lost.

4444. Some fruits may be preserved in a succulent state by being kept in water without boiling. This is practised with regard to the cranberry; it also succeeds with the smaller kinds of apples.

4445. *But the method used by M. Appert,* and which we described as the most perfect mode of preserving animal food, *succeeds equally with vegetables and fruit* of all kinds. There is only this difference, that the vegetables and fruit need not first be parboiled, as in the case of animal food; as they are not dressed, they must be treated in cooking them as raw vegetables.

4446. *The following fruits and their juices* are preserved in this manner: white and red currants, in bunches or stripped; cherries, raspberries, mulberries, &c., apricots, peaches, nectarines, and plums of all kinds; likewise, pears peeled and cut in quarters, with their pips taken out. These fruits are put into strong, wide-mouthed glass bottles, corked with the greatest care, and luted over with a cement made of lime and soft cheese, spread on linen and bound down with wire. The bottles are then enclosed separately in canvass bags and put into a kettle of water, which is gradually heated till it boils; they are thus kept until it is presumed that the fruit is, as it were, boiled in its own juice; the whole is then left to cool, and the bottles are examined to see that they are secure before they are put away for store.

4447. Gay Lussac had found before M. Appert that the *juice of the grape,* or of any other fruit, may be preserved by boiling it for a short time without sugar, and secluding it from contact of air. This prevents fermentation. Grape sirup is much used on the Continent.

4448. *M. Appert's Method of preserving the following Vegetables: Asparagus.*—They are first plunged into boiling water, and then into cold water; to take away their peculiar sharpness. The stalks are placed in the jars with great care, the heads downward; the jars put into the water-bath only till the water boils.

Windsor beans are gathered when small, and put into bottles immediately, as the skins turn brown by keeping; one hour in the water-bath. They may also be stripped of their skins if that is preferred.

French Beans.—The pods put into bottles; if very large, cut in pieces; an hour and a half in the water-bath.

Artichokes.—The stools and very few leaves first plunged into boiling, and then into cold water; after draining, they are half dressed by being placed over the fire in a sauce-pan with butter and seasoning herbs. When cold, they are bottled, and placed in the water-bath half an hour.

Carrots, cabbages, turnips, parsnips, onions, potatoes, celery, cardoons, red beet, and generally all vegetables, may be preserved, either simply scalded or parboiled; put into bottles, and then into the water-bath for an hour.

Green pease may also be kept fresh by M. Appert's method; but they are the most difficult of all the ordinary vegetables to preserve completely. If gathered too young, they dissolve into water; and if they are kept several days before they are bottled, they lose all their flavour, become hard, and ferment, sometimes so as to burst the bottles. They are often very well preserved simply by putting them into well-corked bottles and burying them in a trench in the ground, taking care to invert the bottles. Sometimes they are scalded, drained, dried in cloths, spread on plates, and put into a cool oven, and afterward hung up in paper bags to harden; in which case they must be soaked before they are used. But no method will preserve entirely the sweet flavour and marrowy substance of the young pea. M. Appert's method, however, is the best.

4449. *The following fruits are usually kept in shops preserved in bottles:*

Cherries,	Raspberries,	Greengages,
Moselle cherries,	Gooseberries,	Damsons,
Red currants,	Russian and Swedish cranberries,	Preserved green pease in tins.
Black currants,	American cranberries,	

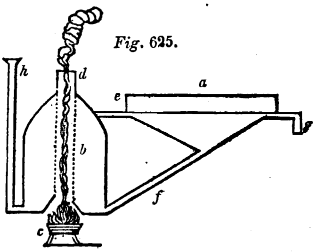
SECT. III.—PRESERVING VEGETABLES BY DRYING COMPLETELY.

4450. Many vegetables, except those which are extremely succulent, may be preserved by drying. For this purpose, they should be well cleaned and spread upon the floor of an oven or kiln, and dried by a gentle and gradual heat, taking care that the heat be not so great as to scorch them. The thicker sorts of roots, as carrots, turnips, potatoes, &c., should be sliced. It is essential that the drying be complete, the interior as well as the exterior parts. After being completely dried, till the leaves crumble between the fingers, they should be packed in paper, or very dry boxes, and put into casks.

Baking apples and pears may be preserved by slicing them about the thickness of a sixth of an inch, and drying them in the sun, or in a slow oven.

4451. *To dry vegetables so as to render them capable of being preserved and ground into flour*, a method was contrived by Mr. Forsyth, which was, to slice the roots and lay them upon a plate of metal heated by steam, which has the advantage of drying them equally without burning. He made the following apparatus for this purpose: *a*, *fig.* 625, is a shallow vessel for holding the sliced roots; *b* is a boiler of water heated by a chafing-dish, *c*, a lamp, or any other mode, the heat from which passes through the boiler in a tube ending at the chimney *d*; *e* is the pipe by which the steam passes from the boiler to the bottom of the vessel *a*; *f* is a waste-pipe for the condensed steam, and *g* a pipe for the waste steam; *h* is a pipe for adding cold water to the boiler. But any other form of boiler will answer; it is only necessary that steam from it shall be conveyed under the bottom of the shallow vessel *a*, into which the vegetables are put; and this may be of any shape and size that may be found convenient.

Fig. 625.

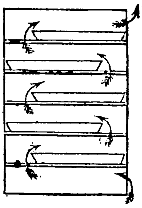


When the starch or flour of potatoes is extracted, it is easily preserved for years by packing it closely in barrels and keeping it dry.

4452. *To preserve sweet and savoury Herbs for seasoning by drying.* Although dried herbs are inferior to those in a fresh state, yet they are still extremely useful. Drying in the sun is often uncertain; and they are better dried in a drying stove, not too warm so as to burn them, or by a good fire. It is important that they should be dried as quickly as possible, that they may not lose their flavour by fermenting and growing mouldy. They should be spread thin, and often turned; and when dry, they should be shaken in a large meshed sieve, to get rid of the eggs of any insects that would otherwise be hatched among them. The same method and precaution should be used in drying flowers; but some succulent flowers, as the petals of the liliaceous plants, cannot well be dried. When dried, rub the leaves off the stalks; pound, sift, and keep them in bottles well corked.

Field's drying closet, *fig.* 626, is convenient for this purpose. It consists of a closet having trays placed in shelves, in which the herbs are put; and a current of air heated by a stove below it is made to enter through apertures, and to circulate between the shelves by an aperture in each, according to the direction of the arrows. The details of construction are described in "Gray's Operative Chemist."

Fig. 626.



4453. *Corn is preserved by drying in granaries.* In some parts of the country, particularly in the east of Scotland, the proprietors of land have had granaries erected on their estates, where, in times of plenty, they store the grain and meal which they receive from their tenants as part of their rent; and it is well known that these storehouses have often been the means of preventing scarcity, and an unreasonable rise in the price of provisions. It is essential to the preservation of grain that it shall be carefully guarded from damp, otherwise it will heat and be damaged. When injured by wet, it may be rendered fit for grinding by being kiln-dried, but it will no longer be fit for sea. Many cargoes have been so heated on long voyages, when shipped in bulk, that the pickaxe was necessary to get it out of the hold, and then it was quite useless, and was burned for manure. The granary of a farm-house in England is generally no more than a room well ventilated and dry, in which the corn is seldom kept above a month or two, usually in sacks. This room is sometimes over the barn, for the convenience of raising the corn into it with ease after it is threshed; occasionally it is a detached building, raised upon stone pillars a little way from the ground; and in this way the corn is deprived of its superfluous moisture, and rendered more fit to be ground into flour. Great care is taken to clear the corn thoroughly from any loose particles that may adhere to it, of dust, chaff, &c., before it is laid up in a granary, in the following method: after bringing it into the granary, it is spread about six inches in thickness, and turned from time to time about twice in a week, and once in a week it is well screened. This management is continued for two months, and after that it is laid a foot thick for two months more, and during this time turned once or twice a week if the season be damp, and now and then screened over. After about five or six months it is raised to five or six feet thickness in the heaps, and then turned over once or twice a month, and screened occasionally. When it has lain two years or more, it is only turned once in two months, and screened once a quarter; but how long soever it is kept, the oftener the turning and screening are repeated, the better the grain will be found to keep. In turning the grain, it is tossed by means of shovels from one part of the room to the other, in which operation the dust and other light substances fall to the floor, while the grain, being heavier, reaches to a greater distance. By these means corn has been kept in granaries thirty years; and it is asserted that the longer it is kept, the more fine flour it yields in proportion to the corn, and the purer and whiter the bread is, the superfluous humidity only having been evaporated in the keeping. At Zurich, in Switzerland, it is said that corn has kept eighty years, or longer, by the same methods of management. It is stated that the public granaries at Dantzic are seven, eight, or nine stories high, having a funnel in the midst of every floor, to let down the corn from one to another. They are built so securely that, though every way surrounded by water, the corn contracts no damp, and the vessels have the convenience of coming up to the walls for their lading. Lord Gardenstone, in his "Travels," informs us that at Geneva, where corn is preserved for a long time in granaries, it is turned about every twenty days for two years, till it acquires a sufficient degree of firmness, and it is then moderately kiln-dried. Insects, particularly the weavil, are very destructive to corn kept in granaries, and they are best kept away by frequent turning and good ventilation, or by keeping the corn completely from access of air.

4454. *In preserving flour*, keeping it perfectly dry is the principal consideration. The barrels, or bins, in which it is contained ought to be of well-seasoned oak, as that is the wood which has the least sap, and is the driest. The soft woods are more apt to imbibe damp, which would cause the flour to turn musty. Fir gives flour the taste of turpentine, and ash is subject to be eaten by worms; oak is free from these faults. Flour is liable to be attacked by small insects, which sometimes do immense mischief where it is laid up in magazines for public uses. These insects have their bodies composed of rings, and are of an oblong, slender form. When they have got into flour, they multiply so rapidly that the only method of saving it from destruction is to convert all that is still left into bread without delay.

4455. *Flour and biscuits carried to sea in the British navy* are preserved in casks made of wrought iron. Formerly these were coated with paint, to prevent oxidation and render them water-tight; but this having been found to communicate a bad taste to the flour, biscuit, or other materials which they contained, they are now coated on the outside with a waterproof composition composed of India rubber (caoutchouc), black resin, and Venice turpentine. For sea store it has been recommended to take out well kiln-dried grain, carefully stored in charred chests, since this will keep better than flour. The grinding could be easily performed by a portable mill.

SECT. IV.—PRESERVING VEGETABLES BY SALT.

4456. Any vegetables may be preserved in a strong brine made by dissolving four pounds of salt in a gallon of water; the vegetables are put into this and kept quite covered with it. French beans, artichokes, olives, samphire, and barberries are often preserved in this manner.

In Holland and Germany, where large quantities of French or kidney beans are salted in every family, a machine is used for cutting them expeditiously, which greatly resembles a turnip slicer. The sliced beans are immediately put into a cask with alternate layers of salt, and a weight being put upon them, they are pressed till they begin to ferment slightly; the salt liquor is then poured off, and they are covered up and put into the cellar as store. Before cooking, they are steeped in fresh water, and are found to be an excellent corrective of the oily qualities of animal food. They are preserved thus for sea store.

SECT. V.—PRESERVING VEGETABLES BY VINEGAR.

We have already mentioned the antiseptic property of vinegar.

4457. *Sauer kraut* is the name of a preparation of cabbage by means of salt and vinegar much used in Germany, and which is likewise found of particular value in long voyages. The mode of preparing it, as described by Parmentier, is the following: The heads of white winter cabbages, after removing the outer leaves, are to be cut into fine shreds, and spread out upon a cloth in the shade. A cask which has had vinegar in it is to be selected, or if none can be had, the inside should be rubbed over with vinegar or sauer kraut liquor. A layer of salt is to be put in the bottom of the cask, caraway seeds are to be mixed with shreds of cabbage, and they are to be packed in the cask to the depth of four or six inches; and layers of this kind, with salt between each layer, are added till the cask is full, stamping them down with a wooden stammer, as they are put in to half their original bulk; some mix a little pepper and salad oil with the salt. Some salt is to be put on the top, and some of the outside leaves of cabbages. About two pounds of salt are necessary for twenty middle-sized cabbages. The head of the barrel is to be placed upon the cabbage leaves, and must be loaded with heavy stones; and a common method is for a man who has clean wooden shoes on to tread the cabbage down in the cask. A fermentation will take place, and some juice will be given out, which is green, muddy, and fetid; this rises to the surface, and is to be replaced by fresh brine. When the fermentation is over, the casks are closed up. Cabbages are preferred, but any other vegetables may be treated in the same manner.

In this country, vegetables are seldom preserved by means of vinegar, except when intended for *pickles*, which are employed only as condiments to add to various dishes.

Pickles.

4458. *There are three modes of pickling in common use. First Method.*—Such vegetables as are hot of themselves, and do not require the addition of spices, and such as do not require to be softened by heat, as capsicums, chili, nasturtiums, button onions, radish pods, horseradish, garlic, and eschalots, are simply put into the strongest vinegar. Some use distilled vinegar, white wine vinegar, or wood vinegar. The jars are half filled with this, and when the vegetables are put in, they are immediately tied down with bladder, leather, or sheet India rubber.

Second Method.—Heating vinegar and spice, and pouring them hot over the vegetables to be pickled, which are previously prepared by sprinkling with salt, or immersing in brine. This method is applied to gherkins, French beans, cabbage, brocoli, cauliflowers, onions, &c. In this method the vinegar is not boiled, as this would diminish its strength by evaporation.

The third method is where the vegetables require softening by heat, as walnuts, artichoke bottoms, beet root, and sometimes onions and cauliflowers.

4459. *In the last two methods, which include the common practice of pickling*, it is necessary that the substance of the vegetables should be penetrated by the vinegar.

As all vegetables abound with their peculiar juices, which, if mixed with the vinegar, would be so diluted as to spoil, it becomes necessary, in the first place, to throw salt on the vegetables, which, to a certain degree, combines with their juices, and is rendered fluid, or they may be boiled in a strong brine of common salt; and this process is in many instances facilitated, as in the case of walnuts, cucumbers, &c., which are covered with a thick skin, by penetrating the vegetables with a needle, so that the action of the salt may be more immediate and penetrating. This loss of the natural juice is afterward supplied by the vinegar they imbibe.

To assist and improve the flavour of the pickle and to correct its sourness, various pungent and aromatic spices are generally added, as pepper, pimento, ginger, capsicums, cloves, mace, or mustard. For the preparation of acid pickles, the vinegar prepared from wood is by some preferred to common malt vinegar, as it contains no mucilage, which renders common vinegar liable to spontaneous decay, and prevents the pickles made with it from keeping well. Another advantage in the wood vinegar is, that it can be had of a greater degree of strength.

Some direct that the pickles should not be boiled in the vinegar, as that would evaporate its strength, and that the best way is to parboil them first in the brine and spices and then taking them out to get cold before they are put into the vinegar, which should be warmed so as to simmer, but not boil. The spices may be simmered with the vinegar. Pickles should be kept carefully from the air, and covers of India rubber can now be had for tying over the jars, instead of bladder or leather; these resist much better the action of the acid.

4460. *The following are examples of the methods usually employed in pickling:*

4461. *To pickle Gherkins or young Cucumbers.*—These should be of the size of the finger; if smaller, they have not attained their flavour; and if much larger, they are probably seedy. Puncture them with a needle, and throw over them some dry salt; when this dissolves, in a day or two, pour it off, and add a fresh quantity, which allow to remain for a couple of days; then take them out, and let them drain on a cloth. Afterward wipe them, put them into jars, and pour on them boiling vinegar in which ginger, black pepper, sliced horse-radish, mace, cloves, and allspice are infused, with shallots or garlic, if agreeable. In two days drain off the vinegar, which boil and pour on the cucumbers. If this process be repeated three or four times they will become perfectly green and plump. French beans may be pickled in the same manner.

4462. *To pickle Onions.*—Take the small buttoned onions, remove the external peel, and throw them into milk and water, in which plenty of salt has been dissolved; set them on the fire, and when they have boiled, pour off the liquor and drain the onions on a sieve. When cold, put them into glasses, and cover them with distilled vinegar prepared in the following manner: Put into a quart bottle some sliced ginger, bruised pepper, and mace; fill it so completely up with distilled vinegar that when it is corked there shall be as little air as possible. When this has stood three or four days to receive the flavour of the spices, render the cork secure by wire, and apply over it a luting composed of lime and white of egg. Put this bottle in a sauce-pan with cold water over the fire, and when it has boiled about ten minutes, remove it in the sauce-pan, and let it there continue till cold. Pour some of this vinegar cold on the onions, and they will keep for many months.

4463. *To pickle Red Cabbage.*—The cabbage should be chosen firm, but the largest are not the best. Trim off the outside leaves, and quarter the cabbages; take out the large stalk and slice the quarters, sprinkle a little salt between the layers; if too much is used, the colour will be injured. Let the whole remain till next day, and shake it, that all the brine may run off; put it into jars with a hot pickle of vinegar, an ounce of black pepper and allspice to each quart of vinegar; also half an ounce of ginger, horseradish, and salt, two capsicums, and a drachm of cayenne. Garlic, eschalots, broccoli, and cauliflowers may be pickled in the same way. The cabbage is at first rather blue or purple; the red colour which it acquires is in consequence of the acid, which has the property of turning all vegetable blues red. This red colour being admired, to heighten it, some add a little cochineal, which is harmless; others add some beet root.

4464. *Pickling Walnuts.*—Take green walnuts, run a needle into each in several places, and throw plenty of salt over them. In three or four days pour off the liquor that has been produced, and add a fresh quantity of salt to extract more of their juice; in about eight days they will become brown and tender. Take them out and let them drain for two days. Arrange them in a jar, and pour over them boiling-hot vinegar containing spices, as ginger, black pepper, cloves, and some garlic, if approved. Leave the jar uncovered as long as any steam arises from them. In two days boil again the vinegar that covers them, and pour it on as before. When cold, secure them from the access of air by a bung covered with bladder, and tied over with leather. Most pickle vinegar, after the vegetables are used, may be turned to use, walnut pickle in particular; it may be boiled up, putting to each quart four or six anchovies chopped small, together with a large table-spoonful of chopped eschalots. Let this stand a few days till it is quite clear, then pour off and bottle. It is excellent for sauce for hashes, fish, and various other dishes.

4465. *Piccalilly, or Indian Pickle.*—White cabbages sliced, cauliflowers pulled to pieces and scalded, radishes topped and tailed, French beans, celery in three inch lengths, shoots of elder peeled, clusters of elder flowers unopened, all salted for two or three days, then mixed with apples and cucumbers sliced, and a large proportion of ginger, turmeric, long pepper, and mustard seed, as the pickle is expected to be very warm; the vinegar must also be the strongest that can be procured, and just sufficient to float the articles; any other vegetables may be used at pleasure.—*Gray.*

4466. *Hot Pickle.*—Pick into moderately sized pieces a cauliflower, puncture some French beans, cut into slices about an inch long some of the red part of a carrot, slice some heads of celery, and pieces of the white part of a cabbage; throw sufficient dry salt over them, which repeat a second time; after which let them dry in the sun for a couple of days; prepare the ordinary spices as before directed, to which add an ounce of genuine cayenne pepper loosely tied up in a muslin rag; let this boil in the vinegar, and afterward let it remain in the jar with the pickles. Boil the vinegar two or three times, and pour it on the pickles; if you wish them of a yellow colour, to resemble the India, add some turmeric to the pickle.

4467. As vinegar is a corrosive substance, capable of dissolving several metals, and likewise some of the glazes of earthen-ware which contain lead, great care must be taken in selecting proper vessels to prepare and keep pickles in, otherwise dangerous consequences may ensue from poisonous matter being introduced into the pickle from the action of the acid upon the vessels containing it. Pickles should never be made or kept in any vessel of metal; for the vinegar will dissolve copper, and produce verdigris, a poisonous substance; and it acts upon lead, forming acetate of lead, another poison; and neither pewter, tin, nor zinc are altogether safe; to say nothing of the inconvenience of having the vessels corroded. Iron is harmless, but is liable to be corroded by vinegar, though slightly. If covered with a glaze containing no lead, it is perfectly safe. It is said that on the Continent they have invented pickling vessels of cast iron, with a lining of thick glass; when the liquid is in the vessel, the glass heats gradually, and does not crack. The safest materials for pickling vessels are *unglazed* earthen-ware, glass, porcelain, or earthen-ware covered with a glaze containing no lead, such as stone-ware. It being thought a desirable quality in many pickles that the vegetables, such as samphire, gherkins, French beans, &c., should preserve their green colour, copper has actually been put in with them expressly for this purpose; but we trust only by those who were unacquainted fully with its poisonous nature.

It is proper to state that directions of this kind are to be found in many books on cooking, as in the "Ladies' Library," vol. ii., p. 203. "Boil the vinegar in a bell metal or copper pot; put it hot on your cucumbers." Now this direction is given, because it was observed that the cucumbers were thus dyed green; but this effect is produced by the vinegar having corroded the metallic vessel, and forming verdigris. Again, in the "Modern Cookery, or English Housewife," we have a receipt for *greening* for pickles, composed of a bit of verdigris, distilled vinegar, and salt; and in Mrs. Raffeld's "English Housekeeper," p. 352, we are told that, to render pickles green, they should be boiled with halfpence, and that the pickle should stand for twenty-four hours in copper or brass pans! When we read directions given with such extreme ignorance of the poisonous quality of copper, it is no wonder that we hear also of many persons being actually poisoned by the use of pickles, to say nothing of health having been injured in numberless instances, without the causes being even suspected.

4468. *In the pickles made for sale*, great importance is attached to their being of a good colour; and there is therefore a strong temptation to use improper means for obtaining this end. As it is impossible to be certain by whom, and how these are made, it appears prudent that every family should, as much as possible, make their own pickles, in order to be thoroughly acquainted with their composition.

The following pickles are usually kept in the shops in London:

Walnuts,	Green capsicums,	Love apples,
Gherkins,	Red ditto,	Piccalilly, after the Indian manner,
Nasturtiums,	Radish pods,	French olives,
Onions, white and brown,	Rock samphire,	Spanish ditto,
Artichokes,	Capers,	Bombay mangoes,
Jerusalem, ditto,	Red Chillies, English,	Melon ditto,
Red cabbage,	Ditto, West Indian,	Garlic,
Cauliflowers,	Horseradish,	Eschalots,
Mushrooms,	English mixed pickles,	Cucumbers,
Beet root,	West Indian ditto,	Capsicums.
French beans,	Ditto, bird pepper,	
Barberries,	Sour-krout,	

Sect. VI.—Preserving by spirits.

4469. Spirits preserve animal and vegetable substances upon the same principle as vinegar; namely, by coagulating the albumen, which is the first to putrefy; but it is seldom or never employed for the preservation of animal food, as it generally renders it hard and indigestible. Fruits are preserved in brandy or other strong spirits. Those which are usually so preserved are plums, apricots, cherries, or peaches. They should be gathered before they are perfectly ripe, and soaked for some hours in very hard water to make them firm. As the moisture of the fruit weakens the spirit, it ought to be strong, and five ounces of sugar should be added to each quart of spirit.

Olive oil is used for preserving a few vegetables, as truffles; the jars should be closely luted to prevent access of air.

Sect. VII.—Preserving fruit and vegetables by means of sugar.

4470. Before sugar was in use, honey was employed to preserve many vegetable productions, though this substance has now given way to the juice of the sugar-cane. Various fruits, flowers, herbs, roots, and juices, when boiled with sugar or sirup, were employed in pharmacy as well as for sweetmeats; these were called *confections*, from the Latin word *conficere*, to make up. Vegetables whose virtues would be lost by drying, or by other modes, may be preserved by means of sugar for a considerable time unimpaired; the sugar preventing the natural decomposition and moulding which would otherwise take place. This method is therefore very effectual, and its expense alone is, in many cases, the chief objection to its use.

4471. In the present day, such is the increase of luxury, that the confectioner forms a distinct profession, which has relieved the domestic establishment, in a great measure, from numerous duties which were formerly considered important and essential. The business of the professed confectioner is very complicated: it requires considerable skill and practice; and in order to exercise his trade, which comprehends the preservation of fruits in a great variety of ways, the preparation of ices and creams, and the making of cakes and ornamental devices, &c., some costly apparatus, and a collection of tools is necessary which a private family would be unable to manage without having devoted a large portion of time to handle them with dexterity and effect. The most difficult preparations of this kind may now be purchased, if not at a cheaper rate than they can generally be made at, at least with a greater saving of time and anxiety: an arrangement which certainly leaves the mistress of a family more leisure to cultivate other branches of knowledge of more importance. Nevertheless, it is extremely useful that all who direct the affairs of a family should have a general knowledge of this as well as other subjects on which many of our comforts depend. But our object in this place is rather to establish some general principles in this part of the preservation of food, illustrated by some examples applicable to the wants of private families, and such as they might easily put in practice, than to enter into all the details of the business of a professed confectioner. Numerous receipts for preserving and for preparing sweet dishes of various kinds which are usually brought to table, or appear at the dessert, will be found in Book XV., Chap. III.

4472. *Confections, or substances preserved by sugar, may be divided into,* 1. *Liquid confects*, or fruits either whole or in pieces, preserved by being immersed in a fluid transparent sirup, as the liquid confects of apricots, green citrons, and many foreign fruits. 2. *Dry confects* are those which, after having been boiled in the sirup, are taken out and put to dry in an oven, as citron and orange peel, &c. 3. *Marmalade, jams,* and *pastes*, a kind of soft compounds made of the pulp of fruits, or other vegetable substances, beat up with sugar or honey, such as oranges, apricots, pears, &c. 4. *Jellies* are the juices of fruits boiled with sugar to a pretty thick consistence, so as, upon cooling, to form a trembling jelly, as currant, gooseberry, apple jelly, &c. 5. *Conserves* are a kind of dry confects made by beating up flowers, fruits, &c., with sugar not dissolved. 6. *Candies* are fruits candied over with sugar after having been boiled in the sirup.

Sect. VIII.—Preserving fruits and vegetables by means of sirup.

4473. Although sugar passes so easily into the state of fermentation, and is, in fact, the only substance, as we have stated, capable of undergoing the vinous stage of that process, yet it will not ferment readily except it be dissolved in a sufficient quantity of water; and it will not ferment at all if the quantity be sufficient to constitute a very strong sirup: hence sirups are used to preserve fruits and other vegetable substances from the changes they would undergo if left to themselves.

A great number of fruits may be preserved in their natural state in a fluid transparent sirup of a proper consistence, that penetrates into every part of the fruit. The method of effecting this requires considerable care; for if the solution of sugar is too weak, in consequence of its tendency to ferment, it will quickly become sour if kept in a temperate degree of heat; such a solution, therefore, is not calculated to prevent the natural fermentation of vegetable juices; and if the sirup be too much concentrated, the sugar crystallizes, and thus spoils the fruit.

4474. *Proper strength of Sirup.*—It has been ascertained that a solution of sugar prepared by dissolving two parts of double-refined sugar in one of water, and boiling this a little, affords a sirup of the right degree of strength, and which neither ferments nor crystallizes. This appears to be the degree called *smooth* by the confectioners, and is proper to be used for the purposes of preserving fruits.

4475. *The sirup employed should sometimes be clarified*, which is done in the following manner: Dissolve two pounds of loaf-sugar in a pint of water; add to this solution the white of an egg, and beat them well. Put the preserving pan upon the fire with the solution; stir it with a wooden spatula, and, when it begins to swell and boil up, throw in some cold water, or a little oil, to damp the boiling; for, as it rises suddenly, if it should boil over, it would take fire, being of a very inflammable nature. Let it boil up again, then take it off, and remove carefully the scum that has risen. Boil the solution again, throw in a little more cold water; remove the scum, and so on for three or four times successively; then strain it. It is considered to be sufficiently boiled when some taken up in a spoon pours out like oil; and when a thin skin appears on blowing upon the sirup, it is judged to be completely saturated. The heat when sufficiently boiled, and of the proper strength, is 221°. In this manner the sirup will become quite transparent. It is scarcely necessary to say that, if a greater quantity of sirup is wanted, the proportions of sugar and water must still be the same. Instead of loaf-sugar, some have used only brown sugar, which they have clarified to do as well as refined sugar, by mixing with the solution some pounded charcoal, which is boiled with the sugar; by straining repeatedly this black mixture, the charcoal is kept back, and the sugar becomes colourless.

4476. *In the confectioner's art* there is a great nicety in proportioning the degree of concentration of the sirup very exactly to each particular case; and they know this by signs, and express it by certain technical terms. But to distinguish these properly requires very great attention and considerable experience.

The principal thing to be acquainted with is the fact, that in proportion as the sirup is longer boiled, its water will become evaporated, and its consistence will be thicker. Great care must be taken, in the management of the fire, that the sirup does not boil over, and that the boiling is not carried to such an extent as to burn the sugar.

4477. *We give the following degrees of boiling the sirup, as distinguished by the professed confectioner;* though, perhaps, such nicety is seldom attained in domestic practice. The 1st degree is called the *thread*, which is subdivided into the little and great thread. If you dip the finger into the sirup and apply it to the thumb, the tenacity of the sirup will, on separating the finger and thumb, afford a thread which shortly breaks; this is the *little thread*. If the thread, from the greater tenacity, and, consequently, greater strength of the sirup, admits of a greater extension of the finger and thumb, it is called the *great thread*. 2d. By longer boiling, you obtain the *pearl*, which is denoted by the thread admitting of being drawn without breaking by the utmost separation of the thumb and finger; this makes candied sugar. 3d. By farther boiling, you obtain the *blow*, which is known by dipping a skimmer with holes into the sirup, and blowing through them; if bubbles are perceived, what is termed the blow is obtained. 4th. The *feather* implies more numerous bubbles; and then the sugar will fly off like flakes while the skimmer is quickly tossed. 5th. The *ball* admits, by additional boiling, the sirup to be rolled into a ball, previously dipping the finger into water, then into the sirup, and subsequently into the water again. 6th. The *crack* denotes that it does not stick to the tooth, and cracks when broken. To know when it has attained this degree, dip a teaspoon or skewer into the sugar, and let it drop to the bottom of a pan of cold water; if the sugar remains hard, it has attained the degree termed *crack*. 7th. The last degree is termed the *caramel*, beyond which a partial burning, or, rather, carbonizing of the sirup will take place. This is a very elegant covering for sweetmeats. We should observe that ornamental confectionery can seldom be executed well but by the hands of professed confectioners.

4478. *Pulpy fruits are preserved whole in sirup*, as follows: The fruits that are the most fit for this mode are, *apricots, peaches, nectarines, apples, greengages, plums of all kinds, and pears.* As an example, take some apricots not too ripe; make a small slit at the stem end, and push out the stone; simmer them in water till they are softened and about half done, and afterward throw them into cold water. When they have cooled, take them out, and drain them. Put the apricots into the preserving pan with sufficient sirup to cover them; let them boil up three or four times, and then skim them; remove them from the fire, pour them into an earthen pan, and let them cool till next day. Boil them up three days successively, skimming each time, and they will then be finished, and in a state fit to be put into pots for use. After each boiling, it is proper to examine into the state of the sirup when cold; if too thin, it will bear additional boiling; if too thick, it may be lowered with more sirup of the usual standard. The reason why the fruit is emptied out of the preserving pan into an earthen pan is, that the acid of the fruit acts upon the copper of which the preserving pans are usually made. From this example, the process of preserving fruits by sirup will be easily comprehended. The first object is to soften the fruit by blanching or boiling it in water, in order that the sirup by which it is preserved may penetrate through its substance. In proportion as the fruit is unripe or hard, it will require to be boiled three or four times in the sirup; when it is of a softer texture, the sirup drained off, and poured on the fruit in its boiling state, will be sufficient, as it is important to retain the shape and appearance of the fruit as perfect as possible.

4479. *Fruits preserved by Sirup without Heat.*—Many fruits when preserved by boiling lose much of their peculiar and delicate flavour, as, for instance, pineapples; and this inconvenience may, in some instances, be remedied by preserving them without heat. Cut the fruit in slices, about one fifth of an inch thick; strew powdered loaf-sugar an eighth of an inch thick in the bottom of a jar, and put the slices on it. Put more sugar on this, and then another layer of the slices, and so on till the jar is full. Place the jar with the fruit up to the neck in boiling water, and keep it there till the sugar is completely dissolved, which may take half an hour, removing the scum as it rises. Lastly, tie a wet bladder over the mouth of the jar, or cork and wax it.

4480. *Dry Confects, or Fruits preserved by boiling in Sirup and drying afterward.*—Any of the fruits that have been preserved in sirup may be converted into dry preserves by first draining them from the sirup, and then drying them in a stove or very moderate oven; adding to them a quantity of powdered loaf-sugar, which will gradually penetrate the fruit, while the fluid parts of the sirup gently evaporate. They should be dried in the stove or oven, on a sieve, and turned every six or eight hours, fresh powdered sugar being sifted over them every time they are turned. Afterward they are to be kept in a dry situation in drawers or boxes. Currants and cherries preserved whole in this manner, in bunches, are extremely elegant, and have a fine flavour. In this way it is also that orange and lemon chips are preserved.

4481. *Marmalades, Jams, and Fruit Pastes.*—The preserves which bear these names are of the same nature, and are now in very general request; they are prepared without difficulty by attending to a few directions; they are little expensive, and they may be kept without spoiling for a considerable time.

4482. *Marmalades and jams differ little from each other;* they are preserves of a half liquid consistence, made by boiling the pulp of fruits, and sometimes part of the rinds, with sugar. The appellation of marmalade is applied to those confitures which are composed of the firmer fruits, as pineapples or the rinds of oranges; whereas jams are made of the more juicy berries, such as strawberries, raspberries, currants, mulberries, &c. *Fruit pastes* are a kind of marmalades, consisting of the pulp of fruits first evaporated to a proper consistence, and afterward boiled with sugar. The mixture is then poured into a mould, or spread out on sheets of tin, and subsequently dried in the oven or stove till it has acquired the state of a paste. From a sheet of this paste, strips may be cut and formed into any shape that may be desired, as knots, rings, &c.

In the more juicy fruits, the pulp is boiled till much of the aqueous part is evaporated before the sugar is added. This is best performed in broad shallow vessels; but, when the pulpy matter begins to get thick, great care is necessary to prevent its burning. This accident is almost unavoidable if the quantity be large, and the fire applied, as is often the case, immediately under the pan; but it may be entirely avoided by putting the pulpy mass, when thickened to the consistence of a sirup, in shallow earthen pans, and placing them in an oven with its door open, moderately heated: in this manner the heat will be applied equally to every part. A still better plan, but more tedious, is to place the vessel containing the pulp in another vessel containing boiling water, which is called the water-bath. The application of steam, by means of what is called the *steam preserving pan*, is the best contrivance for making marmalades, jams, and all other culinary preparations which are liable to become injured by a degree of heat exceeding that of boiling water. See wood-cuts in "Furniture," Book V.

4483. *Orange Marmalade.*—Scoop out the pulp of Seville oranges into a hair sieve, beat it, and press the juice through into a pan below: boil the skins in water in the preserving pan till they are tender; then take out the white part, and cut them into small strips; add this to the juice, and to each pound of the fruit add a pound of clarified sugar, and boil the whole for about half an hour to the degree called the *feather*. Take it off, stir and mix it well, and boil again till it hangs to the spoon, being the degree called the *crack*. Take care not to boil it too much, but watch it carefully, as the proper consistence is important. When right, pour it into pots; cover them with paper dipped in brandy, and tie a bladder over it. Common oranges are not equal to the Seville, but they will make very good marmalade. If the sugar is broken in pieces and boiled with the fruit, without being first clarified, it will do; but then it must be well skimmed as it boils. Marmalade should be made between February and the end of March, as the Seville oranges are then in their best state.

4484. *Scotch orange-chip Marmalade, according to Meg Dods.*—Take equal weight of fine loaf sugar and

Seville oranges; wipe and grate the oranges, but not too much. (The outer grate boiled up with sugar will make an excellent conserve for rice, custard, or batter puddings.) Cut the oranges the cross way, and squeeze out the juice through a small sieve; scrape off the pulp from the inner skins, and pick out the seeds; boil the skins till perfectly tender, changing the water to take off part of the bitter. When cool, scrape the coarse, white, thready part of the skins, and, trussing three or four skins together for despatch, cut them into narrow chips; clarify the sugar, and put the chips, pulp, and juice to it: add, when boiled for ten minutes, the juice and grate of two lemons to every dozen of oranges. Skim and boil for twenty minutes; pot, and cover when cold.

4485. *Quince Marmalade.*—Boil some ripe quinces in a small quantity of water till they are tender; pare the skins off, cut them into quarters, and take out the cores; stew the parings and cores in some water; strain this, and add the water to the quartered quinces. Put the whole into a preserving pan, with as much sugar as the weight of the quinces. Boil this till it is of the proper consistence for a marmalade, bruising it with a wooden spatula.

4486. *A marmalade may be made in the same manner* by using pears, apricots, peaches, pineapples, or any other fruit of a pulpy nature.

4487. *Jams* require the same care and attention in the boiling as marmalade; the slightest degree of burning communicates a disagreeable empyreumatic taste, and if they are not boiled sufficiently they will not keep. That they may keep, it is necessary not to be sparing of sugar.

4488. *Raspberry Jam.*—Pick a sufficient quantity of fresh ripe raspberries, gathered on a dry day; mash them, and pass them through a wicker sieve; to one pint of the pulp add a pound of loaf sugar, pounded or broken small: put the whole into a preserving pan over a clear fire. When it begins to boil, skim it well, and stir it for half an hour, taking great care not to let it burn. When done, put it into small pots, cut some pieces of paper round to the size of the pot; dip them in brandy, and lay them on the jam; also, tie another paper over the pot. Some add a little red currant juice to the raspberries; but this will demand some more sugar: others add a little honey to make it richer.

4489. *Strawberry jam and barberry jam* are made in the same manner. The sugar used may first be clarified: add one sixth of currant juice.

4490. *White Gooseberry Jam.*—This is a homely preparation, but very useful where there are children. It is made as the last, only the gooseberries, which should be quite ripe, must be well boiled until they begin to break. Each pound of fruit requires a pound of sugar; and the gentle boiling must be continued till the jam is of the right consistence. Red gooseberry jam is made in the same way.

4491. *Currant Jam* may be made the same way.

The months when jams and jellies are usually made are June and July. They should be examined in August to see if there be any tendency to fermentation, or any mouldiness; if so, they must be reboiled and prepared over again. In warm seasons this is very liable to happen.

4492. *To preserve Damsons for Pies.*—Take equal weight of fruit and clarified sugar. If any of the damsons are broken, boil them first some time in the sugar; then add the whole quantity of fruit, and boil till it jellies; pot, and tie paper over. But the best mode is Appert's, given already, p. 792.

4493. *Fruit Jellies.*—These are compounds of the juices of fruits combined with sugar, concentrated by boiling to such a consistence that the liquid, upon cooling, assumes the form of a tremulous jelly. Vegetable jelly is a distinct principle existing in fruits, which possesses the property of gelatinizing when boiled and cooled; but it is a principle entirely different from the gelatin of animal bodies, although the name of jelly, common to both, sometimes leads to an erroneous idea on that subject. Animal jelly, or gelatin, is glue; whereas vegetable jelly is rather analogous to gum, though different from it, and not nearly so nutritious as animal jelly or gelatin. (See Book VII., Chap. VII., Sect. IX.) In preparing vegetable jellies, it is necessary to guard against boiling them too long, since this destroys their property of gelatinizing, and they then assume the appearance of mucilage or gum; and this accident is most likely to occur when the quantity of sugar is too small to absorb the water of the juice. Jellies are most perfect as to beauty and transparency when clarified sugar is used; but for ordinary purposes refined sugar answers very well.

4494. *Currant Jelly.*—The usual method of obtaining the juice is to bruise the currants, and to pass them through a sieve; but then it is apt to be turbid and thick. A better mode is to warm the fruit by steaming it, or by putting it closely covered into a slow oven; the juice will then flow from it without much pressure. Put it now in the preserving pan on the fire to boil, in order to evaporate some of the water; let it boil a quarter of an hour; then take it off, skim it, and pass it through a flannel bag to render it clear: add sugar to it in the proportion of a pound and a half of refined sugar to one pint of the juice, and put this on the fire to simmer very gently, until, by dipping a spoon in the jelly, and again raising it, the jelly becomes stiff; then the boiling is sufficient. Take it now off the fire, and let it stand till the scum has collected on the surface; remove this, run the whole through a hair sieve, and put the clear jelly into pots. When cold, cover the surface with jelly paper steeped in brandy. What remains on the sieve will do to make pies, or mix with any common jam; and the jelly will be more delicate if no squeezing is employed. A small proportion of raspberries will improve the flavour.

4495. *White currant jelly* is made in a similar manner; only the finest sugar should be used, and the boiling and straining should be done very carefully, as the colour is easily injured. White raspberry juice may be added. The sugar should be high-boiled.

4496. *Black currant jelly* is generally used medicinally; it is made in the same manner.

4497. *Grape Jelly.*—Spread some of the ripest grapes on straw; at the end of a fortnight pluck them from the stalks, and boil them for five or six minutes only, in order that the juice may be extracted with ease by pressure; next pass the juice through a sieve, add a quarter of a pound of white sugar to each pound of juice, and boil the whole for half an hour, and afterward set it to cool; in twenty-four hours it will be a fine jelly, useful to invalids.

4498. *Robs are vegetable juices simply inspissated* by evaporating most of the water in a vessel over a fire till they acquire the consistence of sirup, which will prevent their running into fermentation. The fruits are to be squeezed in bags to obtain the juices. Sometimes a little sugar is added to make them keep better. Rob of elderberries will keep without sugar, and is sometimes employed medicinally.

4499. *Sirup of Lemons.*—Dissolve by a gentle heat a pound and three quarters of sugar in a pint of lemon juice, and skim it well; add an ounce of lemon peel cut thin; simmer the whole gently for a few minutes, and then strain it; when cold, bottle it, and keep it in a cool place. If lemons cannot be had, this may be made by dissolving crystallized lemon juice in sirup, and flavouring it with sirup of lemon peel.

4500. *Sirup of Oranges* may be made in the same way. Both these are useful for sauces and for punch.

4501. *Sirup of Lemon or Orange Peel.*—Macerate all night in a close vessel, with a pint and a half of boiling water, three ounces of the outer rind of lemon peel or Seville orange; strain and let it stand to settle; pour off the clear part, and add to it two pounds of loaf-sugar; evaporate by a gentle heat till it comes to a proper consistence for a sirup.

4502. *Fruits preserved by Candying.*—All fruits before being candied must first be boiled in sirup, after which they are taken out and dried on a stove, or before the fire; the sirup is then to be concentrated or boiled to a candy height, and the fruit dipped in it, and again laid in the stove to dry and candy: they are then to be put into boxes and kept dry.

4503. *For beautiful preserves for the dessert*, see "Confectionery," Book XV.

4504. *Conserves consist* of fresh vegetable matters beat into a uniform mass with refined sugar; and they are intended to preserve the virtues and properties of recent flowers, leaves, roots, peels, or fruits unaltered, and as near as possible to what they were when fresh gathered, and to give them an agreeable taste. Vegetables whose virtues are soon destroyed by drying, may be preserved in this manner for a considerable time unimpaired. The preparation of conserves is extremely simple. The sugar is first ground to fine powder, and then mixed by long beating (not by solution) with the vegetable pulp, or other material. No heat or other mode of preparation is employed; so that the vegetable matter remains as nearly as possible in the state in which it existed in the plant at the moment of gathering. The most usual of these are conserve of roses, mallows, rosemary; of hips, orange flowers, violets, jessamine, citrons, and sloes: they are chiefly medicinal. The apothecaries, under the title of conserves, comprehend all kinds of confects, both dry and liquid, whether of flowers, fruits, seeds, roots, or leaves, if they are prepared with sugar or honey to preserve them.

4505. *The following fruits and vegetables preserved, chiefly for the dessert, may be had in the shops in London:*

Muscatel raisins in bunches.
Jordan almonds.
Gusinarven, or Portugal plums.
Prunes impériales, the largest sort of French plums.
Prunes de Tours.
Prunes du Roi.
Prunes de la Reine, or prunes fleurées.
Prunes de Brignolles, or prunellas.
Prunes de Mirabelle, or pistolle.
French dried pears.
French dried apples: these keep a long time.
Portugal dried cherries.
Portugal dried peaches.
Elemi, or chosen Smyrna figs.
Turkey flat figs.
Do., in cakes with almonds.
Commadra in cakes, with almonds.
Marseilles almonds.
Almond figs, fig cakes, and almond pines.
Egyptian, Mogadore, and Barbary dates.
Portugal black grapes.
Spanish green grapes.
Hamburgh black grapes.
Malaga and Oporto pomegranates.
Spanish muskmelons.
French and Spanish olives.
Candied orange and lemon peel chips.
Preserved West India ginger.
Preserved East India ginger.
Preserved green limes.
Preserved pineapples.
Preserved tamarinds.
Pineapple jam.
Guava jelly.
Brazil nuts.
Cashew nuts.
American ground nuts.
Pistachio nuts.
Spanish chestnuts.
Fresh cocoanuts with milk.
East India candied ginger.
East India chou-chou.
Preserved nutmegs from Batavia.
Preserved cashew apple.
Apricots, greengages, strawberries, cherries, &c., preserved in apple jelly from Rouen.
The following fruits dried in sirup or in crystal sugar, from Auvergne; apricots, gages, peaches, cherries, strawberries, nectarines, Mogul plums, pineapples, Siberian apples, pears, &c.
Chinois glacés.
Mirabelles de Metz.
Apricot, greengage, and pippin tartlets.
Preserved oranges and lemons, carved, in jelly.
Norfolk biffins and biffin paste.
Gelées de fruit, dried in cakes.
Bottled fruits for tarts: apricots, greengages, peaches, cherries, raspberries, strawberries, currants, damsons, gooseberries, bullaces, rhubarb, American, Russian, and Swedish cranberries.

Marmalades, Jams, and Jellies

Apricot marmalade.
Orange marmalade, Dundee.
Greengage marmalade.
Quince marmalade.
Raspberry jam.
Strawberry jam.
Gooseberry jam.
Barberry jam.
Red currant jam.
Black currant jam.
Pineapple jam.
Red currant jelly.
Black currant jelly
Apple jelly.
Ditto, from Rouen.

If these are put into *patent stone jars*, they will keep very long.

BOOK XI.

ON THE GENERAL ARRANGEMENT OF A KITCHEN, AND ON THE CULINARY PROCESSES, AND APPARATUS FOR COOKING.

CHAPTER I.

INTRODUCTION AND GENERAL REMARKS.

4506. *The situation of the kitchen* with respect to the rest of the house demands the particular consideration of the architect. In London, and in many other large cities and towns, the great value of ground renders it desirable to economize space as much as possible; and hence the kitchen is almost always placed in the basement story. In the country, however, this mode of arrangement is not so necessary, and the kitchen is often a separate, though attached building, which is better on several accounts, as will be perceived from the following enumeration of the requisites of a good kitchen.

4507. 1. It should be sufficiently large, and the parts conveniently distributed. 2. It should be lofty and well ventilated. 3. There should be good light, especially in those places where the cooking is immediately going on. 4. It should be well supplied with water and fuel. 5. There should be easy access to it, without passing through the house. 6. It should be so placed that the odour of the cooking should not be perceived in the house; nor should the latter be incommoded by the noise of the culinary operations and servants. 7. The appendages to the kitchen, as scullery, pantry, store-room, fuel-room, &c., should be arranged near to it. 8. If possible, some of the offices are best placed round a small courtyard, which would be very useful for many operations that are proper to be performed out of doors and out of sight.

4508. It may be sufficient at present to enumerate a few things in the interior that must be attended to in designing every large kitchen. There should be some good side lights as well as a skylight, if the latter be practicable. There must be a sufficiently large chimney, with a kitchen range, stewing stoves in brick, hot plate, roasters, ovens, and other fixtures for cooking, with proper flues, independent of that belonging to the range; dressers, plate-shelves, and other necessary furniture. The floor should be stone, and the skirtings stone or slate. The cooking is carried on by fires made with wood, coal, peat, or charcoal: steam, gas, and lamps are likewise employed; and also combinations of several of these modes, each of which demands peculiar contrivances.

4509. In considering the form and general arrangement of kitchens, regard must be had to the nature of the establishment, and the kind of cooking to be performed, since the apparatus necessary for a small family, where economy of expense and house room is a material object, ought to be very different from what are required in the kitchen of a person of large fortune, or in a public establishment.

4510. "*The distribution of a kitchen*," Count Rumford observes, "must always depend so much on local circumstances, that general rules can hardly be given respecting it: the principles, however, on which this distribution ought in all cases to be made, viz., convenience to the cook, cleanliness, and symmetry, are simple, and easy to be understood; and in the application of them the architect will have a good opportunity of displaying his ingenuity and showing his taste. Should he condescend to consult the cook in making these arrangements, he will do wisely, on more accounts than one." He observes farther, "Cooks, in general, are averse to all new inventions; and this is not surprising, and ought by no means to be imputed to them as a fault. Accustomed *to work with their own tools*, they naturally feel awkward and embarrassed when others are put into their hands: and to this we may add, that there is always a degree of humiliation felt by those who, after having been accustomed to consider themselves, and to be considered by others as masters of their profession, are required to learn anything new, or to do anything in any other manner than that in which they have been always accustomed to do it, and in the performance of which they have acquired praise. It will not, however, be difficult to convince those of the profession who are possessed of a good understanding, and are above low and vulgar prejudices, that certain alterations proposed will meet with their approval *when they become better acquainted with them.*"

4511. *With respect to the various operations of cooking*, Dr. Prout observes that "they are preparatory to the solvent action of the stomach. Of these operations, man's nature has taught him to avail himself, and they constitute the chief means by which he is enabled to be omnivorous; for, without such preparation, a very large portion of the matters which he now adopts as food would be completely indigestible." The same eminent physician considers cooking as operating upon our food much in the same way as the digestive organs in the commencement of their operation: and he says farther, that "in some individuals the powers of digestion are so weak, that the stomach is almost incapable of dissolving solid food of the most simple kind; and that a crude diet of the flesh of animals in a hardened state, 'from bad cooking,' is little else than poison." He adds, "the culinary art engages no small share of attention among mankind; but, unfortunately, cooks are seldom chemists; nor, indeed, do they understand the most simple of the chemical principles of their art. Hence their labour is most frequently employed, not in rendering wholesome articles of food digestible, which is the true object of cooking, but in making unwholesome things palatable."

4512. *As an illustration of the power of cookery, it may be observed that the alteration produced in the qualities of substances by the application of heat* is remarkable. The cassava root, when raw, is a fatal poison to man and beast; but, prepared by fire, it is not only innocent, but forms the common food of the West Indians. The strong odour of the onion is destroyed by boiling. The root of the wake-robin has a juice that will blister the skin; but when boiled it is as mild as the potato. Mushrooms have little taste when raw, but become very savoury when cooked. The raw potato is ill-flavoured, extremely indigestible, and could not be eaten as human food unless it was cooked; but by roasting or boiling it becomes farinaceous, sweet and agreeable to the taste, wholesome, digestible, and highly nutritious. Coffee is disagreeably bitter in its raw state, and the fine aroma for which it is distinguished is entirely the result of the process of roasting. When, in the preparation of bread, considerable heat is applied to the dough, a complete change is produced in its chemical properties; the raw substance differs entirely from the flour: it no longer makes a tenacious paste with water, nor can starch and gluten be any longer extracted from it.

4513. *The application of considerable heat to raw animal food by any of these processes produces in it several chemical changes.* Much water is evaporated, the muscular fibre is rendered opaque by the coagulation of the albumen, and it becomes likewise more tender; the gelatin, which is never liquid in the raw state, is rendered soluble; the fat is partly liquefied, without being melted out of the cellular substance.

4514. *By applying heat to vegetables*, the more volatile and watery parts are, in some cases, dissipated. The different principles, according to their peculiar properties, are extracted, softened, dissolved, or coagulated; but most commonly they are changed into new combinations, so as to be no longer distinguishable by the forms and chemical properties which they originally possessed. Raw vegetables contain much free acid, a great part of which counteracts the digestive functions: the heat of the cooking processes destroys this acid, partly by extraction, and partly by altering its nature: boiled vegetables, therefore, contain little or no acid. By heat, sugar is often formed, as in the case of apples, and new and agreeable flavours are developed: the alimentary properties have been improved, the farinaceous matter is rendered soluble, and the vegetable fibre is softened. Numberless other instances might be mentioned of the influence of heat upon the nutritive properties of substances employed as food.

4515. *The whole subject of food, and its preparation by cookery*, are, as we have before more than once stated, so dependant upon the chemical history of the various substances employed, that it is impossible to study them advantageously without reference to that science; and it is for that reason we have endeavoured to prepare the reader for our present section by some preceding ones. Cookery, indeed, may be considered, in some respects, as a branch of practical chemistry. On a general view, we may divide the various processes of the cook, as generally practised in England, into roasting, baking, broiling, frying, boiling, and stewing.

CHAPTER II.

RATIONALE OF THE SEVERAL PROCESSES EMPLOYED IN COOKERY.

4516. Without entering into those minute details which will be given in another part of this work, entitled "Directions to the Cook," Book XII., Sect. III., we shall shortly describe the rationale of the various cooking processes, and what are the leading circumstances which distinguish them from each other; at the same time, we shall take the opportunity of pointing out the principal chemical changes which they severally produce upon the substances subjected to them. We shall afterward describe the utensils employed in the several processes.

Roasting.

4517. Roasting, as it is usually practised, is fixing meat upon a spit, or suspending it before a fire, and causing it to move round; but this motion is not essential to the process of roasting. It is sufficient that all sides of the meat should be, by some means or other, exposed to the radiant heat of a fire, while, at the same time, a current of air passing over the meat carries off all the steam and other volatile substances that are raised by the process. This species of cookery is therefore divided into roasting before an open fire, and roasting by enclosing the meat in a heated vessel, furnished with a contrivance by which hot air can enter and pass out again, such as the *Rumford roaster*, to be afterward described. In both cases the principle is the same, and also the effect produced.

The first change in roasting is the melting of the fat exposed to the heat of the fire, while, at the same time, the watery fluids on the external part are converted into vapour; but, as the heat penetrates deeper into the meat, the juices undergo important alterations. The gelatin, which, in the raw state, was partly solid, is now liquified, and forms the gravy, which acquires an agreeable taste from its union with the ozmazome; while, at the same time, the albumen of the muscular fibre coagulates by the heat, and acquires a firmer consistence. The change takes place first on the outside, and it requires a considerable time before the heat can penetrate completely to the centre of the meat; but it does so, at last, gradually, and the steam which is formed in consequence, coming from the interior, and bursting out upon the surface, breaks and rends the fibres of the meat, loosens their texture all through the mass, and permits some of the gravy to come out and fall into the dripping-pan, together with the melted fat. As the loss of this would render the meat less sapid, it is continually returned upon the joint by a long spoon, being seasoned with a little salt, a practice well known by the term *basting*, without which a good roast cannot be effected. Towards the middle of the process, the intense heat begins to carbonize the outside, so as to form a kind of crust, which is prevented from increasing too much by turning round and managing properly the heat of the fire, and by repeating the basting sufficiently often. Dredging a little flour on the meat, to cause a froth, is the last part of the process. The dripping-pan should be kept perfectly free from coals or ashes falling into it.

4518. The process of roasting before the fire with a spit is performed in England with admirable dexterity, and little seems to be wanting in this respect by an experienced cook; but it must be observed that it is one of the most difficult processes she has to perform, and that vigilant attention, with much practice, are necessary to make a good roaster. Minute directions for roasting will be given under the Section "Directions to the Cook," Book XII., Sect. III. The following observations are of a more general kind. Managing the fire well, so as to have it clear in front, to get as much as possible of the radiant heat, is essential to success. A screen, covered with tin, is useful, both to reflect heat upon the meat, and thus to save fuel, while, at the same time, it keeps off the draught of cold air that comes to the fire. To roast meat well, it is essential that the fire should not be too fierce at first, otherwise the joint will be scorched: it is usual to keep it, at first, at a greater distance from the fire. The cook is enabled to tell when the meat is sufficiently done, partly by its appearance, and partly by the time it has been roasting.

The meat should not be too long exposed even to a moderate heat, as that would dissipate all the juices, while it coagulated the albumen, and would dry up the muscular fibre. The sapidity and completeness of the roast depends upon the preservation of the juices, and that exact alteration of the exterior surface which is just sufficient to brown it, and thus develop, or, rather, form, by a partial decomposition, the principle called ozmazome, on which the particular flavour of roast meat depends. It is proper here to state that, in many contrivances for cooking, merely enclosing the meat in a heated part of an apparatus, without any current of air passing through it, is improperly termed roasting; whereas, as will be more particularly explained hereafter, it is only *baking*.

Occasionally large Quadrupeds, such as a Bullock or Sheep, are roasted entire.—Among the Jews, the Paschal lamb is obliged to be roasted whole. It may be found difficult for an English cook to bring a whole lamb well dressed to table, but in the East it is not at all uncommon to roast a sheep entire; and those who have not seen it can scarcely imagine how well such a mass of meat may be so cooked. Thevenot says, in his "Travels," that "it is common in Persia to perform this species of cookery. It is done in an oven, which has an opening at the top; after this has been well heated, the meat is hung up in it, and a dripping-pan put under to receive the fat; in this manner it is well done on all sides." The Armenians wrap the sheep in its own skin, and surround it with burning coals. M. Blaquire informs us that in Greece he has seen a whole sheep or lamb turning before a huge fire of wood; this was common among the shepherds. A stake was passed through the carcass, being supported upon two forked sticks stuck in the ground. When the roasting was completed, the animal was carried away and placed against a tree, where it was cut into pieces. Meat is often roasted whole in Italy, and cut from the spit and sold in the market-place.

4519. *It is sometimes necessary to intenerate, or make tender*, meat or poultry that is either fresh killed, or that is naturally tough from age. If there is time, hanging it up a sufficient time has the desired effect, as we have already explained under "Preservation of Food." Whatever accelerates incipient putrefaction serves to render meat tender. It is a well-known fact, that a fowl of any kind, not many hours killed, will become as tender, if buried five or six hours in common garden soil, as if it had been kept above ground two or three days. Fowls newly killed, and dressed before they are cold, and, consequently, before the fibres become rigid, are always tender, as are all the internal parts of animals.

Broiling.

4520. Broiling is a quicker kind of roasting, by putting the meat *over*, instead of before the fire. For this purpose, to prevent smoke, the first should be very equal and clear, and the meat must be turned often, using a peculiar kind of tongs for the purpose, not a fork, which lets out the gravy. As the outside albumen is set firm almost immediately, it prevents much of the internal juices from escaping, and hence the great sapidity of meat well broiled, which is justly esteemed one of the best modes of cooking. Broiling is a simple mode of cooking, often best suited and most acceptable to the fickle appetite of the invalid; and it is recommended by comfort and economy to solitary diners and small families, as affording a means of dressing a small quantity of meat *hot* as delicately as the largest quantity. The English beefsteak and mutton chop are celebrated all the world over, and there are many other excellent things which are done best in this mode. Broiling has likewise the recommendation of being the most expeditious mode of cooking. Some improvements of the apparatus for broiling will be found in our account of "Kitchen Furniture."

Frying.

4521. Frying is a kind of boiling in oil or fat. As these sunstances are capable of being heated to a much greater degree than water, the necessary change is produced upon the meat much sooner than in boiling in that fluid; this is also, at the same time, effected, in some degree, by the radiant heat from the frying-pan; so that, in fact, the process is intermediate between roasting and boiling, and by the intervention of the iron between the meat and the fire it gets very equally dressed. The best substance to fry with is oil; but good butter, if clarified, answers very well, though, if not clarified, it is apt to burn, and give out an empyreumatic flavour, owing to the milk it contains. Good lard, if quite fresh, will do very well. It requires some nicety to make the oil of the proper degree of heat· if not hot enough, the fry will be merely boiled or sodden ir fat, and not fried; and if too hot, it will be scorched before it can be heated through. Frying is often a convenient mode of cooking, as it may be performed by a fire which is not large enough for roasting or boiling. But Dr. Kitchener observes that, though this is one of the most common of the culinary operations, yet it is one that is seldom performed perfectly well.

Baking.

4522. Baking meat in an ordinary oven differs from roasting in this, that the substance is heated in a confined space, and the fumes arising from it are not carried off, no current of air passing through the oven. This is of considerable importance in dressing meat; in baking, the agreeable and peculiar taste of roast meat is not completely developed, a slight empyreumatic taste is acquired and communicated, which a nice palate can almost always distinguish. With respect to the making of pies or pastry, this objection is of little consequence, as the crust defends the articles baked. With this exception, the changes produced by baking are nearly the same as by roasting.

Notwithstanding the objection we have mentioned to meat baked in the ordinary baker's oven, yet for those whose palates are not sufficiently delicate to perceive the defect, this mode of cooking has many advantages of economy, both of time and expense; indeed, a careful baker, who will take some trouble in keeping the inside of his oven perfectly clean, may avoid much of the usual defects; and the oven has been significantly termed "the poor man's kitchen."

The following directions for baking meat are from the excellent manual by Mistress Margaret Dodds:

"The baker's oven, or the family oven, may often be substituted for the cook and the spit, with greater economy and convenience; and for some particular joints and kinds of viands it is even more suitable. A baking-dish ought to be in the form of a trough, and at least six inches deep, that the meat may, in fact, stew in its own juices, as it gets little or no basting; but a *pig* must be baked in a shallow tin dish; the dripping-pan of a bachelor's or Dutch oven will answer very well. Prepare things to be baked as for roasting, but season more highly. A *fillet* or *breast* of veal, if not very highly fed, will bake as well as it will roast. The oven is equally suitable for a *leg* of pork, but a *loin* requires to be sweated in roasting; it is too greasy when baked. A *pig*, if not very old, and if the baker is careful to anoint the crackling as in roasting, bakes very well. His ears and tail must be put in buttered papers, if you would hope even to see them returned from the oven. Geese and ducks may be baked, if not old and rank; in which case they must be sweated in roasting before the fire, to overcome the flavour. A *leg* of *mutton*, with potatoes parboiled and peeled, and an onion shred, makes, when baked, an excellent plain family dish, the mucilage of the potatoes combines so kindly with the fat of the meat. The noble *sirloin* disdains to be cribbed in the oven; but a *rump of beef* slightly salted for a few days, washed, highly seasoned, and baked with plenty of butter in a deep, covered vessel, is esteemed a delicacy. A *hare* or *rabbit* may be baked, allowing pieces of butter in the dish, and putting a large piece or a rich stuffing into the inside of the animal. Herrings, sprats, salmon, haddocks, and eels may all be highly seasoned and baked with advantage. Bakers' ovens have one great drawback; they are accused of being real sponges for gravy, so that they often indemnify the baker's apprentices for the trouble saved to the cook. Besides, meat is seldom got home in season from these wholesale receptacles for all manner of joints. Hams are often soaked and baked when they are used in great quantity, and when the object is to cut thin. Fish, if baked, must have plenty of butter." It is to be observed that most of the last-mentioned evils may be avoided by having ovens at home.

4523. *In baking pies*, in particular, the state of the oven should be attended to. Almost every oven has a temperament of its own. Puff paste requires rather a smart oven to make it rise light. Raised paste must have a quick oven. Practice and observation are very necessary in the management of an oven.

4524. *Among the singular methods of baking*, we may mention that which was originally practised by the natives of Otaheite when they were first discovered by Captain Wallis. They dug a pit in the ground about a foot deep, and a yard across; then, having paved the bottom neatly with clean pebble-stones, they made a fire in it with dried leaves and the husks of the cocoanut. When the stones were sufficiently heated, they took out the embers and raked out the ashes, and then covered the stones with a layer of green cocoanut leaves. The animal to be roasted, perhaps a small hog or a dog, was carefully wrapped up in the leaves of the plantain and placed in the pit, where it was covered over first by the hot embers, and then with bread-fruit and yams wrapped up in the same kind of leaves. Over the whole was spread the remaining embers, mixed with hot stones and cocoa-tree leaves; and, lastly, all was closed up with earth to keep the heat in. After the meat had remained in for a time proportioned to its quantity, it was taken out well dressed, tender, and full of gravy. Captain Wallis thought it was better dressed in this way than in any other Captain King informs us that the same method is still practised by the inhabitants of Chiloe in cooking the excellent shell-fish that abounds in that island.

Boiling.

4525. Boiling consists in keeping the food for a sufficient time in water heated to the boiling point; if the water does not quite boil it is called *simmering*. This mode of cooking is so common a process, and so familiar to every one, that (as Count Rumford observes in his Essays), "few probably take the trouble to inquire how, or in what manner, the effect is produced. The cook knows from experience that if his meat remains immersed in boiling water a sufficient time, it will be *done*, as it is called in the language of the kitchen; but if he be asked what is done to it, ten to one but he will be embarrassed to find a satisfactory answer."

In boiling the flesh of animals, considerable chemical changes are effected. The gelatin, which is always more or less solid in the raw meat, is dissolved by the water, while, at the same time, the albumen, a principle analogous to white of egg, and which is soft in the raw state, is consolidated. When the boiling has been effected by water quite at the boiling point, and the boiling carried on very fast, this is apt to wrap up the fleshy fibre, cause the albumen on the outside to set solid, and to prevent the access of the heat to the interior: hence boiling fast hardens the meat; and when cooked in this way, it will be too much done on the outside, while the interior will not be done enough.

The albumen begins to coagulate at 164°, and at 212° becomes firm. In large concerns, if various-sized joints are boiled together, the small ones will be done before the large; for the time of boiling a joint must be proportioned in some degree to its size. A degree of heat somewhat under 212°, or *simmering*, is most proper for making meat tender. Meat, to be well boiled, should be put into cold water, that the heat may penetrate gradually to the centre; but there are a few exceptions to this rule; fowls and white meat generally require the water to be a little warm. Soon after the boiling commences, a scum arises, which consists of a portion of the albumen with some fat from the outside; this is to be carefully skimmed off.

4526. *In Book II., Chap. I., on "Heat," we gave an explanation of what constitutes boiling properly;* namely, the conversion of water into steam by its being heated to 212°; and we showed that water cannot be heated higher in open vessels; all fuel employed to raise the heat above that point is wasted in merely raising steam. It is very important that all cooks should be thoroughly acquainted with this fact; some imagine that by using much fire, and making the water bubble much, it is made hotter in proportion to the noise and motion it makes. Using much fire will cause the water to evaporate, or boil away faster, but it will be no hotter; and as the cooking of the meat properly depends upon the temperature, and not the quantity of the water, the meat will not be done any sooner by boiling fast; on the contrary, in many cases, it will be hardened, as was explained above, and will be longer in doing. By too rapid boiling, not only is the meat rendered harder, but much of its savoury juices are thus evaporated and lost. The great art in boiling, therefore, for economy and good cooking, is to keep the water *just under the boiling point;* and after it once boils, it is amazing how little fuel will effect this; all beyond that is waste.

4527. *Large joints of meat,* as rounds of beef, hams, legs of mutton, &c., are best boiled in a copper, or some vessel over a closed fire-place, as it is easier to regulate the heat in this manner than with a kitchen range; on this account, boiling by means of steam is advantageous for economy. In boiling in water, it is sufficient if the joint be quite covered with it; there is nothing gained by a larger vessel; indeed, when that is small, the liquor becomes a kind of broth that may be useful. As the water wastes by evaporation, it must be replenished by the addition of some cold water, but better by warm water, if that is at hand.

4528. *In giving directions for boiling vegetables,* there is sometimes a little confusion, some recommending soft, and others hard water. This can only be cleared up by attending to the chemistry of the subject. Soft water has a greater solvent power than hard; and when the object is to extract the juices of vegetables, soft water must be used; as, for instance, in the making of tea or barley-water; but when the juices are not to be extracted, but preserved in the vegetable, then hard water is proper enough, as containing salts which lessen its solvent powers; accordingly, we observe that the cook throws a handful of salt into the water in which she boils her vegetables, which has the effect, although probably she is not aware of it, of making it hard. Vegetables, to be digestible, should be well boiled; and some recommend boiling them in two waters. An analogous observation is made in boiling meat, which is more juicy and tender when hard water is employed than when soft is used, because the solvent power of the latter extracts too much the juices of the meat. With respect to fish, as firmness after boiling is a desirable quality, hard or salt water is decidedly the best; and the cooks put salt into the water to prevent the fish being soft.

4529. ***Boiling, although the simplest mode of cooking, was probably not the first invented.*** To make water hot enough for boiling requires vessels to contain it that will resist the fire. It is remarkable that the inhabitants of the Pelew Islands, when discovered by Captain Wilson, though they baked their meat and fish, were not only unacquainted with the art of boiling food, but were ignorant that water could be made boiling hot, having no vessels in which it could be heated. Some nations, as the Esquimaux, have, however, found out methods of boiling water by hollowing out vessels in a natural substance called potstone, and others have contrived to boil in wooden vessels by throwing red-hot stones into the water.

Stewing.

4530. Stewing differs from boiling in this, that the heat is never to be raised to the boiling point, but only to a very gentle simmering, with a very small quantity of water. Of course, it requires much longer time to cook in this manner; but in stewing, the texture of meat is rendered more tender; the gelatinous parts are more completely dissolved; and instead of a considerable part going into the water, as in boiling, the whole of the juices are preserved in the stew, which is therefore very nutritious. Dr. Prout is of opinion that one of the operations of the gastric fluid is not only to dissolve the aliment taken into the stomach, but to cause its combination with water preparatory to the decomposition which it is to undergo, in order to be separated into those elementary principles from which new combinations are to be afterward prepared by the animal organs; now the process of stewing effects a good deal of this, and therefore leaves less for the operations of the stomach. Stewing is, therefore, found to be not only a very perfect mode of cooking, but also very economical, because a very small quantity of fuel, properly applied, is sufficient to keep up the simmering for a great length of time. In Continental cookery this method is very much practiced, and some of their contrivances are highly deserving of imitation, particularly by the working classes, and others, with whom economy of fuel and time is an object.

Soup.

4531. *In treating, in this place, on the making of soup,* it is not our intention to encroach upon the province of the cook, to whom practical directions, in a future part of the work, will be given for preparing various dishes of this sort. Our object at present is to consider it generally as a particular mode of cooking, and chiefly to point out some chemical principles connected with it, which should be understood by those who are desirous of examining the subject with a view to public objects.

4532. *Soups may be described* as decoctions, more or less strong, of animal and vegetable substances, generally of meat with vegetables, and seasoned with salt, spices, &c. They may be made in an infinity of ways; there is no end to the combinations of meat, fish, vegetables, spices, and mucilage, with water; but of all meats for making soup, beef is esteemed one of the best.

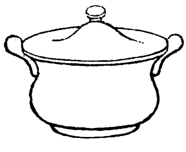
In our description of boiling and stewing, we stated that the gelatin of raw meat is softened by the heat, and is dissolved by the water; but not so the albumen, that being insoluble in water. Soup, therefore, contains the first of these principles, but not the latter, which remains attached to the meat. Besides the gelatin, soup made with vegetables contains also the soluble principles extracted from them, of which mucilage is the most abundant. Both the gelatin and the mucilage combine readily with water, and likewise with each other; but the fat of the meat, which melts with the heat, will not, as is well known, unite readily to water; by means of mucilage or starchy matter, however, oil and water are made to unite, as happens in what is termed by apothecaries an *emulsion*. Thus, almond emulsion is formed by beating up almonds with water or some other fluid; the oil of the almonds is made to combine with the water by means of the mucilage and starch of the almond. In the same manner, much of the dissolved fat in soup is made to unite, and prevented from rising to the surface, by means of thickening added, which consists of flour, rice, oatmeal, or some such material containing starch and mucilage; and thus a good deal of the fat is made to unite with the soup; what refuses to do so, and rises to the surface, should be skimmed off. Dr. Kitchener recommends, in order to save time, that the soup should be made the evening before it is wanted, and when it is cold the fat may be removed from the surface, which, when clarified, is useful for all the purposes of dripping; and Beauvillier observes that this is the best of all the fats used for frying.

4533. *In making soup, the operation should be conducted very* slowly, to give time for the above combinations to take place, and the heat should always be under the boiling point of water, or what is termed simmering.

4534. *It is the opinion of physicians that the nutritive powers of soup have been overrated* by Count Rumford and others, and likewise those of jelly prepared from animal substances, which consists of coagulated gelatin. A very small quantity of solid gelatin, when dissolved in water and cooled, causes it to gelatinize, or set into a jelly; and an erroneous estimate has been formed of the strength of soups by observing their forming a jelly when cold. Gelatin, likewise, is considered by Dr. Prout and others as less nutritive than albumen; but it is the first only that is found in soups, as we have stated; the albumen is retained in the meat. Hence soups, generally speaking, cannot be considered so nourishing to stomachs that can digest solid food; but as gelatin can be digested by persons of weak stomachs, who cannot take more substantial sustenance without inconvenience, soups are very proper for certain invalids. Notwithstanding these medical opinions, which are, no doubt, correct, we have the examples of France, Germany, and other Continental nations, as well as Scotland, in favour of the nutritive power and wholesomeness of this kind of cookery, and there is no doubt that the converting a small quantity of animal food into soup with vegetables is by far the most economical way of using it; and it is to be wished that the strong prejudice that prevails in England against it, particularly among the working classes, was removed.

4535. *The bouillon of France* is a kind of soup, or stew, well known to every family there by the term *pot au feu*, and forms the dinner, and often the breakfast, of a large proportion of the inhabitants of Paris. The manner of preparing it is as follows: An earthen pot, with a cover, called a *marmite* (*fig.* 626), is provided, made to hold from one to seven pounds of meat. A sufficient quantity of lean meat (*bœuf maigre*), usually part of the leg or shoulder, according to the family, is put into this vessel, which is then filled up with cold water, say about five pints of water to one pound and a half of meat. The pot is then placed on the hearth close to the wood fire, and generally upon the hot ashes. When it begins to simmer, or boil gently, the scum which is thrown up is carefully removed from time to time with a spoon, which requires three quarters of an hour before the whole is thrown up, and the meat and water cleansed from every impurity. A carrot, half a parsnip, a turnip an onion, a little celery, or, in short,

Fig. 626.



any vegetables in season, are then added, together with salt and spice. After these additions, the pot remains covered at the fire, and is kept just simmering for six hours more, hot water being supplied in the room of what is evaporated. Length of time appears to be essential to the perfection of this soup; and all who are acquainted with French soups acknowledge their excellence.

4536. *Soup can be made from bones alone*; and though this information may not be of much importance in English domestic economy, where it is seldom practised, still it is an interesting subject, and some useful application may be made of it in certain situations. The composition of bone has been described in Book VII., Chap. II., as consisting of a solid form of certain earthy salts, chiefly phosphate of lime, enclosing a little cartilage and abundance of gelatin.

4537. *Cold water has scarcely any action on bone*; but by maceration in water a long time, the texture becomes more loose and open, and the gelatinous part becomes gradually softened.

4538. *Boiling water acts considerably upon bone*, when reduced to small pieces by rasping or bruising. The first effect is to dissolve and separate the natural oil, which rises to the top, and when cold concretes to a suety fat. The water dissolves a portion of the gelatin, which composes a very considerable part of the substance even of the driest and most compact bones.

M. Pelletier made some accurate experiments on this subject. He macerated six pounds of dry bone shavings, procured at the button-mould makers, for two days in cold water, and then boiled them for nine hours in twenty-four quarts of water. The produce was a very strong, clear jelly, and at the bottom of the vessel was an earthy residue. By subsequent boiling, the jelly became so stiff, when cold, as to bear being cut up into firm slices, which, when hung up on strings in the air, dried in a fortnight into glue of a good quality. The dried glue weighed fifteen ounces and a half. Fifty pounds of ivory shavings gave nine pounds and a half of clear glue. These facts are sufficiently known to many practical economists who are in the habit of preparing jellies from ivory turnings and shavings; and it is a matter of common observation that bones contribute, when boiled with meat, or in soup or gravies, to the richness of the liquor; but it is not commonly known how much gelatin may be extracted from all bones, even the hardest and driest. This gelatin, when dried, may be preserved unchanged for years.

The quantity of jelly is much increased by giving the water by which it is extracted a higher degree of heat than the boiling point; or by reducing the bones to a fine powder, and using repeated coction and pulverization.

The former method was used by Papin in his *digester*, the latter mode was brought into notice by M. Proust. No method extracts the jelly so completely as long boiling in Papin's digester with a very great heat; but the jelly which remains in the water, and the oil which swims on the top, are found to have acquired a burned, unpleasant taste. The method of Proust is preferable; chop the bones into small pieces, and extract the fat in the way mentioned above; then dry the bones, and powder them by some pretty strong mechanical power; boil them with about ten times their weight of water for some hours, till half the water is wasted, more or less, according to the kind of bone, the joint and thick bones making a richer jelly than the thin bones. This proportion of water is sufficient to leave a jelly of about the same richness as would be produced by one ounce of portable soup dissolved in thirty-one ounces of water. The extraction is much assisted by using a close lid, but not fastened down as in a digester; uncooked bones are here understood. The bones of boiled meat still contain a great deal of nutriment, but roasting renders them unfit for this purpose.

4539. *The extraction of the gelatin from bones is now performed in France by another process*, namely, by dissolving all the earthy salts by an acid, leaving the whole of the gelatin. When bones are steeped in diluted acid, as the muriatic, a slight effervescence is perceived, and they are rendered soft and flexible by the gradual abstraction of the earthy basis, or skeleton, which we have said is chiefly phosphate of lime, that becomes dissolved in the acid. The residue is a spongy substance retaining the form of the bone, and consists of the gelatin and cartilage which had originally filled up all the minute cavities of the bone. Nearly the whole of this may be dissolved in boiling water, and yields a solution possessed of all the properties of gelatin. The cartilage which remains undissolved by the water appears identical with coagulated albumen, or white of egg.

A very nutritious kind of ship's biscuit has been made of this gelatin and flour.

4540. *Soup made of gelatin from bones* was used some years ago in the hospitals of Paris; and, notwithstanding the public opinion against it, was said to be sufficiently wholesome; but of late its character has declined, and it is not considered nearly so nutritive as soup made in the ordinary way from meat. In fact, as has been stated, gelatin has of itself but little nutritive power; and it was owing to this having been overrated that many errors respecting soup were propagated. We are the more desirous of pointing out the inferiority of this preparation of soup, lest any persons connected with public establishments might entertain erroneous views on this subject.

CHAPTER III.

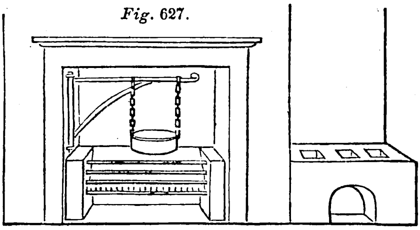
CULINARY APPARATUS.

SECT. I.—FIRE-PLACE.

4541. In considering the apparatus necessary for cooking, our first attention is necessarily directed to the fire-place.

The usual form of the fire-place of a kitchen in the towns of England about fifty years ago was that of a very large, open chimney (*fig.* 627), in which was a very strong iron grate for the fire, called a *range*; the throat of this chimney was enormously large, and the consumption of fuel immense. To support kettles over the fire in boiling, a crane was placed, moveable upon a centre, to which the vessels were suspended by iron hooks that were made to lengthen and shorten to keep them near or farther from the fire: afterward, to economize fuel, the front bar of the range was made to fold down; and moveable iron cheeks were added, to reduce or enlarge the fire by winding them with a rack and pinion; also a little trivet was placed upon the upper bar, to support a tea-kettle or other small vessel. The consumption of coals, with all these improvements, was still very great, not only in large establishments where much cooking was done, but likewise in families of the middle class, where economy is more an object. When stewing, or what are termed *made dishes*, were required, charcoal stoves were used. These are small square pits sunk in a mass of brick-work, generally at the side of the chimney breast, in which lighted charcoal was put, and over which the stew-pans were placed on trivets. As there were no flues to carry off the noxious gas disengaged from the burning charcoal, the kitchens were rendered very uncomfortable, and likewise unhealthy, when stewing was much employed; and as the deleterious nature of these charcoal vapours was not generally understood, no precautions were taken to guard against their bad effects.

Fig. 627.



4542. *Such was the English kitchen when Count Rumford directed the public attention to the enormous and useless expenditure in fuel, as well as to other matters connected with it.* In Germany he had been concerned in the arrangement of public establishments for the poor, and some of his inventions were put in practice with great success; but the difference in the modes of living in that country and in England prevented these improvements from being easily adopted here, and we have no example in this country of his German kitchens described in his "Essays," which were convenient for the cook, and where the economy of fuel was carried to such a degree as left nothing to be desired. In consequence, chiefly, of the writings of Count Rumford, and the various culinary arrangements fitted up in the Royal Institution, and in other places, from his plans and suggestions, a manifest improvement has taken place among us in this department; and though some of the best of the count's ideas have been thwarted through the interested and erroneous views of individuals, yet much good has resulted from his philanthropic and zealous endeavours to benefit society. A portion of this good consists in his having shown how the principles of science may be applied with advantage to the subject of a kitchen, formerly considered as beneath the attention of the philosopher, and abandoned altogether to tradesmen, whose very limited education disqualified them from understanding this subject properly. Since that time, however, considerable progress has been made in the fitting up of kitchens, and many improvements have gradually taken place: our limits will not permit us here to give their complete history, and we must content ourselves with describing such constructions as are now in general use.

4543. *Kitchen Range.*—One of the improved kind now used is represented in *fig.* 628. This grate contains a partition of iron, *a*, which is moved by concealed rack-work and a

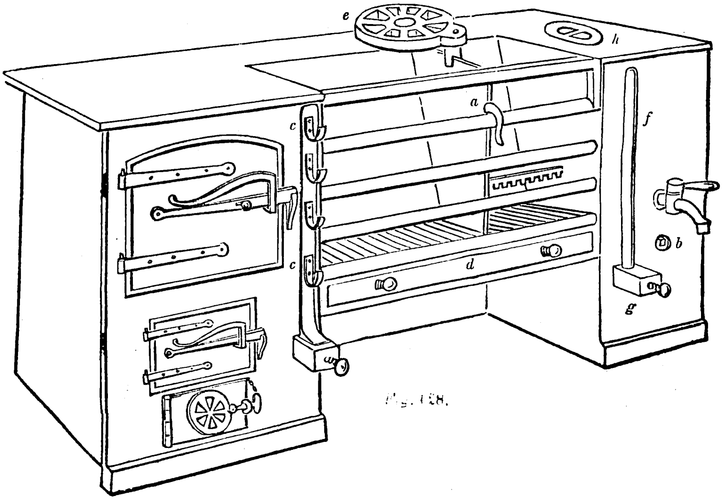


Fig. 628.

key, which goes into the hole at *b*; this is for the purpose of enlarging the fire when roasting is to be done, or contracting it when the cooking is finished. On the top of this partition is a revolving trivet, *e*, to hold a tea-kettle or sauce-pan over the fire. The top bar of the grate folds down, to reduce the height of the fire when necessary, and to support sauce-pans or boilers. A shelf or drawer, *d*, below the fire, may be pulled out to hold the dripping-pan, plates, dishes, or anything where heat is required. On one side of the fire-bars is a series of hooks, *c c*, which one end of the spit rests in, the other end being carried by the chain coming up against the upright round, *g*, *f*, which is attached to a horizontal piece, *g*, that can be pulled out a little to bring the spits nearer or farther from the fire; and the hooks at the other end are also fixed to an upright bar that may be moved out in a similar manner. It is scarcely necessary to mention that the spits are carried round by a jack, and hung at one end by the jack-chain, that works in a grooved wheel fixed to the spit; and that behind the spit is the tin screen mentioned when describing the process of roasting. By this range, also, more than one spit may be in action above one another at the same time. Besides the range itself, which has been just described, there is now frequently attached to it on one side a boiler, *h*, fixed, and forming part of the apparatus: this boiler, extending along the back of the fire as well as on one side, being heated by the fire in the grate, affords a constant supply of hot water, which is drawn off by a stop-cock with a lever handle. On the other side of the range there is an iron oven, heated by a small fire below it, and which, when well managed, serves to bake pastry, &c.

It must be observed that, to bake well in this oven, it is necessary that it shall be so constructed that the fire may circulate over the top of the oven and under the top plate, as well as round the sides and back, in order that the heat may be thrown down upon the things in the oven. When the oven is heated only on one or two sides, and not on the top, it does not perform nearly so well.

The boiler is supplied with water by an oval aperture in the top, closed by a heavy piece of cast iron, fitting it exactly, and having a projection on the under side that goes into a groove. This groove is always full of water from the condensed steam, and the water prevents any steam escaping from the boiler; for, before any can come out, it must make its way through the water in the groove, and also be strong enough to lift up the cover, which, therefore, acts as a safety-valve. To prevent the trouble of supplying the boiler every day with water by hand, some have it supplied from a small cistern in the kitchen with a ball-cock.

With respect to these range boilers, it happens that in a very few years, according to the kind of water used, a stony deposition, of the same nature as the fur of a common tea-kettle, is formed in the inside; and this incrustation, when it arrives at a considerable thickness, impedes the boiling of the water by its being a bad conductor of heat. When this happens, the top of the boiler must be taken off, and the hard incrustation cut off with a chisel. If suffered to remain, not only would the water boil slowly, but the boiler, by getting red hot, would soon be burned out. The best way is every three or six months to clean off the incrustation by scraping, while it is so thin as to scale off.

The boilers, which extend at the back as well as the side of the fire, as represented in *fig.* 628, called by ironmongers *L boilers*, are difficult to get at to clean, and, indeed, cannot be cleaned effectually through the opening usually left; in consequence of which, they frequently burn out at some place and give way. Some, therefore, prefer having the boiler at the side only of the fire, and fasten on the top of it with screws, which, being easily taken out, admit free access to the interior; others omit the oven, and make the boiler extend to both sides of the range, as well as at the back, in which the cleaning out of the boiler is more easily effected by an opening on each hob.

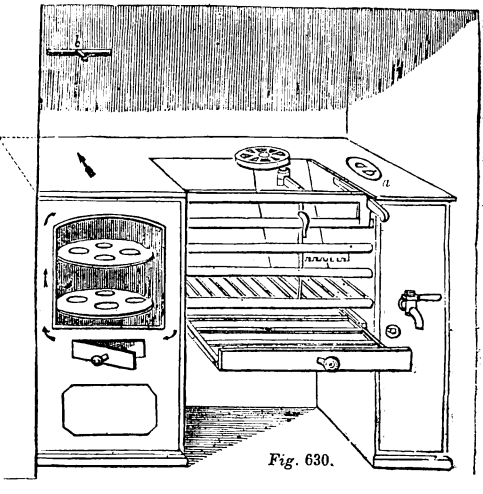
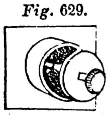


Fig. 630.

The doors of the fire-place for the boiler and oven ought to fit very close; and there should be a register in the ash-pit doors, which are made best in the form shown in *fig.* 628, by which a very small

Fig. 629.



quantity only may be admitted; this register, which has been long used, is much better than some now employed, as at *fig.* 629, where a circular opening is closed by a flat plate made to move out by a screw.

Other range ovens are heated only by the fire in the range, without any below it, as in *fig.* 630, where there is a narrow aperture in the side of the grate, by which the smoke and heat are allowed to pass beneath the bottom of the oven, in the direction of the arrows, thence round the side farthest from the fire, and over the top, then, lastly, into the chimney flue, there being a damper, *b*, to regulate the draught. Below the oven is an aperture to clean the flue occasionally.

In other ranges, again, there is no circulation round the oven, which is heated only by the fire in the range on one side of the oven, assisted by a *mass of iron* that lies in the fire, and communicates between it and the inside of the oven, thus affording a certain quantity of heat to the latter by conducting it from the fire: in these ovens, though there is no circulation, there is a cavity left all round the side farthest from the fire and the back by the bricklayer, in setting them, which prevents the heat from being absorbed by the walls. But this last kind of ovens, without any circulating flue, do not perform nearly so well, although some ironmongers assert they do, as where the flame and smoke pass all round. Very small kitchen ranges sometimes have an oven and side boiler, both heated by the fire in the middle, without the boiler extending along the back of the fire; but such a range cannot have a partition to wind up to reduce the size of the fire, as the latter must come up to both oven and boiler; these cannot be expected to act so well; but they are useful, and much cheaper.

It is a good method, though seldom practised, to have the side of the oven next the fire made of double iron, with half an inch between the plates, to prevent the too violent heat on that side. By a late improvement, the shelves in the oven are made circular and to revolve, so that the different sides of the dishes placed upon them can be presented in rotation to the hottest part. This is shown in *fig.* 630, where the door is left out to display the shelves.

4544. *In very large kitchens*, where a great deal of cooking is performed, the range is usually made of much larger size, and the bars are of great strength. The boiler is likewise made of wrought iron instead of cast, for greater strength and durability, and placed at the back of the fire only, whence they are termed *back boilers* (see *fig.* 631).

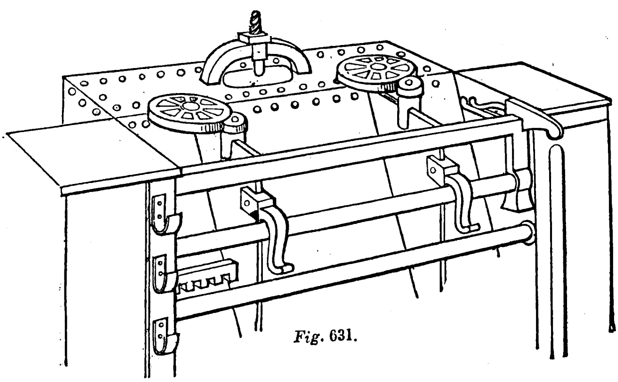
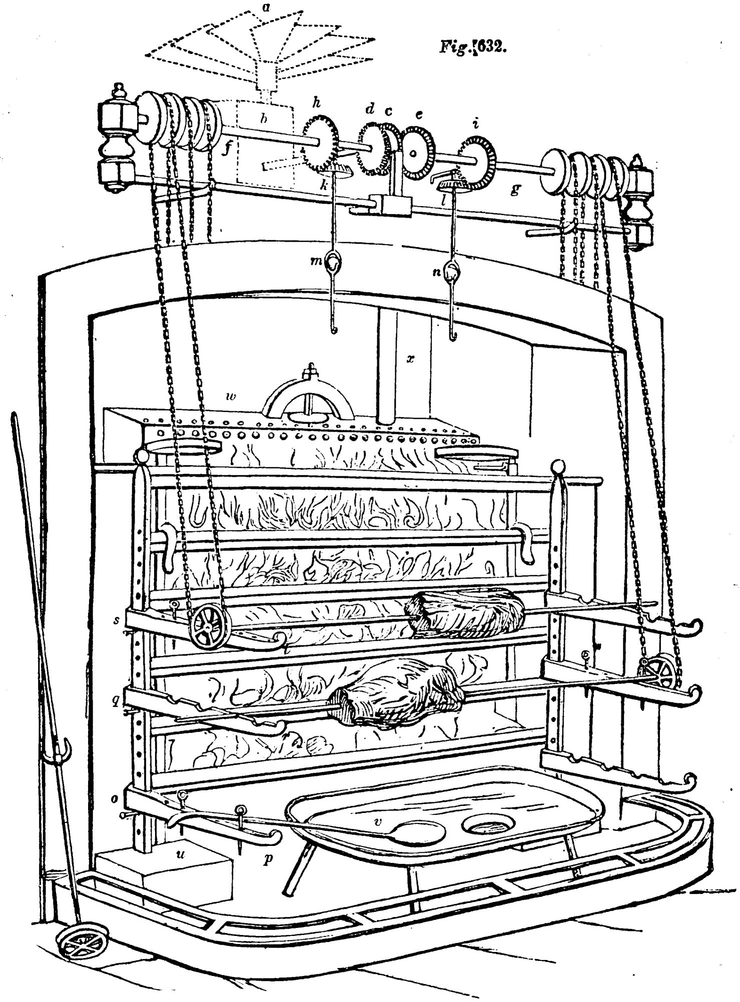


Fig. 631.

A pipe from the boiler conveys water from it, and it is kept full from a supply cistern A man-hole for cleaning it out frequently is provided at the top, which is secured from the steam coming out, by an arch of iron, and a screw and nut. There are two winding up partitions for reducing or enlarging the fire. *The kitchen fender* is made of strong iron, with a flat double bar on the top; and sometimes there is a pit below the grate for the ashes, covered by a grating to separate the cinders.

4545. *It is commonly stated by ironmongers* that ranges of this kind, with boiler and oven, perform the operations of boiling and baking *without any additional expense or consumption* of fuel. This statement is absurd. The large quantity of iron in the range, and the water in the boiler, absorb heat from the fire; and therefore, with such appendages to the grate, there must be a certain loss or extra expenditure of heat absorbed, which can only be supplied by more fuel than would otherwise be necessary; but in many cases that loss is not to be regretted when put into comparison with the advantage and great convenience of having hot water always at hand without any trouble, together with a hot oven, either to bake in or to keep things warm. The boiler will even retain its heat, in a considerable degree, for several hours after the fire is extinguished.

Fig. 632.



These improved modern ranges are sold at various prices, according to their size, quality, and strength, from two or three pounds to eight, ten, or fifteen.

Fig. 632 represents the *kitchen fire-place at the City of London Club House* in Broad-street. Here there is one of the largest class of ranges, with a back boiler, and a smoke jack which turns six spits occasionally. *a*, the fan wheel of the smoke jack, in dotted lines, is behind the chimney breast in the flue of the chimney; *b* is a box enclosing two bevel wheels, one horizontal on the axis of the fan, and connected with another one vertical, the axis of which comes through the chimney breast, and has on it another vertical wheel, *c*, the latter turning two bevel wheels, *d* and *e*, which are fixed on the long axis, *f g*, that extends across the chimney, and which, of course, is made to revolve. On both ends of this axis is a grooved cylinder, in the grooves of which are chains to go down to the grooves of the wheels attached to the spits. In the wood-cut, two only of the chains are represented in action; the rest are only partly shown hanging down perpendicularly, to prevent crowding the figure. Besides these parts, there is on the same axis, *f g*, two more bevel wheels, *h* and *i*, which turn two smaller ones, *k* and *l*, the axes of which are vertical, and have on them universal joints, *m* and *n*. These last are called by the cooks *danglers*, and their use is to turn, by means of another wire and hook, any smaller articles that may require to be roasted, and for which spitting may not be convenient: the motion of these, of course, will be vertical, as when meat hangs by a string or bottle jack. The supports for the spits, *o p*, *q r*, *s t*, are not attached to the range, as in smaller ranges, but are inserted in two upright standards, which are fixed in masses of iron at the bottom, *u*, which can be moved farther out or nearer to the fire; the supports also, *o*, *p*, *q*, &c., can be raised or lowered. One end of the spit acts against an iron pin, and the other lies in a semicircular notch. *v* is the large dripping-pan with its ladle for basting, having a very long handle, to enable the cook to baste without being exposed to so fierce a heat as proceeds from this range, which is usually quite filled with a dense fire. *w* is a back boiler of wrought iron, from which a pipe, *x*, proceeds to carry hot water to the baths near the bedrooms in the upper stories, the boiler being supplied with cold water by another pipe from the high-service cistern. In the range are two winders for contracting the fire, but which in this place are never used, because the fire, being constantly wanted, is kept up till the evening, when it is suffered to go down, and is then smothered with the ashes. Coke alone is the fuel employed, which makes a very bright and hot fire. In some other large ranges, as that in Buckingham Palace, which is of the same construction, coke only is employed, requiring no renewal for the whole day.

4546. *More examples of kitchen ranges* will be given in Chap. IV.

Sect. II.—Apparatus for Roasting.

4547. Roasting is probably the most ancient mode of cooking, and it was at first performed in the open air by means of large fires, the waste of fuel being immense; a circumstance frequently of little consequence in countries where wood can be always had by the trouble of only gathering, and where sometimes the consumption of it is rather an advantage than inconvenience. But in colder countries, where fuel is scarcer, the operation is performed in the house; and in the oldest kitchens, from the size of the fires used in them, it would seem as if the original process had been partly imitated.

4548. "*In olden time*," says Aubrey, "the poor boys did turn the spits, and licked the dripping-pan, and grew to be lusty knaves." Even dogs were sometimes taught to perform this tedious operation. Afterward the science of mechanics was called into request, and *jacks* were invented. At present, there are two principal kinds of these in common use, *wind-up jacks* and *smoke-jacks*.

4549. *The common wind-up kitchen jack, moved by a weight*, is constructed in the following manner: *a*, *fig.* 633, is a barrel, round which is coiled a line of considerable length, and having one end fastened to a compound pully, *b c*, containing three or four sheaves, to which is appended a weight, which, by descending slowly, moves the barrel round with the proper velocity. The weight and pully are usually kept outside the kitchen, the line passing through a hole in the wall. An endless chain passes round the barrel, *a*, and the spit, *h*, which last, of course, turns with the same velocity as the barrel. To render the motion equable, and to prevent the jerks that would take place should the meat not be spitted quite equally, a fly, *g*, is attached to the machine, to effect the motion of which, a wheel with teeth, *o*, is fixed upon the barrel, and the teeth work in a screw fixed on the upright axis of the fly. When the weight has descended as far as it can, it is again wound up by a handle placed upon the square end of the barrel spindle; but the machine should be so calculated that it should not be necessary to wind it up during one roast. The length of time it may go without winding may be increased by the system of pulleys, or by causing the weight to descend into a small well formed for it. Servants object much to the trouble of winding up this jack, little as that trouble is; and hence smoke-jacks are suffered to supersede them, notwithstanding their simplicity, and being less apt to be out of order.

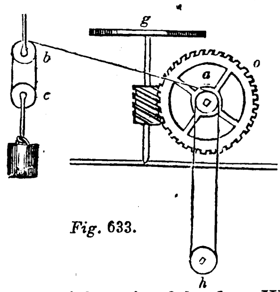
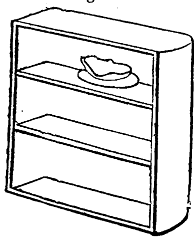


Fig. 633.

4550. *The smoke-jack*, invented to obviate the trouble of winding up the common jack moved by weights, consists of a horizontal wheel filled with spokes, or radii, of metal, placed obliquely, in the same manner as the sails of a windmill or the little circular ventilators sometimes seen in windows, and turned, like them, by the current of air striking upon them. This wheel is fixed in the inside of the flue, and the motion of its axis is easily communicated to another wheel, to which is attached a chain that goes over one fixed to the spit. A very complete smoke-jack is represented, *fig.* 632.

Notwithstanding that Count Rumford long ago pointed out the waste of fuel occasioned by the employment of this machine, it continues to be as great a favourite as ever. He justly remarks that, to cause the smoke-jack to go round with sufficient force to carry with it its load of meat, it is frequently necessary to make a greater fire than the mere roasting and other cooking requires; hence it is very expensive; and that, besides, it is very liable to be out of order, and is difficult to be got at when it requires cleaning; added to which, it is not unfrequently the cause of smoke; and its situation prevents that cure for smoky chimneys which Count Rumford recommended as the most effectual. That the smoke-jack increases the draught of the chimney, as some ironmongers pretend, is a statement almost too ridiculous to be seriously refuted. The assertion that all the fire that is required to make a smoke-jack perform properly would be necessary in the kitchen for other purposes, and, consequently, that they occasion no additional expense of fuel in roasting, is very incorrect, though a small fire will make it turn when not loaded with the spit.

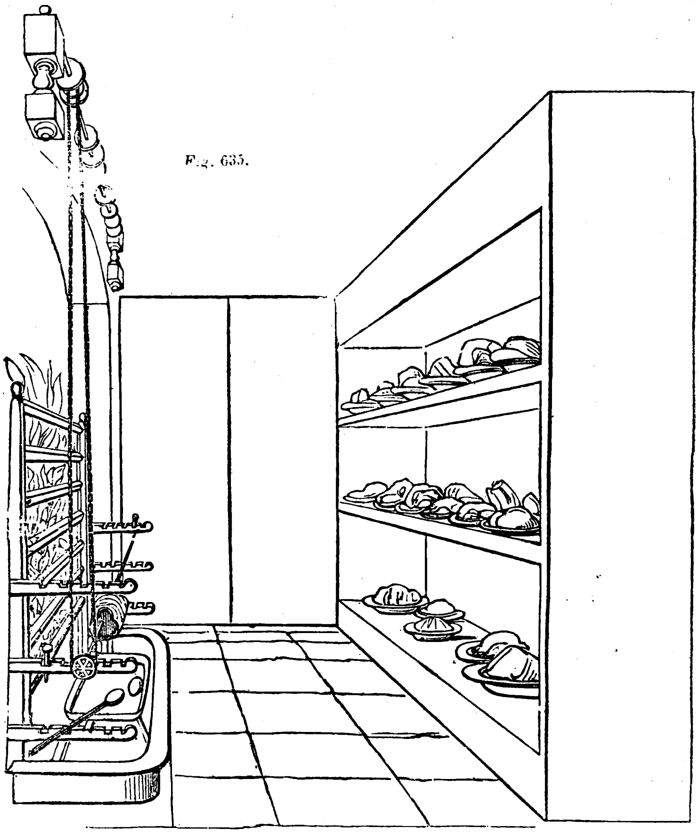
Fig. 634.



4551. *To increase the effect of the fire upon the meat in roasting*, as well as to prevent the radiant heat from incommoding the kitchen, *a screen*, *fig*. 634, is always placed before the fire, lined within with tin plate. This is now generally furnished with shelves to place plates and dishes upon to warm, or to keep the meat hot until it is wanted. On the back of the screen are sliding doors for taking out the dishes.

4552. *The heat from very large ranges would be intolerable to the cooks*, were it not for the screens which are placed before them. *Fig*. 635 represents

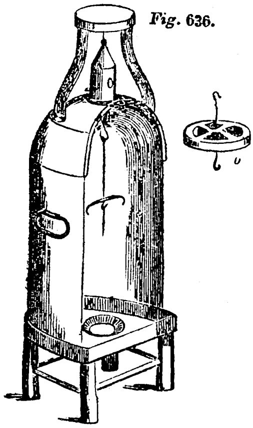
Fig. 635.



that of the City Club House on the side next the fire. It is about seven feet high, lined with tin plate, and has shelves on the side next the fire to place dishes with meat on to keep hot; doors on the back give access to the dishes. It is a great improvement to shut in also the ends by folding-doors, thus entirely enclosing the fire-place. By this means the greatest part of the radiant heat of the fire is stopped from coming into the kitchen. In the wood-cut the doors on the nearest side are supposed to be removed to show the screen; they are only opened when the cooks wish to look in.

4553. *The bottle-jack and niche screen*, *fig*. 636, when well made, is often a useful substitute for the spit. It consists of a spring enclosed in a brass cylinder, and requires winding up every time it is used; the joint is fixed to an iron suspended from the cylinder containing the spring, and this is usually fastened to a niche made of tin, which serves to reflect much heat, that assists in the roasting. At the bottom, on a stand, is a small dripping-pan, or well, to collect the gravy. This apparatus is capable of roasting

Fig. 636.

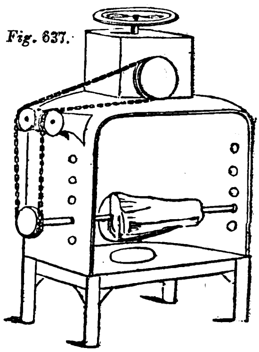


a tolerably large joint; but, if the joint be small and light, a weight of cast iron, *b*, is necessary to be attached, to make it turn more steadily. Some of these are made to go two hours without winding.

Some cooks say that the bottle-jack is best used without the screen, or only one of the common kind, when the fire is large; for, with its own niche screen, the reflection is so powerful that the meat is apt to be dried up too fast. The whole apparatus is extremely useful where the economy of fuel is to be much regarded; for it will roast very well, with attention, when placed before a very small fire, so that, with it, there is never any occasion for a large fire in the range; and therefore it is much used in small families.

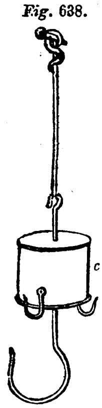
4554. *An improved spring-jack* for roasting, *fig.* 637, has lately appeared, in which the meat is fixed on a spit lying horizontally in the usual manner. A box on the top contains the spring, which carries round a wheel on the front; round this an endless chain passes over two pulleys to the spit, which goes through on the side of the tin screen. By means of several holes, and shortening or lengthening the chain, the height of the spit can be adjusted; and there is a flywheel to regulate the motion.

Fig. 637.



We should not omit the humble string and weight, *fig.* 638, by means of which many a small joint or piece of meat is roasted by the simple twisting and untwisting of a worsted string: *c* is a tin box filled with some heavy substance, and costs only sixpence. This will roast about six or eight pounds of meat, and two smaller hooks are added for less articles. The only objection is the attention necessary, as the string requires a slight twist every five minutes.

Fig. 638.



Roasting, as it is usually conducted on a spit before a kitchen range, consumes more fuel than all the other modes of cooking; and it was from this circumstance that Count Rumford was induced to turn his attention to the means of economizing, without injuring the perfection of the roast.

4555. *One of the principal inventions which he brought to England in* 1795 was a method of dressing meat, at that time unknown here, by which it could be roasted quite as well as is usually done before a large open fire in a kitchen range, by shutting it up in an apparatus, somewhat resembling an oven, that required only a very small quantity of fuel to heat it, with the advantage of a great saving of trouble. Every nice palate can distinguish between meat baked in a common oven and that which has been roasted before an open fire; but the *Rumford roaster* completely annihilated this difference, and no one could distinguish between a joint properly cooked in this machine and one done before a range. In consequence, not only hundreds, but thousands of Rumford roasters were made, and employed in English, Scotch, and Irish kitchens; and it was universally allowed that they entirely answered the desired object.

4556. *The original Rumford roaster* was a cylinder of sheet iron laid horizontally, and set in brick-work, with a small, closed fire-place below it, the smoke and flame passing all round the cylinder, and then descending some way before it passed off into the flue. In the interior there is a dripping-pan, placed upon two long sliders, forming a kind of sledge, which can be drawn out and pushed into the roaster. In this dripping-pan a sort of gridiron is placed, on which the meat is laid; and a little water is put into the pan, on which the melted fat falls, and is thus prevented from being burned; or sometimes an inner pan is put over the water, and receives the fat, which, in that case, will not mix with it, nor yet be burned, because the water cannot be heated higher than the boiling point, which is not enough to burn. It might be supposed that water thus placed within the roaster would have the effect of making the meat sodden, from the steam; but Count Rumford observes that steam itself is always perfectly *dry*, and that it is only when beginning to be condensed by cooling that it becomes moist: as it cannot cool inside the roaster, no such condensation can take place; and, as the dry steam will occupy the upper part of the roaster, separate from the air, it can have no effect in rendering the meat moist. This steam, however, is ultimately carried off by the steam-tube at the top of the roaster.

An essential part of this machine is the contrivance by which a stream of very hot air is made to blow upon the meat, at a certain part of the process, for the purpose of browning it, and giving it the taste peculiar to roasted meat. In the count's first roasters this was effected by means of two tubes of iron placed a little below the bottom of the cylinder opening into the farther end of it, and lying just above the fire, which played upon them and heated them. At the commencement of the process of cooking meat with this apparatus, the outward ends of these tubes are kept closed by stoppers; but, some time before the meat is done, the stoppers are taken out, and then a strong current of air, intensely heated in passing through them, enters into the inside of the roaster, blowing upon the meat; this air passes out through the steam-tube, carrying with it all the steam and other vapour.

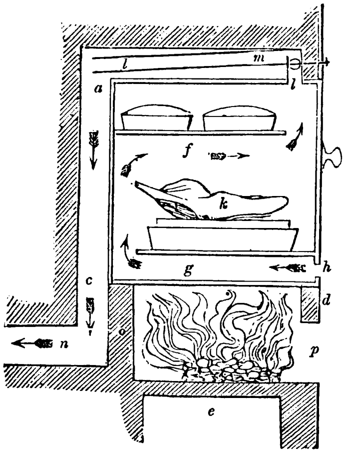
As these tubes, being exposed to a violent fire, were apt to be destroyed in time, endeavours were made to effect the same thing by other means, which were tolerably successful. Instead of tubes lying over the fire, a portion of the cylinder was devoted to this purpose, by making a horizontal division near the bottom, and the portion of the cylinder below this served for the hot air, the front opening into this space being closed by a register. When the roasters were afterward made square, a still simpler method was employed, which continues in use among the ironmongers.

4557. Although we have mentioned and described the proper Rumford roasters, of which we have stated that a great number were executed and put up about thirty or forty years ago, and are particularly described in the count's "Essays," we have avoided entering into more details respecting them, because they are no longer manufactured in the original form, and therefore cannot be purchased. It would also be very difficult now to find an ironmonger who could make one correctly, and perhaps scarcely possible to procure a bricklayer who could be depended upon to put one up without some mistake, thirty years being sufficient to deprive us of those persons who understood them in Count Rumford's time. We cannot, therefore, recommend at present the original Rumford roaster, since, though an admirable invention, yet, if executed by the present workmen, there would be a great chance of its failing, from some cause or other. When the Rumford roasters first appeared, many doubts were entertained with respect to their efficiency. As the meat was shut up in a confined space, in an apparatus having the general appearance of an oven, it was natural enough for some to suspect that it was rather *baked* than *roasted;* and it may be well to mention that Dr. Kitchener, celebrated for his gastronomic acquirements, appears not to have been accurately informed on this point. In his interesting work, entitled the "Cook's Oracle," he observes, "The machines the economical grate-makers call *roasters* are, in plain English, *ovens.*" Now iron roasters are very different from iron ovens; and both were made and sold by "economical grate-makers;" but the only complete iron roaster is that invented by Count Rumford, which was executed and employed in the military academy at Munich previous to 1790. This date is mentioned here, because some persons have, very unfairly, set up a claim to the invention of a roaster of the same kind, although produced subsequently to the count's first visit to England, when he placed several in public establishments in this country; and one may be still seen, though not in use, in the kitchen of the Foundling Hospital.

4558. *The difference between an oven and a roaster is this:* In the former the meat is shut up close during the *whole operation of baking;* whereas, in the latter, the machine is kept closed for a certain time only after the commencement of the operation; but then a strong current of very hot air is admitted into the lower part of the apparatus, which, after traversing below and above the meat, is suffered to escape at the top, carrying with it the steam, and drying up and browning the surface of the meat, which thus does not absorb those empyreumatic particles that are produced in baking. The effect produced in a roaster is, in fact, exactly analogous to what happens in turning the meat before the fire; for it is to be observed that the meat, being placed in the roaster upon a grated slider or drawer, when this is pulled out, it can likewise be basted. Many persons, indeed, who had used these machines, considered the meat dressed in them as peculiarly juicy and well-tasted. When, added to this, it is considered that, instead of the large clear fire necessary for roasting a joint on a spit, two or three pounds of coal will suffice with a roaster, and that, instead of constant attendance, very little here is necessary; that in the processes all accidents by cinders, ashes, or other things falling into the gravy are prevented, and that, instead of the kitchen being made very hot by a large fire, the heat from the roaster is not even felt, it is surprising that cooks have not been delighted with an invention that had so many advantages in its favour. Nevertheless, it must be admitted that many servants, who know very well how to roast with a range, would be at a loss, at first, to manage this machine properly: like the use of every new tool, they must have sagacity and patience enough to discover the best practice, or submit to be taught.

4559. *Apparatus of an analogous kind are at present made by various ironmongers, and termed roasters,* which, though a departure from the best construction of Count Rumford's, are, however, an imitation of them, and depend upon his principles partly for the advantages they possesss over a common oven. They are always square, and of cast iron, containing a great deal of metal, and, consequently, expensive, though durable; and they are usually connected with some other apparatus, as a hot plate, hot closet, &c. These, in modern kitchens, of which we shall give a few examples, are executed by manufacturers in various forms, each having his own arrangements, and are better or worse as the makers are more or less acquainted with the principles on which they ought to be constructed. Some of them, denominated roasters, are not so in fact, there being no circulation of *hot air* within, and having merely an aperture in the door closed by a register, which does not answer the purpose. Others have been invented evidently without the maker understanding the use or intention of the circulation of air. In short, as each manufacturer describes his peculiar machine as his own invention, and as the public has no prototype to refer to for comparison, criticism is evaded. These machines really belong to a class which Count Rumford also invented and described in his "Essays," under the name of *roasting ovens*, which, however, perform very tolerably, and are much employed at present, being found extremely useful in economizing both fuel and labour in public or large kitchens.

Fig. 639 represents a general section of the roasting oven as it is now usually executed, in which many details are left out, and only sufficient is shown to explain the principle. *a b c d* is the body of the iron roaster, which is of a square form, larger or smaller, and set in the brick-work, with a fire, *e*, below it, *b d* being the front of the roaster. The fire which burns on the bars, *e*, ascends round both sides of the roaster in a cavity left between it and the brick-work, passes over the top in a similar cavity, and then descends by the back of the roaster *a b*, in the direction of the arrows, making its exit by the horizontal flue, *n*, that goes at last in the perpendicular flue to the top of the house. It is to be observed that the fire is stopped from passing at once into this flue by the brick-work, *o*. *p* is the fire door, which is of iron, and kept shut, the fire being fed with air from the ash-pit, the door of which has a regulator. Within the oven, *a b c d*, are two shelves, *f*, *g*, also of iron, the lower one being near the bottom. For the circulation of hot air, when required, *h* is an aperture beneath the door of the roaster, having a register to close it when it is not wanted. When the hot air is to circulate, this register is opened, and the air which is heated by the bottom of the roaster turns out at the farthest end of the lower shelf, as represented by the arrow, passes over the meat placed in its pan and gridiron, *k*, ascends through the vacancy occasioned by the upper shelf not reaching to the front, and finally passes off into the tube, *l l*, which can be closed by a register, *m*, moveable by a small rod coming to the front. This hot air then joins that from the fire, and passes into the flue.



4560. *In the management of all the varieties of the roaster*, care must be taken not to employ too much fire: an error which those who are not accustomed to them are apt to commit at first, not imagining how small a fire is sufficient. It is likewise requisite frequently to sweep out, with a wire-handled brush, the flues round them, for which purpose proper openings are left by the bricklayer who sets them, if they are set in brick, or by the ironmonger, if the whole is made of cast iron, which they frequently now are, and which, if not the most economical mode at first, is perhaps so in the end, less repairs being necessary. The inside of the roaster should be kept perfectly free from grease, otherwise the burning of this will give an unpleasant taste to the meat. Since the difference between baking and roasting is, that the latter demands a circulation of hot air round the meat, whereas the former does not, it is obvious that, if the apertures in the square Romford roaster, through which the hot air enters and goes out, are closed, it becomes, in fact, an oven; and hence it can be employed to bake as well as to roast; but it is remarkable, and what could scarcely be expected, it can be made to roast one dish and bake another at the same time. This will be understood by reference to the section, *fig.* 639, where, on an upper shelf, are seen dishes, which may be supposed to be pies standing to be baked, while the joint below it is roasting. This upper shelf is capable of baking, because, as it goes quite to the back, there is no circulation of air round it, the hot air making its exit, according to the direction of the arrows, in front of this shelf and up through the steam tube, without touching the pies, which are therefore surrounded by hot air, *nearly*, but without any current.

4561. Some roasters are likewise made so large as to contain several shelves for roasting, and are contrived so that the current of hot air shall circulate over the different dishes, each being placed in a separate dripping-pan, to prevent the gravy and fat of one dish from falling on another; and these, if well managed, are found to answer.

There is a precaution to be taken in opening the door of a roaster when meat is roasting in it, which ought never to be neglected; that is, to open the steam tube and openings for hot air for about a minute, or while a person can count forty or fifty, before the door of the roaster be thrown open. This will drive away the steam and vapour of the roaster which otherwise would not fail to come into the room.

As it will sometimes happen that the meat will be done before it is time to send it up to table, it may be either taken out of the roaster and put into a hot closet, which may be situated over it, and heated by the smoke from the latter, or it may remain in the roaster till it is wanted, by a particular management. For this purpose, the roaster must be cooled a little, otherwise the meat will be overdone; and this cooling may be effected by shutting the register of the ash-pit; next, opening the fire-place door and the damper in the chimney; then taking out the fire, or covering it up with cold ashes; and, lastly, opening the damper in the steam tube, and openings for the admission of air into the roaster. By these means the heat will soon be driven up the chimney, and moderated till the interior of the roaster is cool enough; and then the meat may be put into it, and all the doors shut.

4562. *It is necessary that the fire-place door of a roaster or oven should fit well;* otherwise the air that enters will probably pass over the fire, instead of through it, and thus carry off into the chimney part of the heat of the fire, and, in fact, act in cooling the apparatus. A single door of iron will let the heat come through it, and the oven will not be so well heated. The door should be of some non-conducting material; either lined with fire-stone, or it may consist of two plates of iron, with a space between to contain confined air. Some have employed double doors, kept an inch or two apart, but so fixed together as to open at once.

4563. *A method of roasting by means of gas flame* will be described under "Cooking by Gas," Chap. III., Sect. X.

4564. *The well-known Dutch oven, fig.* 640, is an extremely useful apparatus for the kitchen of a small family. Its principle is the heat obtained by a strong reflection from the inside, when the oven is placed upon a stand close to the fire. It is usually made with a little dripping-pan in the bottom, and it has a shelf in the middle to place anything upon that requires to be warmed or browned; a small piece of meat, or a bird, may be roasted by removing this shelf, and suspending the article by one of the hooks, which are made to turn to expose the different sides of the meat.

Fig. 640.

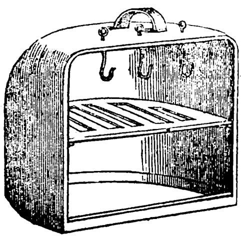
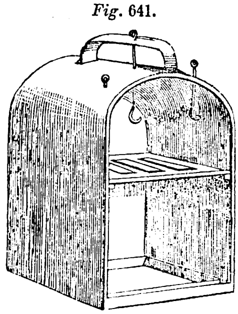
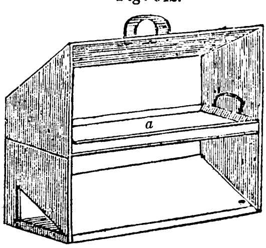


Fig. 641.



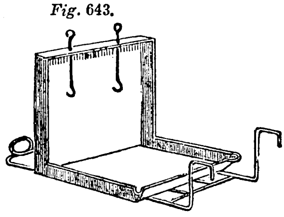
4565. *The Yorkshire oven, fig.* 641, differs from the last in being higher in proportion to its width, thereby giving more room for anything suspended to be roasted; and by a slit in the handle, the meat may be removed farther from the fire, or nearer to it. There is likewise a door in the back for access to the meat. The shelf is only placed occasionally, as in the last.

Fig. 642.



4566. *The American oven, fig.* 642, is an improvement on the Dutch. By means of a bottom slanting upward, and the top slanting downward, the reflection of heat is still stronger. In this case, the meat, or other article, is laid in an iron tray, *a*, which is moveable, and may be lifted out by two handles, the top moving back on hinges; beneath the false bottom is a place for warming plates. This apparatus is coming much into use, being found extremely convenient for roasting and baking bread, cakes, &c.

Fig. 643.



4567. *A tin toaster, fig.* 643, placed upon a stand of strong wire that hooks on the bars of a grate, and made either loose, or to slide backward and forward on the stand, is an apparatus extremely useful, and which may be purchased for eightpence; not only may cheese or bread be toasted, but a mutton chop may be dressed as well by this as by more expensive apparatus.

4568. *A very convenient apparatus for toasting bread and muffins* is represented in *fig.* 644. It is made of tin plate, and placed on a stand before a clear fire.

4569. *Cheese toasters* are represented in *fig.* 645 and *fig.* 646; in the first there is only one tray for the cheese; in the second there are six small trays.

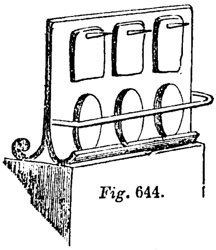


Fig. 644.

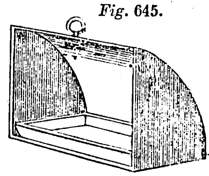


Fig. 645.

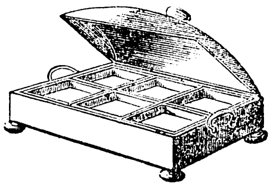


Fig. 646.

SECT. III.—APPARATUS FOR BROILING.

4570. *The common gridiron for broiling* is too well known to require any description. In broiling chops and other fat meat, the flaring made by the melting fat going into the fire is very inconvenient; and to prevent this, some gridirons have grooves in the bars. by which, when the apparatus is placed a little slanting, the liquid fat flows down into a trough at the bottom. These may be seen in daily use in some of the chop-houses near the Royal Exchange; but except these grooves are kept extremely clean, the fat is liable to be burned, and to communicate a flavour similar to that from a frying-pan. Round bars are easier to keep clean than square ones; and when the gridiron is kept upon the slant, with care and atttention, little fat will fall into the fire.

4571. *A broiling stove* (*fig.* 647), made by Mr. Jeakes, Great Russell-street, London, is a great improvement. One of the difficulties in broiling is the keeping the fire perfectly clear, to prevent the meat from being spoiled with the smoke; this difficulty is completely obviated in a very simple manner by this contrivance: A square aperture is formed in a plate of cast iron, *a b*, which is placed upon brick-work, or forms part of an iron body; immediately below this aperture a pit is formed in the brick-work, or the iron, for the fire, having a flue leading from it, at first horizontally, and then upward, terminating in the flue of the chimney. Sliding doors, *c c*, are likewise provided in front, opening into the fire-place. When these doors are shut, and coals or coke are lighted in this pit, or fire-place, the air will draw *downward*, to feed the fire, through the aperture in the large plate, the cover being removed, and when the fire burns well, no smoke will ascend through the square opening just mentioned; there is, therefore, an extremely clear fire to broil over. To support the gridiron at any height, two uprights are placed in the iron plate, with holes, into which projecting points in the gridiron are inserted.

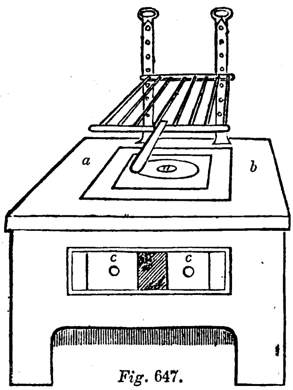


Fig. 647.

When the fire has burned up sufficiently clear, and broiling commences, the sliding doors, *c c*, are opened a little, generally less than is represented in the wood-cut, which, admitting air to the fire in another direction, in some degree checks the draught downward, and therefore moderates the heat. There is also a damper in the perpendicular flue, within reach, by which the cook can regulate the draught, and, of course, the fierceness of the fire.

In the wood-cut, the apertures on the iron plate are represented closed by two squares, one within the other; the inner square is that which is taken out when broiling is required; the larger one is only taken out when cleaning or repairs are required. Within the smallest square is a circular aperture, filled, when not wanted, by an iron disk, as represented in the cut. This last circular aperture, when open, is generally found sufficient, as the heat sent out is intense, and spreads considerably. When broiling is not wanted, the whole of the apertures on the top are closed, as shown in the wood-cut; and the apparatus then serves for a hot plate.

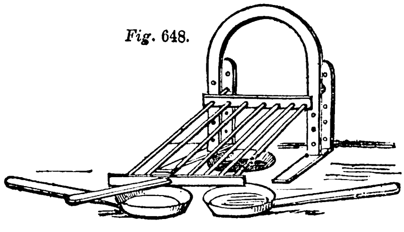


Fig. 648.

Lately an improvement has been made in this excellent broiling apparatus. Instead of the standards being fixed to the hot plate, they are united by an arch, as in *fig.* 648; and the lower part being bent to a right angle, they stand loose by their weight alone, at the proper place, and may be removed when broiling is not required, and the hot plate alone is wanted for boiling or stewing. The best method for using this apparatus is the following:

Instead of keeping the gridiron horizontal, which occasions much of the fat to fall upon the iron, the gridiron should be kept slanting, as in *fig.* 648, by which the fat runs down the bars into ladles placed to receive it; a trough was used at first; but the cook at the City Club found ladles more convenient. We mention this the more particularly, because intelligent cooks are extremely capable of making improvements, when not bigoted, as they too often are, to their own practices. There is another advantage gained by this arrangement, which is, that when meat is on the gridiron, it serves to keep much of the heat from the face of the cook. From having examined the process of broiling by this apparatus, we cannot too strongly recommend it for the cleanness, facility, and expedition with which the process can be performed, as well as the great convenience to the cooks. When broiling is not wanted, a sauce-pan may be kept boiling over this circular aperture; of course, it must be supported upon a little trivet to let the air get down, and the bottom of the sauce-pan not be allowed to cover up the whole aperture. We think it proper, likewise, to mention that, to ensure the right performance of this useful apparatus for broiling, it is by far the most advisable to procure it from the original inventor, Mr. Jeakes.

It is observed by Mistress Meg Dods that "broiling is the most difficult manual office the common cook has to perform, and that which requires the most unremitting attention. She may turn her back upon the stew-pan or the spit; but the gridiron can never be left with impunity." Jeakes's apparatus certainly enables her to attend to this operation more closely than any other, since she is less incommoded by the heat of the fire.

We have represented this broiling-stove by itself, because it may be so executed, and is sometimes done so; but it is frequently also made to form part of a larger hot plate, beneath which the flame passes, and on which various sauce-pans and stew-pans can be placed; and the same fire is sometimes made to heat an oven and a hot closet.

4572. *Fig.* 649 *is a confectioner's stove* and hot plate for boiling sugar, in the establishment of the well-known Mr. Gunter, of Berkeley Square, and which he speaks of as the best for the purpose. This was put up by Mr. Jeakes, and the circular aperture is closed by several rings of iron of different sizes, by which the size of the opening may be varied, and adapted to different vessels. There is likewise a narrow chink, or crevice, immediately beneath the top plate, marked in the wood-cut by a black line, which admits cold air, and prevents the plate from ever being too hot for the sugar; this chink has a register to regulate the air admitted.

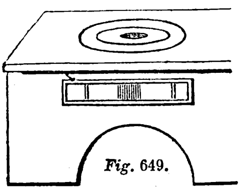
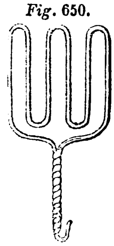
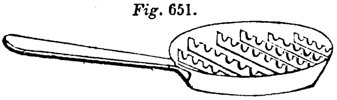


Fig. 649.

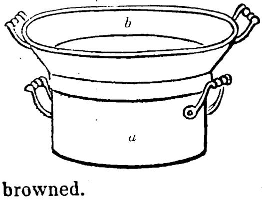
4573. *A small apparatus for broiling* or holding anything over the fire to warm is sold in the streets of London for a penny; and is interesting from its extreme simplicity. It consists merely of a piece of iron, which has been cut an eighth of an inch square, bent as in *fig.* 650, and having a handle, formed by binding the two ends with some wire or a strip of tin. There are no feet; but its use is to put between the bars of a grate, when the fire is low, or over the fire. The size of the gridiron part is usually about nine inches long, and six or seven wide. Some are made with more and closer bars.

Fig. 650.


4574. *An apparatus called a new kind of gridiron* has lately appeared in the shops, and we give it, because it may have its use on particular occasions, without pronouncing upon its general utility. *Fig.* 651 represents this apparatus, which resembles a frying-pan in shape; but it has cross partitions, on which the meat is laid. It is evident that the broiling is effected by the heat radiated from the iron. By this means the fat is prevented from falling into the fire, and causing the flare so troublesome in ordinary broiling. A hint may be taken from this for improving the traveller's frying-pan, or, rather, for converting it into a gridiron.

Fig. 651.


4575. *Perpendicular gridirons*, made of a strong kind of wire, and double, so as to enclose the meat to be dressed, are sometimes convenient; they hang before the fire, and the meat is turned merely by turning the implement; but though this is strongly recommended by Dr. Kitchener, on account of the smoke being quite avoided, the meat is rather roasted than broiled. They may, however, also be used horizontally, without the dripping pan, over the fire, and the turning is then performed with the same facility.

Fig. 652.


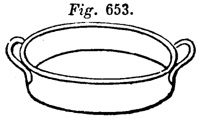
4576. *Braising pans*, *fig.* 652, are copper vessels much used in French cookery for performing the operation termed braising. The lower vessel, which holds the meat, is covered by another, *a*, that fits quite close, so that there can be no evaporation; and it serves also, by means of a raised rim, to hold burning charcoal, by which the meat is browned.

Sect. IV.—Apparatus for Frying.

4577. The common frying-pan is too well known to require anything being said about it. It affords the readiest mode of dressing meat on many occasions; a few sticks, and a stone or brick or two, being all that the traveller or soldier requires or can procure for the operation. The frying-pan is made of wrought iron, and is frequently tinned inside, but that is not necessary, if it be well cleaned out. Count Rumford shows that by covering the frying-pan with a deep earthen-ware bowl, it may be converted into a vessel for cooking partly by steam.

4578. *The Sauté-pan, fig.* 653, is a shallow copper vessel with two handles, used in French cookery to *sauter*, which is a term of art nearly but not quite analogous to *frying;* for in this operation the fillets of meat are frequently turned or tossed over with great celerity as soon as they are affected by the heat; hence the term *sauter*, "to jump;" it is a mode of frying with very great nicety. The name is corrupted by English cooks into *sooty-pan.* See explanation of the terms in French cookery, Book XIV., Chap. I.

Fig. 653.

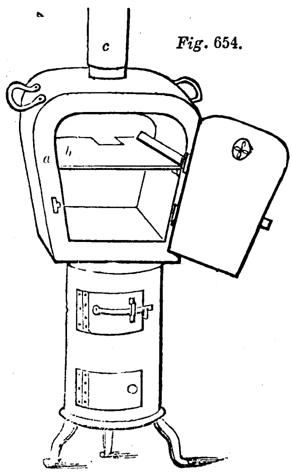


SECT. V.—APPARATUS FOR BAKING.

4579. For various kinds of ovens, we refer the reader to the description of bakers' ovens under "Baking Bread," Book IX., Chap. III., Sect. IX. Some other contrivances of this kind will here be noticed. We have mentioned that ovens are now very generally attached to kitchen ranges; some of these perform very well, while others have been found almost useless. They seldom answer well if the heat comes to one side only from the fire; to be complete, the heat should be made to pass quite round the oven, and also over the top. When a separate fire is made below the oven, there is danger lest the heat on the bottom should be too great; in that case, it is generally necessary to put a tile or a dish with some sand on the bottom, to prevent the bread or meat from being burned.

4580. *Portable ovens* are occasionally very useful. *Fig.* 654 represents a portable oven of sheet iron, of a convenient form. The oven itself is placed upon a sheet iron German stove; and the flame and smoke, after circulating round the oven between the double sides, *a* and *b*, pass off into the vertical tube, *c*. This oven may also be used, but not so well, without the German stove, by placing it on the top of the kitchen grate.

Fig. 654.



4581. *Green's portable oven for baking meat or bread* is represented in *fig.* 655. A cast iron pan, *a*, with a cover, but without a bottom, is placed upon a cast iron shelf, *b c*, in an oven of tin like the American (p. 817), having a plate of tin slanting upward towards the back from the edge of the bottom, and the top of the oven slanting downward as usual. The meat or bread is put into the pan, *a*, and the whole is placed on a stand before a clear fire. The reflection of the heat upward from the slanting bottom, and downward from the top, is so considerable, that it penetrates through the cast iron to the meat sufficient to cook it thoroughly. It is essential to observe that the whole inside of the Dutch oven and of this must be kept perfectly bright, but that the cast iron pan of this oven, and shelf on which it stands, must be japanned black, in order that they may absorb the heat; if these were also of bright tin, the same effect would not be produced. The shelf is placed upon small brackets on the sides; and in order to take out the pan, *a*, with the meat, to examine if it be done, a ring, *d*, with a handle, *e*, is put below the cast iron shelf, by which the whole can be lifted up and put back again, if more time be required. For bread, a tin pan receives the dough, and is placed on the shelf and covered by the pan, *a*. It is said that this oven will bake rolls for breakfast; a seven pound loaf in the forenoon; a pie, meat, or fowl for dinner; cakes for tea; and anything else for supper. It is durable, and not liable to get out of order; it may be particularly useful to emigrants.

Fig. 655.

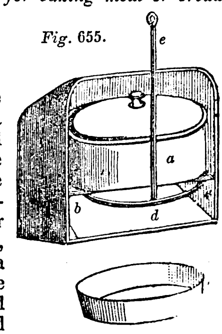
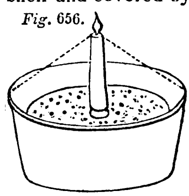


Fig. 656.



4582. *A potato pasty pan, fig.* 656, has been lately invented. A tin vessel, slightly conical, has a cover pierced with holes, which stops an inch and a half below the top; the meat, properly seasoned, is put into the pan beneath this cover. In the centre of the cover is an aperture, into which is screwed a short tube, that can be closed by a stopper which fits loosely. Potatoes mashed with milk in the usual way are heaped up on the cover and round the tube as high as the dotted line, and the whole is put into an oven. The potatoes may serve as a crust to a pie, no other being necessary, and the juice and flavour of the meat will ascend partly through the holes and enrich the potatoes.

SECT. VI.—APPARATUS FOR BOILING.

4583. Vessels for boiling food in are to be considered with reference to the kind of food required to be cooked, its quantity, the fuel employed, the materials of the vessels, and their durability and price. The largest kind are termed *boilers* and *kettles ;* the smaller *sauce-pans ;* those in Britain are always made of metal. *Boilers on a large scale* for public establishments are sometimes made of copper, and set in brick-work like washing coppers ; and occasionally they are made square, which form has some advantages in the setting with brick-work, and the economy of fuel. Count Rumford advocated the propriety of having all boilers to fit into closed fire-places ; but this demands that kitchens should be constructed purposely. With respect to the properties of the several materials of which kitchen utensils are made, we refer the reader to Book V., Chap. V., "Materials of Furniture."

4584. *Boilers so small as to be portable* were formerly always suspended over the fire, or made to stand upon feet, or upon a trivet ; but the waste of fuel by this mode is immense. *Fig.* 657 represents a pot, or kettle, of cast iron made at Carron, and generally used in the north of Scotland for making broth, but in London used chiefly for boiling pitch. Where turf is the fuel, it either stands upon the ground, having the burning fuel heaped up around it, or is hung up by a chain and hooks that clasp into the ears of the pot ; the pots are not tinned, yet are perfectly clean and wholesome. In some places the pot has an iron lid, by which it forms an oven ; the lid is put on the ground, with the meat, bread, or pie on it ; this is covered by the pot inverted, and live coals of turf heaped over it.

4585. *Kitchen boilers, or kettles, fig.* 658, are large vessels of tin, copper, or cast iron for boiling joints of meat, soup, or only water ; they may be round, but are usually oval, with two handles.

Fig. 657.

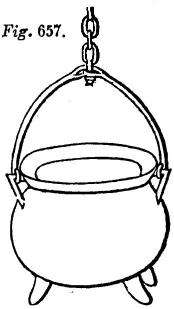


Fig. 658.

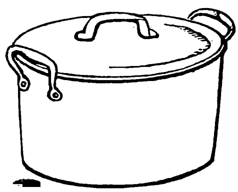
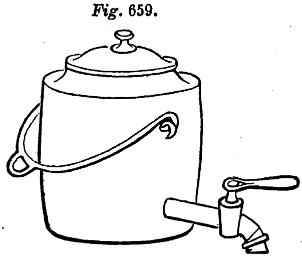


Fig. 659.

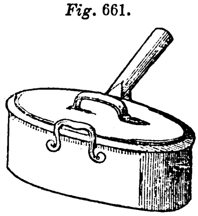


4586. *Tea boilers, fig.* 659, are made of cast iron, and hold two or three gallons of water wanted for tea ; they are detached vessels, and, being boiled over the fire in the range, are kept hot upon the hob ; they have a cock to draw off the water.

4587. *Fish kettles, fig.* 660, are of an oblong form, having two handles, and have a

Fig. 660.

Fig. 661.

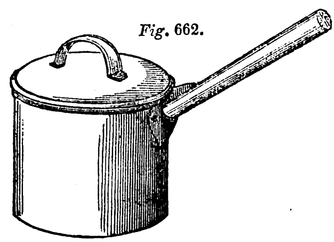


moveable bottom pierced full of holes, on which the fish is laid, and on which it may be raised out of the water by means of two long handles, to prevent its being liable to be broken, as it would be when cooked in a common sauce-pan. A smaller kind, *fig*. 661, is called a *mackerel kettle.*

4588. *Sauce-pans* are the smaller round vessels for boiling, made with a single handle. In Britain these are made of various materials, copper, sheet iron, cast iron, and tin plate ; the most common are those of tin plate, that is, sheet iron tinned. In treating of the materials of furniture, Book V., we explained, under "Iron" and "Tin," the nature of tin plate ; but it is necessary here to repeat that many persons are in error respecting this substance. From nothing being visible on the surface but the metal tin, the iron being entirely covered, many persons imagine that these tin sauce-pans are made wholly of the metal tin, and not of iron; in fact, that those which are usually said to be of *block* tin are made of tin alone; but the truth is, that both common and block tin are merely iron plate coated on both sides with tin. The use of thus coating sheets of thin iron with tin is this: iron alone soon rusts when exposed to the air and damp; but as tin is, fortunately, a metal that does not rust in the air, the iron is plated with it to defend it. Any one may easily convince himself of the nature of tin plate by scraping off with a knife the tin from a piece of a sauce-pan; it will be found that the tin itself is soft, and can be easily cut or scratched, which is not the case with iron; and if the spot so scraped be exposed to damp air, it will soon become covered with rust, while the part that remains tinned will not; also, if the edge of a fresh-cut piece of tin plate be examined with a magnifier, the difference between the iron in the centre and the tin on each side will be easily recognised. What is usually called block tin is merely a superior kind of tin plate. This useful information being gained, which, though familiar to many, is far from being so to all, the precautions necessary for preserving tin sauce-pans will be more easily comprehended; for whatever wears off the tin from the iron exposes the latter to rust, and this in a short time corrodes, or, as it is called, *eats* the iron into holes; whereas, if the tin be protected, the sauce-pan may last for a very long time. (See farther observations on tin plate under "Materials of Furniture," Book V.) One of the principal causes of the destruction of tin sauce-pans is what is termed *burning* in the inside, an effect which is seldom understood. This so-called burning is caused by suffering the sauce-pan to remain on the fire with too little liquid, or permitting some substance to attach itself to the bottom through neglect in stirring, in consequence of which the metal becomes much more heated in that part, and the tin itself is fused and separated from the iron; this may be perceived to have been the case by the ridges and drops of pure tin that will then be seen collected on the inside. The iron, being thus exposed, appears black, and soon oxidates or rusts, which explains the incorrect expression *burned*. There is no remedy for this accident or neglect after it has occurred, since the tin cannot be put on again, and a sauce-pan so treated must, of course, very soon wear out. Tin sauce-pans likewise require to be dried with great care when they are put away, as every good cook knows; because although, as we stated, tin itself is not liable to rust, yet, in the manufacture of tin plate, the iron is seldom or ever so completely covered but that there are little places, even so small as a pin's point, that have escaped the coating, and in these minute spots the iron is liable to be attacked by rust.

From this description of the tin plate of which sauce-pans are made, it will readily suggest itself to every one that it must be improper to scour them often with sand, or any coarse gritty powder, since this must necessarily cover the tin with scratches, and soon wear it off. The tin should be cleaned bright when necessary, by something soft, as soft Bath brick; but even this as seldom as possible: they should be washed out immediately after being used, and the grease removed by hot water, and sometimes, perhaps, by the use of a little soda or potash; after which they should be thoroughly wiped and dried, and kept in a dry place. The French cooks wash out their stew-pans with a lye made with wood ashes, which contains some of the alkali potash: this they call *lessieve*.

Fig. 662.



The handles of common tin sauce-pans, *fig.* 662, are made of a piece of tin rolled round into a conical form; but this, being fixed on with soft solder, is apt to come off if the flame is suffered to come to it. Sauce-pans are made of various sizes, from holding half a pint to several quarts. When they are very large, they have generally an additional handle, such as those represented in the fish kettle, *fig.* 662.

The covers or lids must not be made to project beyond the sauce-pan itself, though this might seem to form a protection against anything getting in; but it occasions an inconvenience, that it draws the smoke into the vessel. The lid and sauce-pan should be precisely of the same diameter. The covers are seldom made double; but it is very advantageous for them to be so, on account of their confining the heat much better. Count Rumford recommended that they should be of a conical form, as *a*, *fig.* 663, with a space for confined air between the horizontal and inclined plate, and a tube through the centre to let out the steam, to which a stopple and chain must be adapted, the handle being placed as in the cut *a*; a better form might be as *b*. The suggestion is excellent, but it does not appear to be adopted. One of the best covers for confining heat, where superior neatness is not a primary object, is wood, or wood lined with tin, *fig.* 664, as being a non-conductor; these are often used where cast iron kettles are employed.

Fig. 663.

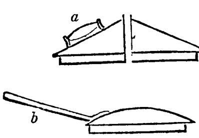
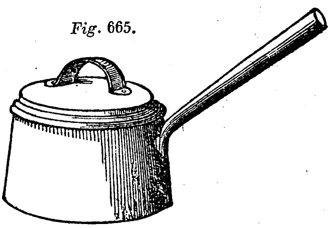


Fig. 664.

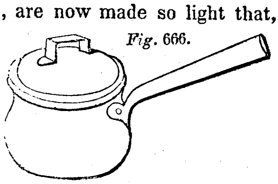
4589. *Copper sauce-pans* are generally of the form of *fig.* 665. These are much more durable than tin plate, but likewise much more expensive at first. It is essential that they should be kept well tinned in the inside. Sauce-pans are likewise made of the same form of *sheet* iron, japanned black on the outside, and tinned within. These are much stronger than those of tin plate, but do not last so long as those of copper. Some cooks have a great prejudice against them, and pretend that iron sauce-pans will turn black whatever is cooked in them ; but this opinion is evidently erroneous, provided the cast iron is kept tinned, or even well cleaned ; and, as we have shown, the iron is not at all prejudicial to health, should the tin wear off. The difference between the two appears chiefly to be matter of calculation as to expense ; for the copper will not only last longer, but will sell for something after it is worn out, which the iron will not. It is said, also, that iron sauce-pans require tinning oftener than copper.

Fig. 665.



Cast iron sauce-pans, fig. 666, though heavier than tin, are now made so light that, when small, they are nearly as manageable, and with care will last a lifetime. These are coming very generally into use ; they are usually tinned inside, but if not, or should the tinning wear off, it is of little consequence, as they are perfectly wholesome without it, and are very little liable to rust. The handles are made of a piece of wrought iron rolled up hollow, and riveted on ; as also the handle of the lid. They are often fitted up with a steamer on the top. The outside is japanned black. It is to be remembered, that though they are very strong if carefully handled, yet they are brittle, and will crack if cold water be thrown upon them when they are hot.

Fig. 666.



Count Rumford suggested the expediency of lining small copper sauce-pans throughout with a thin sheet of another metal, and observes that the cost would not be great, even if that lining was made of silver, which would form a cheap and elegant utensil.

4590. *Lining the inside of sauce-pans with silver* is now effected at a cheap rate by the electrotype process. This will have one advantage, that the silver will not melt like the tin, and, consequently, the accident to the sauce-pan, called " burning," will be avoided ; but it has been shown that tin is sufficiently wholesome ; and it is evident that silvering, being very expensive, is not likely to be used generally.

Attempts had been made in Germany, about forty years ago, to improve cooking vessels made of cast iron, by covering the inside with a *white enamel*, or *glaze*, but this was liable to the objection that the glaze was apt to crack and fly off, from the unequal expansion of it and the iron. This practice has lately been imitated in this country, and, we believe, with better success. Sauce-pans and frying-pans with the inside enamelled appear now commonly in the shops ; but before recommending them, we must wait for the experience of cooks ; and we do not know whether lead is employed in the glaze.

4591. *In ancient times*, the arts of rolling out copper into sheets, and that of tinning as practised at present, were not known ; and as copper cannot be cast, tin or zinc were added to it to render it fusible, which constitutes bell-metal and brass. Sauce-pans were then made of the latter alloy, which is less oxidable than copper alone ; vessels of brass formed the great ornaments of old kitchens, and from their rich colour were favourite objects in the pictures of the Dutch painters. Brass is at present little used in our kitchens, except for *skillets*, small sauce-pans used for boiling milk and starch, being, it is said, less apt to burn to than copper.

4592. *Strong iron boilers, called digesters*, are often used in making soups. They have a lid that screws down tight, so as to confine all the steam ; and by this means the water may be heated several degrees above the boiling point. These boilers were first invented by Papin ; if they are sufficiently strong, the water may be heated to a very high degree, but as there is considerable danger of their bursting with an explosion, if the force of the steam should at last exceed the strength of the vessel, a safety-valve is now placed in the lid, by which accidents of this kind are avoided ; likewise, the heat of the steam can be regulated by putting more or less on the valve. By means of these, not only can meat be entirely dissolved, but even bones, if ground to powder, may have the whole of the gelatin extracted, leaving the earthy part. However, if they are unskilfully managed, the earthy salts of the bones are apt to get mixed with the liquor, and make it both disagreeable and unwholesome. They are now seldom used for this purpose, but may be advantageously employed in making economical soups.

4593. Every person conversant with the most ordinary culinary operations has noticed how often liquids, especially milk, are spoiled by what is called *burning to.* To prevent this evil, Count Rumford recommended double bottoms to all boilers and sauce-pans used in cooking. 'The heat, he observes, is so much obstructed in its passage through a thin sheet of air, which, notwithstanding all the care that may be taken to bring the two bottoms into contact, will still remain between them, that the upper bottom has not time to give its heat as it receives it to the fluid in the boiler, and, consequently, it never acquires a degree of heat sufficient for burning anything that may be upon it.

4594. *The effect of burning to is effectually prevented by the apparatus called by the French "Bain Marie,"* which will be shown among the vessels for stewing. We must observe that this "burning to" is not the same accident as that of *burning*, as it is called, of the sauce-pans mentioned above. The first is the burning of the food, the latter the injury to the sauce-pan itself.

4595. *Preserving-pans* are for boiling sugar and sirups; they are usually of copper, *fig.* 667, and require a well-regulated heat, for which the charcoal stoves and hot plates are convenient. Steam has been employed for preserving-pans; and it has this advantage, that the sugar is never exposed to a heat above 212°, and, therefore, can never be

Fig. 667.

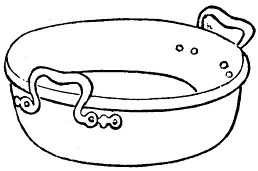
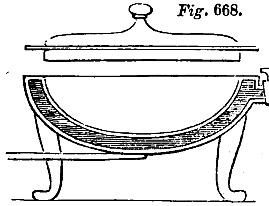


Fig. 668.



burned. For this purpose, the bottom must be double, as in *fig.* 668, and the steam is admitted between by a pipe, while the condensed water runs off by a small pipe from the bottom. They may be made to be detached from the tube when required.

SECT. VII.—APPARATUS FOR STEWING.

4596. Stewing requiring a more gentle and equal heat than boiling, cannot be effected so well over an open coal fire. The only usual method in this country formerly was by means of *stewing hearths*, or *stewing stoves*, which are still employed, and almost universally by French cooks.

4597. *Stewing stoves* are small pits, *a*, *a*, *a*, *fig.* 669, formed in a mass of brick-work, *b*, *c*. These pits are from six to twelve inches square, and four inches or more in depth: they have an iron grate at the bottom, and below that is the ash-pit supplied with air by an aperture in front. Charcoal is always burned in them, and as this gives no smoke, no flue is made. The stew-pans are placed over the fire in these pits on tripods or bars of iron. The front is best made of neat brick-work, but some prefer making this of iron, which lasts longer, and is less apt to get out of order. The top also, which is sometimes covered with paving tiles, is best made of cast iron. The pits themselves ought to be lined with fire bricks, with an iron rim around them, or an inside lining, or a box made of cast iron. The aperture in front, *d*, *e*, may be either left open, or partly filled up with a drawer, *f*, to hold charcoal, and another smaller one of iron, *g*, to receive the ashes, a space, *h*, being still left open for the draught. This kind of stewing stove is found very convenient, and may be fitted up in any place at a small expense. The only objection that appears to it is, that it produces a great deal of unwholesome gas by the combustion of the charcoal, which is extremely injurious to the health of the cooks. Instead of the situation at the side of the chimney, some cooks prefer having the stewing stoves placed on the window side of the kitchen, for the benefit of a full light. These stewing stoves are less employed in London kitchens on a large scale than they were formerly, being, in a great measure, superseded by the hot plates to be described afterward; but the best cooks consider them as superior to the latter, the heat being more mild and more easily regulated; accordingly, sometimes some of each kind are placed in the kitchen. To carry off the vapours of the charcoal, it would not be difficult, in many situations, to have a hood constructed over the stoves with a flue at the top leading into a fire-flue, or through the wall, to the outside of the kitchen.

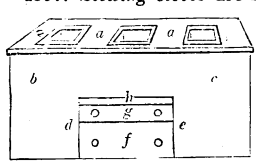


Fig. 669.

4598. A very ingenious method of employing common coal for stewing stoves, instead of the charcoal in common use, was invented by Count Rumford, and executed at Munich, and also at the Royal Institution, in 1800; a great many of them were likewise made in London by various tradesmen; but as they are not manufactured at present, and as those put up in the Royal Institution are no longer to be seen there, we do not think this is the place to enter upon their description; those who are desirous of learning something about these culinary inventions, may consult the count's "Essays."

4599. *The vessels for stewing in* differ from those used for boiling. *The stew-pan, fig.*

670, is usually made of copper, instead of being of tin like the sauce-pan, and they are less deep. The handles of the cover are placed as in the wood-cut.

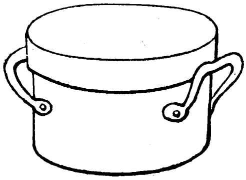
Fig. 670.

The advice to keep copper stew-pans well tinned on the inside cannot be given too often, since it is well known that fatal accidents have happened through neglect of this precaution. The tinning should extend about an inch and a half from the top downward on the outside.

4600. *Stew-pans are likewise made of cast iron;* these answer for stewing as well as those of copper, and are much cheaper at first, though they do not look so handsome in the kitchen as copper kept bright. Many cooks dislike them, and the same observations which we made on iron sauce-pans apply to these. A certain thickness of metal appears to be necessary for stew-pans; for in a common tin sauce-pan, the cooks say it is very difficult to prevent *burning to.* Stew-pans are made a little rounded at the edges of the bottoms, and not angular like tin sauce-pans, and therefore they are thus more easily cleaned out.

4601. *Stock pots* are strong kitchen boilers for stewing meat into gravies and broths in French cookery, *fig.* 671. They are generally made of copper, but have lately been manufactured of cast iron rendered malleable; these are blacked outside, well tinned inside, and answer the same purpose as copper vessels, with the advantages of greater cheapness and wholesomeness. They may be purchased of various sizes, price from 14*s.* to 36*s.*

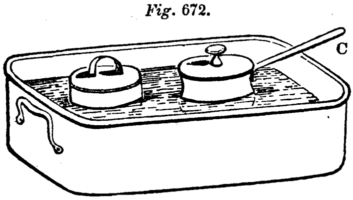
Fig. 671.



4602. *On the Continent earthen-ware vessels are preferred* for stewing, not only on account of their low prices, but because, being worse conductors of heat than metals, they confine it better, and are less apt to burn to. Count Rumford endeavoured to improve cooking vessels of this kind, and several specimens were deposited at the Royal Institution, but, from various causes, they have never found their way into common use; and we are at present nearly destitute of earthen-ware vessels of the proper quality for stewing, and of such price as would render them attainable by the poorer classes.

4603. *The Bain Marie, or water bath* (in Latin, *balneum mariæ*), is an apparatus, *fig.* 672, extensively employed in nice culinary operations, particularly by French cooks, and now generally by English cooks, who have corrupted the name, oddly enough, into *Bambury.* It is made of copper, kept nearly full of water, and heated over a stove, or by steam; it is thus described by the renowned M. Ude: "The bain marie is a flat vessel containing boiling water; you put all your stew-pans into the water, and keep that water always very hot, but it must not boil. The effect of this is to keep every dish warm without altering either the quantity or quality. When I had the honour of serving a nobleman in this country, who kept a very extensive hunting establishment, and the hour of dinner was consequently uncertain, I was in the habit of using the *bain marie* as a certain means of preserving the flavour of all my dishes. If you keep your sauce, or broth, or soup by the fireside, the soup reduces and becomes too strong, and the sauce thickens as well as reduces." This is the best method of warming up soups and similar things.

Fig. 672.



4604. *Hot plates* are a modern improvement used for stewing and boiling. The hot plate is merely a large plate of cast iron, *a, b, fig.* 673, laid hollow on a raised hearth, and having a closed fire burning under it, and traversing in a serpentine manner, by which the plate is heated excessively, and, indeed, sometimes almost made red hot. Upon this plate the various stew-pans, sauce-pans, &c., are set, and the heat is sufficient to keep them stewing or boiling, a method which is found very convenient, and saving a great deal of trouble. With them coal may be used, and the smoke is carried off by a flue. They have, however, the inconvenience of heating the kitchen too much, except some contrivance is resorted to for carrying off the hot air; but they have not the evil produced by stewing stoves of creating the unwholesome charcoal gas. With respect to the heat, it must be observed that it is undoubtedly injurious to health, yet cooks do not, in general, complain of this so much as we might suppose; they say it is hurtful at first, but that in time they get seasoned to it! To insist upon the bad effect of such

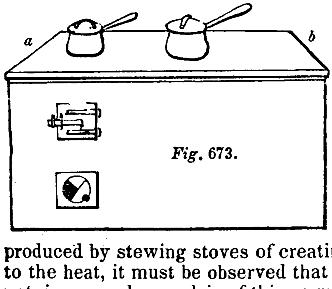
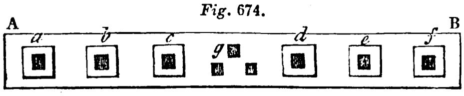


Fig. 673.

heat, probably appears to them like a slur upon their profession, as they imagine cooking and great heat to be inseparable.

Jeakes's broiling stove may be made to form a part of the hot plate. In the kitchen of the City Club, several of these broiling stoves, *a, b, c, d, e, f, fig.* 674, form part of a very long hot plate, A B, extending across one side of the kitchen, and having these charcoal stewing stoves as part of the arrangement, which serves for broiling, boiling, and stewing, with great convenience.

Fig. 674.



The hot plate is best placed in a recess like a large chimney, with a flue to carry off the heated air, as in the kitchen of the Merchant Tailors' Hall, where advantage has been taken of two large ancient chimneys. This convenience cannot be always obtained, except in the case of a new kitchen, where the architect may provide for it. In some places a hood might be brought over the hot plate with a proper contrivance above to carry out the hot air.

SECT. VIII.—COOKING BY STEAM.

4605. The application of steam to the art of cooking is a modern invention; and as this great agent has been found extremely convenient in other arts, it is here particularly so. It has been pretty generally practised in this country with more or less success for nearly half a century, but of late there have been great improvements in the modes of using it and in the apparatus.

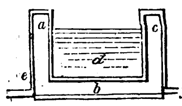
4606. *Cooking by steam is, indeed, one of the greatest advances which have been lately made in the culinary art.* Not only can steam be conveyed to any part of the kitchen with the greatest facility, so as to be used where no fire could be introduced, and thus economy and cleanliness are obtained, but this mode of cooking has several other advantages. Steam kitchens, as they were called, have been sometimes fitted with very complicated machinery, which is expensive, and too much has often been attempted. There is no doubt, by ingenious contrivances, it would be easy to show what steam, as well as gas, is capable of doing; but what we particularly wish is, that cooking should be performed either *better* or *cheaper* than by the ordinary methods. Experiments showing merely what it is possible to effect are, however, always valuable, and ordinary cooks have not yet learned to make all the use of steam that is possible, even by very simple and easy methods; nor can this be expected, except they were better acquainted with philosophical principles. It is only from those who possess this knowledge that improvements in the use of steam can proceed; yet the few leading facts that are essential to be known are far from being above the attainment of those who have most occasion for them, and we shall endeavour to render them easy to be understood.

4607. *We here recommend the reader who wishes to understand steam* to peruse what we have said in Chap. I., Book II., on the subject of the boiling of water, and to consider carefully the description of the manner in which water is converted into steam. But to save a great deal of trouble, perhaps it will be better here to enumerate the principal circumstances respecting steam, at the risk of some complaints of repetition.

Water, then, always becomes converted into an elastic gas called steam, when it is heated to 212° under the ordinary pressure of the atmosphere. Steam itself is perfectly transparent and invisible like common air, and will remain so as long as the heat of 212° is kept up; but no sooner does it come into contact with any body colder than itself than it parts with some of its heat, and can no longer remain in the state of steam, but returns to that of water, which, however, will be at first so hot as to be nearly boiling. This return of steam to its former condition is termed its *condensation*, and there are some remarkable circumstances connected with it. Steam, we have said, is an elastic substance like air, and may be considered as in fact a kind of air or aqueous gas, which requires to be kept up to 212° to be permanent. Now, as a vessel which is called empty is still full of air, it is impossible to put another kind of air into the same vessel except the first be taken out; in like manner, steam cannot be put into a vessel except the common air be extracted. Steam is lighter than common air, and therefore, if introduced into a vessel filled with air, it will occupy the upper part of the vessel, if there are openings by which the common air can get away.

To illustrate this important fact, suppose it was required to put steam into the space *a b c*, *fig.* 675, between two vessels of different sizes, in order to boil the water in the inner one. It would be impossible to cause the steam to enter at *e* except openings are left at *f*, by which the common air could be driven out; but by degrees the whole of the air would thus escape by the pressure of the steam, which would then entirely occupy the space *a b c*. It is in this manner that water is made to boil in vessels placed upon wooden tables at a distance from the fire in the kitchens of some of the London club-houses. Another important fact with respect to steam is, that, if a jet of cold water be suddenly let into a ves-

Fig. 675.



sel thus filled with steam, the latter will be instantly condensed into water, which will occupy only a very small space compared with what it did as steam. Now as the common air had been driven out at first, when this condensation takes place there is neither air nor steam in the space so occupied, which will now be absolutely empty, or, as it is termed, a *vacuum*. This vacuum would have to resist an immense pressure from the surrounding atmosphere; and if the sides of the vessel were not very strong they would give way; but steam itself is able to resist this pressure as well as the air.

From this it must be understood that steam may be conveyed in pipes to any distance, provided the heat of 212° can be sustained, but no farther; and that, as some heat must escape in its course through a length of pipe, it is proper, in conveying it, to cover the pipes with the worst conductors that can be procured, to prevent its condensation.

It is obvious, therefore, that as long as steam can be kept from condensing, it possesses the temperature of 212°, and, of course, has heat enough to effect whatever process of cookery boiling water can.

4608. *Steam is applied in cooking in a great variety of ways.* The food is put into vessels kept full of steam, in which they are subjected to the same degree of heat exactly as in boiling water; or water itself is made to boil by means of steam, either by bringing it by a pipe into the water, or, which is much better, by causing the steam to surround a vessel full of water, as is shown above. One of the simplest methods of employing steam is the following:

4609. *Sauce-pans and boilers are made with another vessel called a steamer* on the top. The bottom of the steamer is perforated with numerous holes to admit of the entrance of the steam from the water boiled in the sauce-pan beneath. This arrangement is exceedingly convenient and economical, since one article of food may be boiled in the sauce-pan, and another may be cooked by the steam in the upper vessel, without any additional expense of fire. Vegetables are often so prepared, and, if it is found useful, any number of steamers may be placed over each other on the same sauce-pan, each steamer having a perforated bottom. *a*, *fig*. 676, represents a sauce-pan with a steamer of tin; *b*, *fig*. 677, is a cast-iron sauce-pan with a tin steamer.

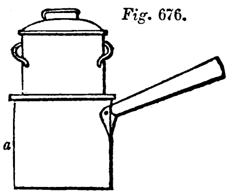


Fig. 676.

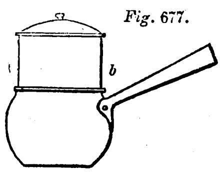


Fig. 677.

Fig. 678 represents one of Count Rumford's kitchen boilers with its steamer, of which thousands were formerly made in London, and which were put up in the Royal Institution, and are described in his "Essays." *a* is a section of the boiler with its steam rim set in brick-work, and heated by its own little fire; *b* is the steamer placed over the sides, fitting into the rim of the boiler. The sides of this steamer are of double tin, the better to confine the heat, the outside being cylindrical, but the inside slightly conical. The conical cover fits into the steam rim of the steamer. This steam apparatus is very perfect for the purpose for which it is intended, but is now no longer made.

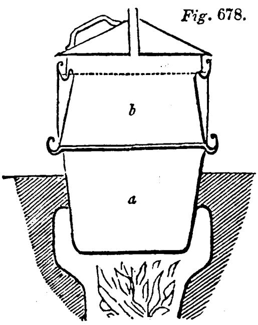
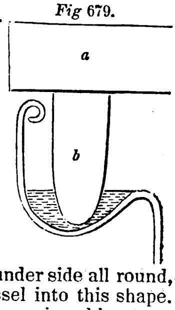


Fig. 678.

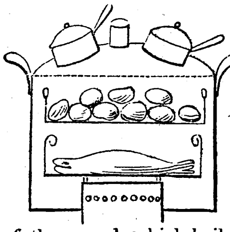
Steam was much employed by Count Rumford for cooking for public establishments on a great scale with a view to economy; and we may here describe an ingenious contrivance of his for preventing the steam from escaping from the large boxes of wood lined with tin in which potatoes and other things were cooked. *a*, *fig*. 679, is a portion of the wooden cover of these steam vessels, and *b* is a projecting tongue on the under side all round, that shuts down into a cavity caused by bending the tin of the vessel into this shape. The consequence of this is, that this cavity is always full of water occasioned by some of the steam condensing; and as the tongue *b* comes down into this water, no steam can escape out of the vessel without first displacing this water, which steam of the ordinary strength cannot do. Vessels, therefore, made with these *steam rims* are steam-tight, that is, do not throw out any steam into the apartment. It must be very easily seen how useful such a steam rim would be in every brewing and washing copper, as well as vessels for cooking by steam; yet this excellent contrivance appears to be forgotten already.

Fig 679.


Although direct steam may be employed very advantageously for cooking meat, fish and vegetables on many occasions, yet we have the authority of some of the best cooks, such as those at Buckingham Palace, the Albion Tavern, City Club, &c., for saying that neither meat nor fish is so well cooked in steam as in boiling water. The juices of the meat are too much drawn out, and fish is rendered less firm than by boiling: hams form an exception. Nevertheless, although this may be admitted to be the fact, still the difference is not so great that we should object to the use of steam when economy or great convenience recommends it. In the case of steaming joints of meat, although much of the rich gravy is forced out of the meat, yet it is all preserved in the dish below, and may be returned upon the meat, or served up with it.

Fig. 680 represents the section of a kettle made by Mr. Evans, Fish-street Hill, in which fish, potatoes, and their sauces may be cooked by the steam of a boiler at the side of the kitchen range. This kettle fits on the oval opening on the top of the range boiler at A, the dots showing the holes which admit of the steam. In this kettle is put an oval plate, on which the fish is laid; and over that is a similar plate for the potatoes, both of which are lifted out by bent wires for handles. In the lid of the kettle are openings, in which are fitted small tin dishes with covers for melted butter, sauces, &c. It is evident that this principle may be modified in numerous ways, of which this specimen may serve sufficiently as an example.

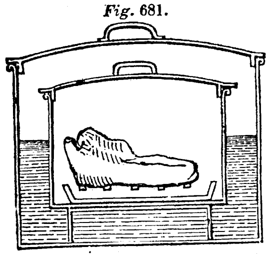
Fig. 680.



4610. *Meat and fish may be boiled in water* by means of steam with great advantage, by the method which is practised at the Albion Tavern, London, and other places, and which has been already described in *fig.* 675, namely, by admitting the steam between the double sides and bottom of the vessel, which boils the water in the inner one; and it is really beautiful to see a great number of tin vessels constructed in that manner boiling various kinds of meat and vegetables, and standing in a line on a long wooden table close to the wall, *at a distance from the fire*, the water being kept boiling by means of a pipe full of steam from the range boiler.

4611. *Meat and vegetables may be cooked merely by their own juices, without the addition of any steam or water.* To effect this, two vessels must be provided, *fig.* 681; the larger one to hold water, and the inner one, of course less, to hold the meat to be cooked. Both must have covers of the ordinary kind. The inner one must be supported upon a trivet, to keep it a few inches from the bottom of the outer vessel. Water must be put into the outer vessel so as to rise a few inches above the bottom of the inner one. The whole is to be placed over a fire or stove, or on a hot plate to boil. When the water in the outer vessel boils, the heat will be communicated to the meat; but the heat in the inner vessel will never be quite equal to 212°, that of boiling water; consequently, the meat will take one third, or perhaps one half, more time to cook than if it were in steam or water; but, on account of the slowness of the process, it will be the more tender. A shallow tin pan, with a few bars across the top, should be put in for the meat to lie on, and to collect the rich gravy that runs from it. Eggs can never be rendered hard in this apparatus; though kept in half an hour, the white becomes only of the consistence of a jelly. It is evident that this is really a balneum mariæ with a cover.

Fig. 681.



4612. *An apparatus for cooking potatoes* without water has been some time sold in the shops, *fig.* 682. This consists of a sauce-pan of sheet iron, to stand the fire on which it is put. Within is a false perforated bottom, to hang in an inch from the bottom of the pan. On this upper bottom the potatoes are laid, and the heat and vapour raised from themselves are sufficient to cook them when the cover is put on. It is evident that if a very little water be put in, the potatoes will be dressed in the steam. This apparatus costs about six shillings, and is found to answer perfectly.

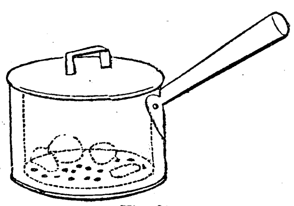


Fig. 682.

4613. *Fig.* 683, opposite, represents the arrangement of a steam apparatus, placed in a recess in the wall in the kitchen of the City Club-house, London. *a* and *c* are vessels containing water boiled by steam by means of the sides and bottom being double, the steam being introduced between them, as described above. *b* is a larger receptacle kept full of steam; in the cover are four circular apertures, in which smaller vessels are placed, having the bottom and sides perforated with numerous holes to admit the steam to the potatoes dressed in them. *d* is another vessel kept full of steam only, for cooking hams. *e* is a section of the vessels *a* and *c*; *f* is one of the small circular vessels in *b* with the holes. The several vessels are supplied with steam from a large steam boiler placed in the scullery, which likewise furnishes steam to various hot closets. It is more convenient to have the boiling and steaming vessels distinct, than to have one placed upon the other, as is sometimes the case, an arrangement only desirable when there is little room.

4614. *g*, *fig.* 683, is a large fish-kettle in the kitchen of the Merchant Tailors' Hall, with double bottom and sides, for boiling several turbots at once in water heated by steam between the sides; *h* is a stand, with two or more pierced shelves, to place the fish upon in the water.

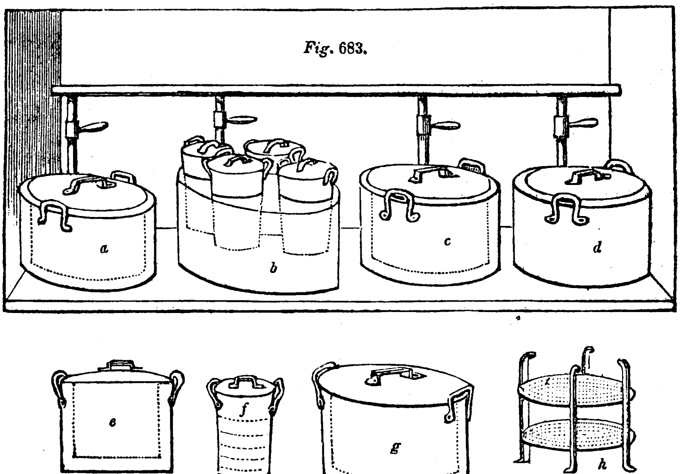


Fig. 683.

4615. *Fig.* 684 represents a *Bain Marie*, in which the water is heated by steam by means of a double bottom having the steam between. It is made of copper, and placed upon brick-work. The same method may be employed with advantage when it is required to heat any liquid without the danger of *burning to*.

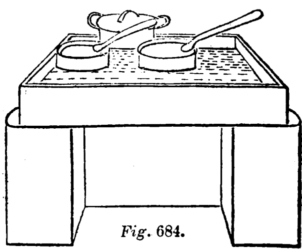


Fig. 684.

4616. The following observations on steam we probably would not have been induced to make, had we not observed, in the description of a cooking apparatus by a London manufacturer, a proof that the subject of steam is not so generally understood as it ought to be by this class of persons. The inventor of this apparatus states that the novelty of his invention consists in his employing what he terms *dry steam*, which, he says, is "*steam not in a pure state, or not completely saturated with water.*" He adds that *his* steam is invisible in the atmosphere, and of a superior kind, &c. It is proper here to state, that such an erroneous view, and such a confusion of ideas, should be corrected, since we believe these are not confined to the individual in question. It appears that some persons have a notion that there are two states of steam, dry and moist. This mistake arises from confounding the visible aqueous vapour which we see issuing from the spout of a tea-kettle with actual steam, and calling this *moist* steam. We have stated above that water rendered perfectly gaseous by boiling is, in reality, always dry, transparent, and invisible; when this steam loses part of its heat of 212° by contact with a colder body, or by coming into the atmosphere, it is condensed into a visible vapour, which, although, in common language, still called steam, *is not, in fact, steam properly; it is steam altered* by a certain degree of cooling; that is to stay, the substance that was steam is beginning to be condensed into water, in consequence of which it has become *visible vapour*. The steam, as it first issues from the spout of a tea-kettle, is transparent and invisible for nearly an inch; but then, losing part of its heat, it begins to be condensed into water, and becomes visible. The difference between the temperature of the transparent and invisible part, or real steam, and the visible cloud of vapour is sufficiently striking; the first would scald the finger if held in it, but the latter would feel merely warm. It is the state of actual transparent steam alone that is capable of cooking, and the vaporous state would be totally ineffective for this purpose. The steam in the interior of every steamer is always perfectly transparent, invisible, and dry, as much as in the apparatus above alluded to, but which is described as peculiar: were steam not so, it could not perform any effect in cookery. It is true that, when the lid is taken off such a steamer, a cloud of vapour appears; but this is because some of the dry and invisible steam is immediately partially condensed, and becomes *vapour* by the cold of the atmosphere. If a cold piece of meat be put into a vessel kept full of transparent steam, at first its coldness will cause the steam to condense upon it, and, of course, to moisten it; but when the meat is heated through up to the same temperature as the steam itself, it cannot occasion any such condensation; and the meat will then remain without farther moistening; real steam being, as we have said, always dry. It cannot be necessary, after this explanation, to notice the absurdity of supposing that dry steam is "steam not completely saturated with water." Dry steam has as much water as the visible vapour, but this water cannot appear as such until it is condensed. See this subject farther illustrated in describing the Rumford roaster, p. 814.

We have stated above that by means of steam, now so extensively employed in cookery, almost every process of the cook *may* be performed by this agent, but probably not with the greatest advantage, and therefore much judgment is required in its application. Even roasting and baking have been effected by high-pressure steam; that is, steam heated in close, strong vessels considerably above 212°, such as Perkins's steam tubes for warming buildings; but it is very doubtful whether this could be applied advantageously in domestic economy; and it is sufficient merely to mention it as a philosophical fact. Steam is, however, usefully employed in hot closets, hot tables, heating water for baths, drying clothes, &c.

Whenever steam is employed, its elastic power, when confined, should not be lost sight of, nor, indeed, any of its properties which we have described. It should be remembered that its force may be equal to that of gunpowder. In all boilers, therefore, for the generation of steam, there should be a safety-valve, which gives way and permits it to escape whenever its power becomes so great as to endanger the containing vessel, otherwise an explosion might be the consequence of its confinement.

4617. *In large kitchens, where steam is much employed,* and required for many purposes, it is the custom to fit up a boiler constructed nearly in the same manner as that for steam engines; but this requires the constant attention of a person experienced in the management of a steam boiler. It may be placed in an apartment adjoining the kitchen, since the steam can be conducted to any place by means of pipes; but care must be taken that all such pipes are accessible in case of any repair being necessary.

SECT. IX.—COOKING BY GAS.

4618. Among the novelties in the culinary art is the use of coal gas for producing the necessary heat. This method has a certain elegance to recommend it, and there are occasions when it may be found useful. Some persons have been so sanguine as to suppose that this employment of gas may soon do away altogether with the necessity of open fires in our kitchens: a hasty opinion evidently founded upon a very superficial and imperfect acquaintance with the business of an ordinary kitchen. Several experiments have been made, which prove that every process in cooking *may*, by the judicious application of burning gas, be effected; but this supposes a great variety of ingenious machinery, and cooks perfectly conversant with their use, to say nothing of the expense. What may be accomplished by future generations we will not at present venture to speculate upon; we know what can actually be done by any one determined to cook everything with gas, *at any* cost, but it is too much to think of its universal adoption at present, instead of the usual methods.

It will be interesting, however, to describe some of the experiments that have been made with success. The subject is at least amusing, and is really deserving of attention, even should its usefulness prove as limited as we fear it will ultimately be found to be.

Notwithstanding what we have just said, it is fair to observe, with respect to the flame of gas procured from the gas-works, that its regularity, the facility with which it can be obtained and conducted to any spot required, and the great nicety with which it can be adjusted in a single jet, or a series of jets, in a line, a circle, or several concentric circles, or any other figure, give it a superiority over every kind of lamp, and might almost tempt one to think that methods may some day be invented for applying it with success to culinary purposes with great advantage of convenience on some occasions, if not of economy.

4619. *To boil with gas on a small scale* is obviously extremely easy; nothing more is necessary than to make the flame play against the bottom of the vessel, *fig.* 685, which will be best if constructed on the principle of the Rumford tea-kettle, described in p. 706. It will be best to have several jets of flame, with separate stop-cocks, and then the boiling may be regulated by shutting or opening some of them. *Stewing* requires only less heat, and, of course, less flame.

Fig. 685.

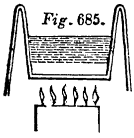
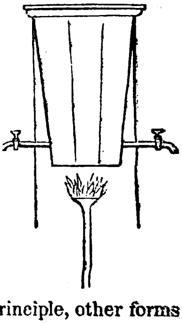


Fig. 686.



Already gas flame is found extremely useful in taverns and similar places for warming liquids and keeping them hot. The flame is made to play under a conical vessel, *fig.* 686, which is surrounded by a cylindrical one, to confine the heat round the sides of the inner one. The latter has sometimes partitions that divide it into several chambers, into each of which a different liquor can be put, and drawn off separately, by means of stop-cocks. The whole apparatus appears in form of a pedestal of any required shape, the flame being concealed in the interior; and it is also evident that, on the same principle, other forms of the apparatus may be constructed.

4620. *Roasting by gas* has been perfectly accomplished by the method for which Mr. Hicks took out a patent a few years ago; and this exhibits one of the most elegant modes of cooking. In this apparatus, *fig.* 687, the meat is fixed upon a spike in the midst of a circle of little flames of gas, and a bright copper cone being brought over the whole, the current of heated air thus produced, together with the reflection of heat from the inside of the cone, are sufficient to effect the roasting. The circle of flames is produced by causing the gas to come up through a pipe, *a*, which is fixed on a table, and fills a horizontal circular ring like that of a table lamp, having a number of small perforations on the top, through which the gas issues. The copper cone, not here represented, having an orifice at the top, comes over the stays, *b c*, and is suspended by a balance weight, so that the cook can let it down until it comes below the flame, or raise it up higher, in order to examine and view the meat. Beneath the circular tube giving out the flames, a shallow dish is placed, into which the gravy and melted fat fall, and then run out at *d* into another dish. *e f* is the meat stuck on the spike in the centre. Nothing can be cleaner or more elegant than this apparatus, by which a roast might be performed, if required, even in a sitting-room; and one advantage is, that the dripping is saved perfectly clean. But it is obvious that one apparatus is only calculated for things nearly of one size; and that for things of various sizes, several cones, or even several apparatuses, may be requisite. With regard to its practical use, we cannot consider it as productive of economy, or as much more than an elegant culinary toy, which may, notwithstanding, be occasionally useful, as an addition to the usual means of cooking.

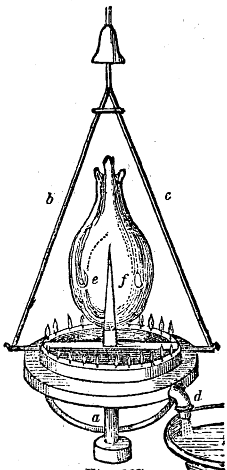


Fig. 687.

Fig. 688 represents *a gas apparatus for cooking*, which is an improvement upon the last, by enclosing the circle of gas flames with its reflecting cone in a cylinder of tin, from the top of which a pipe takes off the burned air; in this the gas is introduced below the apparatus. The door of the cylinder is represented as partly open.

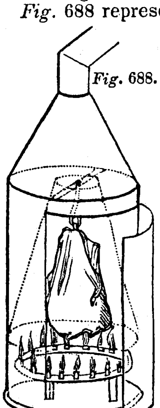


Fig. 688.

4621. *The following method of boiling by diluted gas* is said to have been first tried successfully at Edinburgh: A tube of sheet iron, *fig.* 689, A B, is made about two feet, or two feet six inches long, having its diameter from three to ten inches, according to the size of the vessels to be boiled. The upper orifice of this tube is covered with wire gauze, *c*, of about forty-five wires to the inch, fixed to an iron hoop. Three projections of iron, *a b*, come out from the sides of the tube just below this iron hoop, by which it is suspended and fixed in a hole cut in the top of a shelf or table, D E, for the purpose. The lower end of the iron tube is open, and a gas pipe, F, comes up a little way into it, and throws in a stream of coal gas, which mixes with the common air in the tube, and ascends through the wire gauze. This mixture of airs is explosive, but if it be set fire to as it issues *above* the wire gauze, its flame will not communicate with the mixture in the tube; because, on the principle of Davy's safety lamp, an explosion or inflammation of the gas cannot take place through the gauze. This flame, therefore, consisting of the burning of carburetted hydrogen mixed with common air, will give out a prodigious heat, and any vessel with water placed over it, having its bottom about two inches above the flame, will be made to boil. Cases, or tubes, of two or three inches in diameter will boil a tea-kettle, sauce-pan, or stew-pan; one of nine or ten inches diameter will boil a fish-kettle, or joint of meat, or heat water for a bath. The gas pipe should be furnished with two stop-cocks, one for the workman who fixes the apparatus, to regulate the greatest quantity of gas admitted, to which the cook should not have access, and the other by which the cook can diminish or shut off the gas. The point for regulating is the commencement of the appearance of the yellow flame on the top of the blue flame. If more gas be admitted after this, soot is deposited on the bottoms of the cooking vessels, from the combustion of the gas not being perfect; while, if due proportion be observed, the cooking may be performed without soiling the vessels, which may even preserve their original brightness, no soot being formed. It will be proper to enclose the sides of the table round the bottom of the thick tube, to prevent currents of air from disturbing the gas. It is necessary that great care should be taken

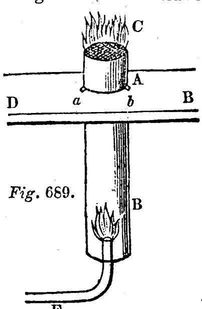


Fig. 689.

not to injure the wire gauze, since, should it get bent or broken, the flame would then communicate to the mixed gases in the tube, and perhaps a dangerous explosion might take place.

To prevent this accident, by protecting the wire gauze, some strew over it a layer of fragments of pumice-stone, which, being incombustible, protects it from any blow or other injury.

A hot plate has been heated by this gas; and it has also been employed to heat an oven.

It is obvious that it is only where gas is supplied *regularly* for illumination, that it can, in general, be available for the purposes of cooking; and that where no contrivances are employed to carry off the noxious gases generated, this use of coal gas must be more or less prejudicial to the health of those exposed to them. It cannot, therefore, be expected to succeed, except in the hands of persons whose scientific knowledge enables them to employ it with safety.

SECT. X.—PORTABLE COOKING APPARATUS.

4622. Various portable apparatus for cooking have been invented, some of which are useful on particular occasions, but none of them are equal to, nor ought to be described as perfect substitutes for the contrivances of an actual kitchen, although the inventors often hold them up to public notice in this point of view. The situations where they may be found useful and convenient are, when cooking is required in an apartment where there is no regular fitting-up for this purpose, in travelling, in camps, at sea, in picknick parties, and similar cases which may be easily imagined.

4623. *The Conjuror, or Camp Kettle.*—Some years ago, an apparatus of this name was very generally sold in London, where some may yet be found at the ironmongers, and is remarkable for the expedition with which a small piece of meat may be dressed in it; sufficient for one person may be done in less than five minutes; and a pint of water can be boiled in the same time, the only fuel being half a sheet of thick brown paper. In the interior of a cylinder of sheet iron, an iron cone like an extinguisher, perforated, is placed over a hole in the bottom, *c*, *fig.* 690, which represents a section of the apparatus. A shallow dish of tin, *b*, with its cover, holds the meat, suppose a beefsteak, and fits exactly into the top of the cylinder. There is a little door on the side, through which the paper wrapped round the cone is set fire to; the door is then shut. The heat of the flame being confined altogether within the cylinder, very soon cooks the meat, an effect which is assisted by the steam being confined by the cover of the dish. The smoke passes off by a pipe.

Fig. 690.

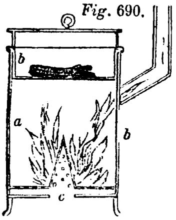


Fig. 691.

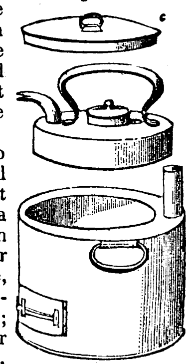


Fig. 691 exhibits a view of the apparatus, with its tea-kettle to fit in the cylinder; *c* is the cover of the round dish mentioned above. This little machine has been found extremely useful, not only in fishing or shooting parties, and other occasions where a dinner might be required at a distance from home, but likewise in numberless instances in the house where cooked meat or hot water may be wanted quickly, and when it is inconvenient to light a fire, particularly in summer. It is, perhaps, impossible to carry economy, convenience, and expedition farther than by this apparatus; but it must be admitted that by this process the meat is neither roasted, fried, baked, nor stewed; but it is completely *done*, and, with proper management, very palatable for those who have a good appetite.

4624. The little apparatus called *Fourneau*, *figs.* 692, 693, used much in Paris, and commonly employed by those who sell things in the streets, is extremely convenient, and would be found useful here on many occasions. It consists of an unglazed earthen-ware vessel, *a*, that bears the fire; in the cavity on the top some lighted charcoal is put; three little projections on the upper margin support the stewing-pan, *b*, also of earthenware, glazed within; there are holes in the lower one to supply a draught of air to the fire. By means of this very simple apparatus, poor people prepare their food, generally consisting of a stew of vegetables with a little meat; and a very small quantity of charcoal will keep this simmering for hours. It is to be observed that the noxious fumes of the charcoal render this apparatus improper to be used in a room,

Fig. 692.

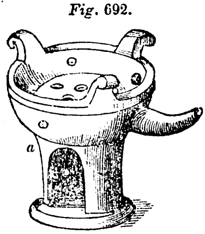
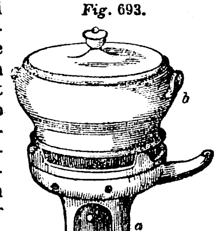


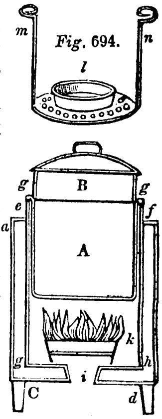
Fig. 693.



except there is a good current of air continually passing through; but it would be very useful in summer for cottagers, when it might be set out of doors.

4625. *Calefacteur Lemaine.*—A portable apparatus, so named from the inventor, for preparing *soup and bouilli*, has been much used in France, and is said to possess the advantages, not only of economy, and requiring little attention, but likewise that of making soup of a superior quality. *Fig.* 694 is a section. It consists of two parts, a cylindrical case with its little furnace, and the boiler fitting within it and holding the soup. The cylindrical case is double, being composed of two cylinders of sheet iron, one within the other, with a space between them; *a, b, c, d* is the external cylinder, and *e, f, g, h* the inner one; both are soldered together at the top. An aperture, *i*, is cut in the bottom of both, and these two holes are connected by a circular rim, which shuts in the space between the two cylinders. Over this aperture, *i*, is placed a small, circular dish of tin, *k*, with perforations in the bottom, containing charcoal or other fuel, which is supplied with air through the aperture *i*; A is the boiler, very little narrower than the space within the inner cylinder of the case; and this boiler has a rim round it at *g, g*, and three little projections corresponding to those openings in the upper part of the inner cylinder, which is higher than the outer one; when the boiler is placed so that the three projections correspond exactly with the three openings, the narrow space between the boiler and the inner cylinder is completely closed; but when the boiler is turned so that they do not correspond, then there is a narrow space open at *f, g*, by which the hot air and fumes of the charcoal can escape. To use this apparatus, water is first poured into the space between the two cylinders that form the case by means of a short tube at the top, closed with a cork, but not represented in the section; also, fuel is placed lighted in the circular dish. The meat and water are then put into the boiler, generally in the proportion of a quart of water to a pound of meat. The boiler is then placed in the case in such a manner that the three little projections do not correspond with the three little openings, so as to allow the smoke, or hot air, to escape, as was mentioned. In about thirty or forty minutes, according to the nature of the fuel, the water between the two cylindrical cases will begin to boil, which will be known by a little aperture and tube made at *b*; and by that time the water in the boiler will likewise be hot, though not boiling. It should be mentioned that a small shallow boiler with a cover, B, fits close on the top of the large one, A; when the water in A is known to be nearly boiling, the smaller boiler, containing water only, is taken off, the soup is scummed, and the vegetables and salt put in. The small boiler is now replaced, and the three small projections on the great boiler turned so as to correspond with the little openings, which allows the boiler to close up the aperture by which the hot air issued. The fire will now be soon stifled for want of draught; but, to preserve the whole as hot as possible, a large piece of baize, flannel, shawl, &c., is thrown over the whole, from the non-conducting power of which, and likewise of the water in the cylindrical case and the upper boiler, the heat of the expiring fire and of the air will be very long retained, even for several hours; during which time the soup will be very slowly and gradually kept at a simmering heat, but not boiling. Some have recommended that the boiler should not fit quite accurately into the case, so as to admit of a very slight draught to the charcoal fire the whole time; but in that case, provision should be made for the escape of the carbonic acid gas, which otherwise would collect in the apartment. The French mechanics, who are much accustomed to this species of cooking, find such an apparatus extremely convenient, as they can put it to work in the morning, leave it to itself, and find their soup ready and excellent when they return to dinner.

Fig. 694.



The boiling water between the two cylinders of the case is for washing the dishes, or any other such purpose, and is drawn off by a cock on the outside. That in the upper boiler may be employed in a similar way, or for cooking something else.

This principle may be varied in many ways. Instead of water between the two cylinders of the case, the space might be filled with charcoal dust, and a tube made from it to conduct away the smoke, and then wood, or even coal or coke, might be burned, if the apparatus is placed under a chimney, or in the open air, and a steamer might be put upon the boiler. By an addition to this apparatus, meat or poultry may also be dressed in a mode somewhat resembling baking, but what the Parisians term roasting; *l* is a flat, circular dish fixed upon a perforated rim, and into which the meat is laid. This dish is now let down into the cylindrical case instead of the boiler, and is suspended at a proper height above the fire by the handles.

4626. *The Bruges stove*, used sometimes in the cottages in Holland and the Netherlands, may be mentioned among other portable apparatus of this kind. This stove consists of a cylindrical case of cast iron, containing a small furnace and ovens. *Fig.* 695 is a section of the stove, and *fig.* 696 a perspective view of the exterior, in which *a* is the furnace, or fire-place, supplied with air by a hole at the bottom, *b*. This fire-place being closed at the top by a cover, the smoke or heat passes through a square aperture represented in the section into the spaces *d, d*, immediately under the flat top of the apparatus, which it heats, and then passes off into a flue up the chimney. The space, *e, e*, round the furnace forms an oven heated by the iron fire-place, *a*. The doors, *f, f*, open into this oven, which serves for baking bread or meat. The top of the apparatus above *d d* serves to set vessels upon for boiling or stewing, the heat coming through the iron being sufficient for that purpose. If much heat is required, the vessels may be placed in circular openings, *g, g, g*, in the top, which otherwise are closed by iron covers, and the top then answers for the hot plate now in common use. The whole stands upon strong iron feet; *h* is a register for the air which supplies the fire; and the fire-place itself may be increased or diminished by employing various-sized circular grates adapted for different parts of the conical furnace; *b* is a moveable drawer into which the ashes drop. The economy of fuel, which may be coal, is evidently considerable in this apparatus; and there may be numerous cases where it may be found convenient and useful, particularly where fuel is dear; and the great heat given out by an iron stove is not objectionable; but it must be observed that, as the heat produced in the apartment by this apparatus, when in operation, must be very great, this must be taken into consideration in applying it; and, indeed, it is usually employed as a warming as well as a cooking apparatus. With this view it should be placed in the chimney, or just outside, the iron pipe which carries off the smoke being inserted into the flue in the usual manner. In this case, however, all the objections to defective ventilation will remain in full force, and likewise the danger of frequent overheating, particularly if used in summer for cooking. We cannot, therefore, recommend this machine for our English cottages, since many other arrangements may be contrived nearly as economical, and much better calculated to promote a change of air, so necessary to health. As an addition to our usual kitchen furniture, it is much inferior to other plans in common use; its great weight is an objection. It may be useful

Fig. 695.

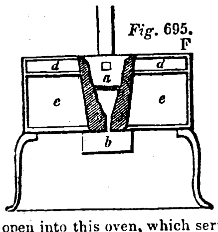


Fig. 696.

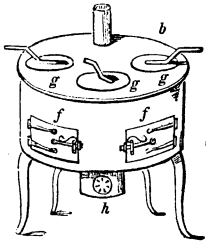
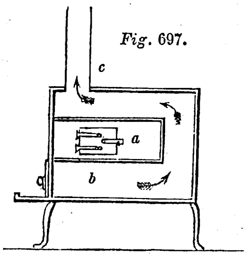


Fig. 697.



to acquaint those who wish to try this stove that it is manufactured by Messrs. Cottam and Hallam, Winsley-street, London, and costs about eight or ten pounds.

4627. *An iron stove, serving also as an oven, is used in the United States, fig.* 697, and is described by Dr. Arnott. This stove is square, and has an iron box in the middle, which is the oven; the wood fire burns at *b*, beneath, and the flame circulates in the direction of the arrows, the smoke going out through the flue, *c*. This serves also to warm the apartment, but has the usual defect of iron stoves.

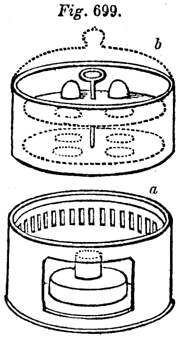
4628. *Cooking by means of a Lamp.*—Among the many resources of the culinary art produced by necessity, or which ingenuity has suggested, is that of performing most of its operations by the heat of a lamp only. The native inhabitants of those regions nearest to the poles, the Esquimaux, who have not the advantage of either coals or wood for fuel, have the ingenuity to employ fish oil burned in lamps made of stone, both for warming their habitations and for cooking their food. Lamps afford a very convenient mode of applying heat on many occasions. The dressing of food may thus be effected in situations where an ordinary fire cannot be had, as on ship-board in stormy weather, in camps, or in travelling. Lamps may be considered as portable furnaces, capable of giving much more heat than is generally supposed. They are made in a variety of forms, adapted to the kind of fuel and the particular objects for which they are employed.

4629. *The spirit lamp* is the most elegant, and, though too expensive for the ordinary operations of cooking, is much employed in certain cases, more particularly in heating a small quantity of liquid, or keeping liquids hot, as in the instances of tea-kettles and coffee-pots, &c.; but cases have occurred at sea and in camps, and in travelling, where the spirit lamp has been adopted as the most convenient. Although the flame of spirit of wine is pale, and gives very little light, it affords considerable heat, and it possesses the important advantages of not giving out the least smell nor smoke, and, of course, of not depositing any soot or stain upon the vessels to which it is applied; indeed, such a lamp was employed with advantage by Captain Parry in his northern voyage. Oil is the general fuel for lamps of this kind; but tallow may likewise be employed, and, indeed, any kind of fat; but such lamps must be of the most simple kind, otherwise the wicks would get clogged. A circular dish or basin, having several wicks at the edge, may be used.

Fig. 698, the construction of the Rumford tea-kettle, with an external cone, *c*, will be found the best adapted for a boiler to be heated by a lamp, the flame playing under the bottom of the interior part.

Fig. 698.

Fig. 699.



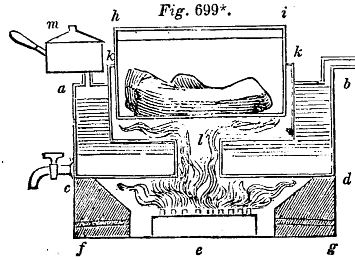
4630. *The chemist's lamp*, on the Argand principle, may likewise be employed as an excellent mode of obtaining heat; and it may be observed that the *double*, or *concentric-wicked Argand lamp* affords so intense a heat that it may be applied to a great variety of culinary operations where portability and great heat are required.

The portable furnaces of the laboratory, of which there are many kinds, may also be used with advantage in many culinary processes.

4631. *A portable apparatus for boiling by a lamp* is represented in *fig.* 690; *a* is a receptacle for the lamp; and the best for this purpose is the chemical Argand lamp with the short copper tube, this affording much the strongest heat without smoke. On this fits the vessel *b*, of tin or copper, to hold the meat to be boiled, or soup to be made; *a*, a stand for holding eggs, as is shown in the cut: the cover is represented by the dotted line, or instead of this may be placed the tea-kettle, *c*.

4632. *An extensive portable cooking apparatus* has been made upon this principle, by which roasting, boiling, stewing, and cooking by steam may all be performed at the same time, the fuel being only an oil lamp; *a, b, c, d, fig.* 699*, is the section of a cylindrical vessel of sheet iron placed over a lamp, with a number of small wicks, *e*, and resting upon a circular stone hollowed out for the lamp, or on an enclosed frame of iron, there being a series of holes all round to admit air to supply the lamp. Within the vessel, *a, b, c, d*, which contains water, another iron vessel, *h, i*, is suspended, to the bottom of which the flame of the lamp is admitted through an aperture, *l*, in the bottom of the boiler with water. The smoke passes off through a minute crevice at *k, k*. It is evident that the flame of the lamp, being so much confined, will produce a powerful effect upon the water in the boiler, and likewise that covering the aperture *l*; it will strike upon the bottom of the vessel *h, i*, in which meat is put upon a stand to roast. If this vessel be di

Fig. 699*.



vided into two by a partition, one half may boil, or the steam may be conducted by means of the pipe *b* to another where the boiling may be done; indeed, sufficient steam may be generated in this way to boil the water in a number of other vessels, and the steam may be admitted into others for cooking by steam. Small saucepans for gravies, &c., may also be fitted on all round, as at *m*. In short, it is easy to see that, upon this principle, with only a strong lamp, cooking may be performed in many ways, and an excellent dinner prepared; but it cannot be pretended that the roasting can be equal to what is done before an open fire. Such an apparatus is very applicable to a ship or to a camp; and for the former, it has been made to swing like a ship's compass. But though we point it out as a contrivance that may be exceedingly useful in such situations, it is absurd to speak of it as one that should supersede the ordinary kitchen, particularly when we consider the cost of the apparatus, which must necessarily be considerable. Something of this kind was manufactured by Mr. Jose, of Bond-street, London, and we believe was invented by Lord Cochrane.

4633. *As an occasional method of keeping anything hot for some time*, may be mentioned placing it in a vessel of sheet iron filled with sand, in which is buried a red-hot iron heater. The non-conducting property of the sand will retain the heat for a considerable time, and will not cause any unpleasant fume like charcoal. See *a*, *fig.* 700.

Fig. 701.

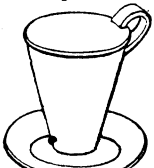
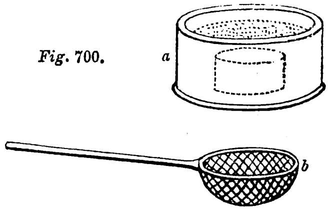


Fig. 700.



4634. *Heat may be occasionally applied to a particular part* of any object by means of an iron ring handle, *b*, *fig.* 700, to which is attached a cup of iron wire that can be filled with live coals.

The little machine called *an Etna*, *fig.* 701, may be mentioned, for the purpose of warming or boiling water in a few minutes. It consists of a tin vessel, in form of an inverted cone, to hold the water, and this is placed in a cup of tin, into which a little spirit of wine or naphtha is poured, and set fire to. The flame striking against the sides of the cone, very soon causes the water to boil. The handle is made to go inside when packed up for travelling.

CHAPTER IV.

FURNITURE OF THE KITCHEN AND OTHER OFFICES.

4635. In the following account of kitchen furniture, the principal things only are described, together with such as have any novelty, or are not very generally known; there are many other small articles with which every family is familiar, and which it is not necessary to mention; but almost all of these will be found in the general list of furniture at the end of this section.

4636. *Kitchen Tables.*—There is generally a very strong, well framed table, with stout legs, placed in the centre of the kitchen. In large kitchens, the top is frequently made of thick elm, for chopping and cutting upon. Smaller tables may be placed along the walls, as is found most convenient. Where economy of space is an object, some may consist of flaps to hang against the walls, to be used occasionally, *fig.* 702, and these are sometimes made to serve as ironing boards. The top, when lifted up, is supported by a jib bracket leg of wood, or an iron rod.

Fig. 702.

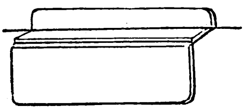
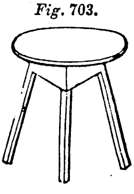


Fig. 703.



4637. *Cheap round tables* may be made, like *fig.* 703, with only three legs, which have this advantage, that they stand steadier on an uneven floor than those with four legs. The legs may even be branches of trees cut to the length, and the top may be square.

4638. *The kitchen dresser* is a strong side-table attached to the wall, with shelves over it serving as a plate rack, *fig.* 704; on the upper side of the shelves, close to the front edge, there are fillets of wood to prevent the plates from sliding off; and there are a

Fig. 704.

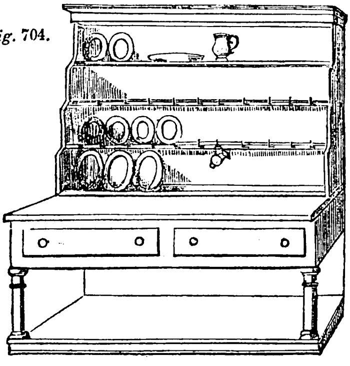
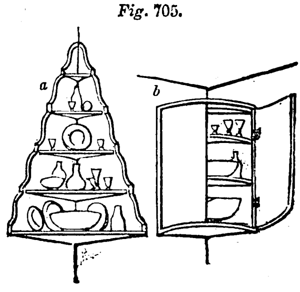


Fig. 705.

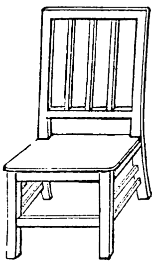


number of hooks on the edges of the shelves to hang small jugs and other things upon. At the bottom of the dresser is the pot-board for placing sauce-pans, tea-kettles, and other things put upon the fire; this part is always painted black. The dresser itself and plate rack are best painted stone or wainscot colour. Instead of the pot-board, some prefer having below the dresser a system of drawers and shelves, enclosed by doors, for holding knives and forks, spoons, spices, and various things necessary for the cook; or there may be one dresser with a pot-board, and another like that just mentioned.

4639. *Closets or cupboards* of some kind are essential in a kitchen, as well as in various other offices. Some are fixtures constructed with the house. *Buffets*, or corner cupboards, *fig*. 705, *a* and *b*, were much in use in days of old, but now are seen only in the cottage or old farm-house. They were used for holding the punch bowls, glasses, and china; but might occasionally be found useful in some of the offices, particularly when there is a deficiency of room. In short, conveniences of this kind must be regulated by the wants of the establishment and the plan of the offices, so that no rules can be established.

4640. *The common kitchen chairs* used in and about London, *fig*. 706, are made strong, of beech or elm, put well together with mortises and tenons, and are not painted, but kept clean by scouring. They are chiefly made in the country.

Fig. 706.



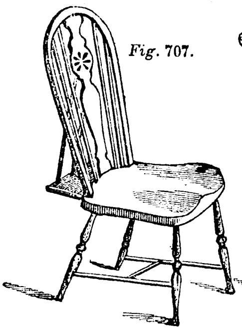


Fig. 707.

Fig. 708.

4641. *The Windsor chair*, *fig*. 707, is much used as a kitchen, and likewise as a cottage and garden chair in many parts of the west of England. The seat is made of elm, a little hollowed out; the outer rail of the back is of ash, in one piece, and bent to the form, its end being inserted into the seat. An additional support to the back is given by two round rails made fast to a part of the chair which projects behind. These chairs are remarkably strong, as well as light and cheap. *Fig*. 708 is another variety of the chair, of a simpler shape; the back rails are made stouter, and have no occasion for the support behind.

4642. *Benches* are long wooden seats with backs to them, *fig*. 709, useful in servants' halls, lobbies, and similar places.

Fig. 709.

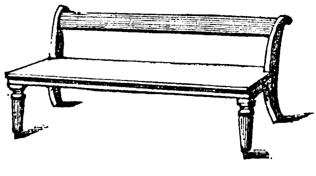
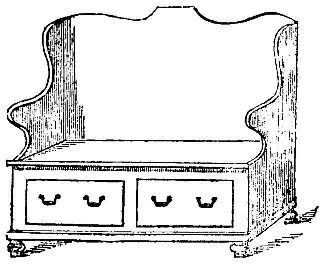


Fig 110.



4643. *Settles* are old-fashioned seats, with high, close backs, to defend those who sit in them from any cold draughts of air, *fig*. *710*. They were formerly common in the corners of the large cottage chimneys, and the seat formed a chest for containing household articles; drawers may be substituted as more convenient.

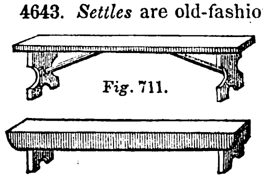
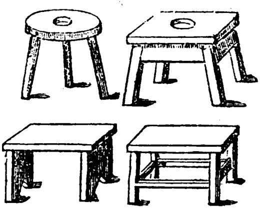


Fig. 711.

4644. *Forms*, *fig*. 711, are the simplest and cheapest kind of seat for a number of persons; and when covered with baize or carpeting, are often made to accommodate in assembly rooms, &c. They may be quickly got up on occasion.

4645. *Wooden stools*, *fig*. 712, are frequently useful for many purposes in the kitchen.

Fig. 712.



4646. *Kitchen knives, forks, and spoons* are well known. There are various knives peculiar to the cook sold at the ironmongers'. Spoons for stirring should be of wood; as those of metal, by wearing, leave some of their substance in the food, which, though small in quantity, is best avoided. Forks and spoons for mixing salad ought, particularly, to be of wood; these the French are very skilful in making.

4647. *The earthen-ware dishes and plates* required by various families are so well known to housekeepers that it is unnecessary to describe them in detail, particularly as they are varying in fashion continually. We refer the reader to the section on "Earthen-ware" for a general account of the manufacture.

4648. *Sinks* belong properly to the scullery and wash-house, but in small kitchens are frequently placed there also, or in the back kitchen. Their use is to wash dishes in, or other articles, and likewise to receive and convey away the dirty water. They are best hollowed out of a single piece of stone, *fig*. 713, but are likewise made of wood lined with lead or zinc. It should be placed, if possible, in a good light; should be supplied by a cock with cold, and if there is convenience, also with hot water. The waste pipe should pass below into a drain, and there should be there a bell stench-trap to prevent any bad smell rising. There should likewise be a sink in the butler's pantry, which might be in the corner, *fig*. 714; also one in the servants' hall; and if this were furnished with a stop-cock and plug in the bottom, it might serve occasionally for washing hands or anything else.

Fig. 713.

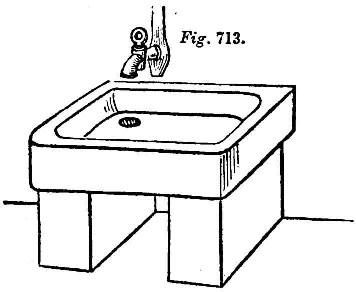
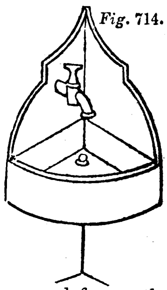
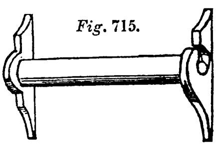


Fig. 714.



4649. *Towel rollers*, *fig*. 715, are generally fixed in kitchens, to hang kitchen towels on, and frequently the door is selected to contain them, as saving the wall for something else. The roller takes out to put on the towel.

Fig. 715.



4650. *Hot Closets*.—One of the improvements in modern kitchens is the facility with which the various dishes are kept hot when they are ready before they are wanted; this is effected by means of hot closets, which are indispensable when large dinners are prepared. A hot closet is merely a closet with shelves, *a b*, *fig*. 716, of a size proportioned to the number of dishes, kept very warm in the inside by flues or steam. Several examples of these may be seen in our subsequent representations of kitchen arrangements. They are sometimes made of cast iron, and placed in a recess over the kitchen oven or roaster, and heated by the smoke and heat that has come from the oven. They may also be heated by steam after it has served to heat boilers. The smoke, or steam, circulates in a space around the outside of the closet, *c*, *d*, *e*, *f*, coming in at one point and going out at another; the doors, which are not represented in the wood-cut, being kept shut. The dishes are placed upon the shelves.

Fig. 716.

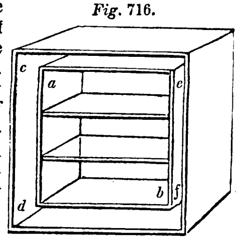
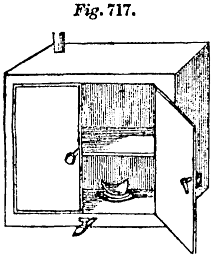


Fig. 717.

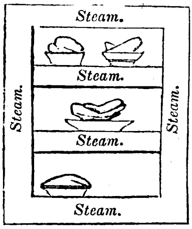


4651. *Fig*. 717 is a portable hot closet, heated by steam, made entirely of tin plate. The outer case consists of two thicknesses of tin plate, having the steam between: a pipe from the boiler conveys the steam to the apparatus, and the condensed water runs off by a pipe with a stop-cock at the bottom.

4652. *A hot closet may also be made* in the screen that stands before the kitchen range, by various modes. A screen with a closet within being constructed on the principle of the above figure, steam is conveyed by a pipe in the floor, and introduced into the space between the closet and the outside casing, the condensed water passing off by another pipe.

Sometimes, when more heat is required, steam is not only car ried all round the hot closet, but even in the shelves, as in *fig.* 718; these being of tin, and double, with the space between about an inch and a half.

Fig. 718.



4653. *An economical and excellent hot closet* is formed by taking a common screen for placing before a kitchen fire when meat is roasting, and closing up the front or side next the fire with sheet iron blacked; forming a door at the back for putting in and taking out the articles to be kept hot. As black iron absorbs the heat powerfully, the air inside, not being able to escape when the doors are shut, becomes very hot. When it is desired to use this hot closet as a hastener in roasting meat, it is only necessary to hang in front, before the black iron, a covering of tinned sheet iron, which may be in two or more plates, according to the size of the hastener, for convenience of lifting on and off. *Fig.* 719 is a back view of such a moveable hot closet, with the door open, showing the shelves, &c. In many cases, white sheet iron will be preferable to black iron, because, while it reflects the heat and hastens the meat, it will conduct and radiate quite enough into the hot closet; and what is collected there will not so easily escape again as through the black sheet iron; this kind of hot closet, it should be observed, is liable to an inconvenience; the wood shrinks so much by the great heat of the fire, that draughts of cold air penetrate into it; these openings, when they occur, must be stopped up by the carpenter, except he is ingenious enough to provide a better remedy. It may not be necessary to have the whole of the screen converted into a closet for keeping the cooked dishes hot: the upper half alone may be found sufficient, and the lower part may be used as a plate warmer, in which case two sets of doors will be proper.

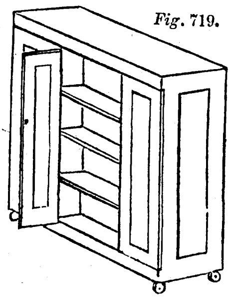
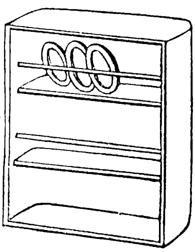


Fig. 719.

4654. *Plate warmers* are quite necessary in establishments where hot closets are not used in the kitchen, and frequently in the dining-room. Those used in the kitchen may be fitted up in the fire-screen on a small scale, as in *fig.* 720; those are made of wood lined with tin, and may have a door in the back to take out the plates and dishes

Fig. 720.



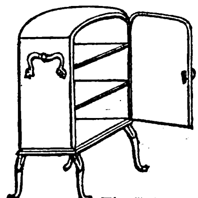
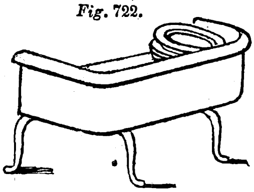


Fig. 721.

Fig. 721 is the well-known japanned plate warmer for the parlour in small families. *Fig.* 722 is a lower kind sold in the shops under the name of *vegetable warmers*, for keeping those dishes of vegetables warm that are not put upon the table. They are set down before the fire.

Fig. 722.



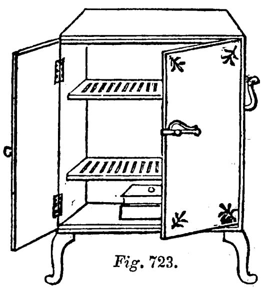


Fig. 723.

4655. *Plate warmers are now constructed*, as *fig.* 723, in which a vessel filled *with burning charcoal* is placed to keep plates and dishes hot; and these are sometimes placed in the dining-room. Although they are found effective for their intended purpose, we cannot recommend the employment of charcoal in this way, since its fumes are so extremely prejudicial, which must add much to contaminate the air, where already several causes, such as respiration and lights, tend to injure it. *An iron heater placed* in such a receptacle *would not have any bad effect*, and though this would not keep hot so long as charcoal, yet, with good management, the heat given by it to the plates will generally last sufficiently long at private dinners. We have seen one fitted up like an elegant piece of oak furniture with carving, *fig.* 724, which remained always in the dining-room, and the use of which could not be suspected. The heater was placed in it just before dinner commenced; and it might easily be renewed without its being observed. It is scarcely necessary to add that it was lined with tin, and had shelves.

Fig. 724.

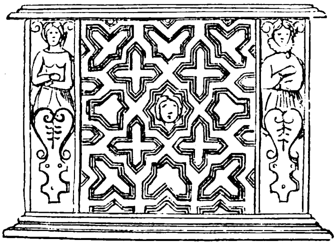
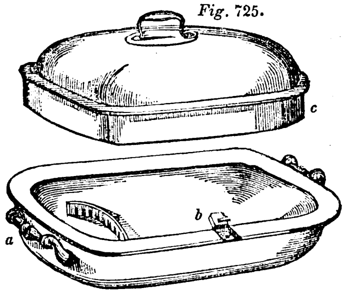


Fig. 725.



4656. *Hot water dishes, a, fig.* 725, are used for certain large joints of meat, hashes, and various other things. They are formed by having a reservoir for hot water beneath the dish itself, the water being poured in at *b*. *c* is the cover.

4657. *Gravy kettles, fig.* 726, are for keeping gravies hot to pour over various dishes as they are cooking; they are of copper, and are heated over the charcoal stove or hot plate.

Fig. 726.

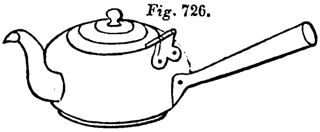
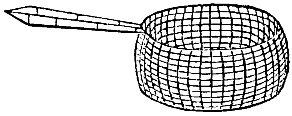


Fig. 727.



4658. *Wire baskets, fig.* 727, with wire handles, are for crisping parsley, or any similar thing, over the fire.

4659. *Spoon drippers, fig.* 728, are for hanging large spoons and ladles on, with a trough below to catch the drippings, that they may not soil tables if laid on them; it is made of tin, and fixed against the wall.

4660. *Glaze-pots, fig.* 729, are for keeping the strong meat jelly called glaze; this is put into a tin vessel that is inserted into another containing boiling water, in the manner of a glue-pot; a hole in the lid is for the brush.

Fig. 728.

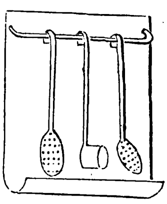
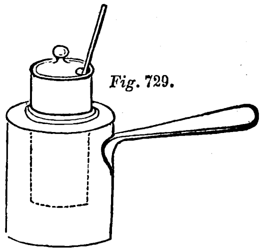


Fig. 729.



4661. *Spice and Flour Boxes.*—In cooking, frequently a few minutes are of great value, and the loss of them a serious inconvenience. It is essential, not merely to the comfort of the cooks, but to the perfection of their processes, by enabling them to acquire precision, that all their apparatus, even apparently of the most trifling kind, should be well contrived for expedition. In a well-furnished kitchen, such as alone will enable the cooks to get up the best dinners, everything should be studied as in a chemical laboratory.

Fig. 730 is a tin box with three divisions: the largest for flour; and of the two smaller, one is for pepper, and the other for salt. *Fig.* 731 is also a tin box with several divisions, for pepper, salt, both mixed, and also for various spices for immediate use, and which are to be always at hand. Tin spice-boxes, with divisions for keeping various kinds of spice, are sold at the ironmongers'.

4662. *Mortars and pestles* are necessary. In considerable establishments, large mortars of marble, placed upon a firm stand, are requisite. Smaller mortars of brass are likewise used.

Fig. 730.

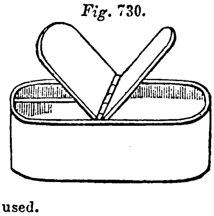
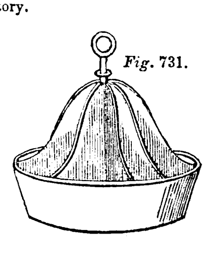


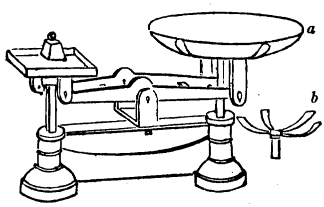
Fig. 731.



4663. *Machines for weighing* are very necessary in every family, that the housekeeper may keep a check upon the tradesman, and for proportioning various ingredients.

The common scales are too well known to require description. *Fig.* 732 is a weighing

Fig. 732.



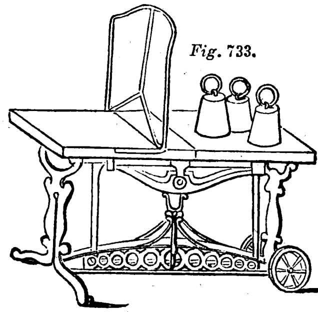
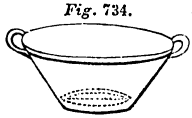


Fig. 733.

machine now generally used as much more convenient. The articles to be weighed are put into the scale, *a*, which lies loose on a cross-piece similar to *b*. The weights are put into the square dish, *c*, and when it descends it gives the weight required. The construction, on the principle of the lever, is easily understood from the figure.

Fig. 733 is a weighing machine generally used for domestic purposes, where larger and heavier articles are to be weighed. It will weigh three hundred weight. Both the above are constructed wholly of iron.

Fig. 734.



4664. *Cullenders*, or *colanders*, *fig.* 734, are vessels having the bottom pierced full of holes, for straining or separating the more liquid from the solid part of substances.

4665. *An iron hand-mill*, securely fixed to the wall, is necessary for grinding coffee, and another for rice flour, barley flour from pearl barley, or oatmeal from groats; and a smaller hand-mill for pepper, &c.

4666. *Cinder Sifter.*—Scarcely anything is more destructive to the furniture of our apartments than taking out the ashes from the grates in the morning, from their flying about, and raising a cloud of dust that afterward settles down over every part of the room, and has to be removed by careful brushing and wiping; but the great mischief generally done by this, which is too often performed in a careless manner, is seldom sufficiently understood, because the operation is performed early in the morning, and the rooms are dusted afterward. We would recommend, therefore, that a cinder sifter should constantly be a part of the housemaid's apparatus. This simple machine, the cost of which is trifling, will not only prevent almost all the destruction we have mentioned, but will save the housemaid herself from the dirt inseparable from the usual mode, and, what is not undeserving of attention, economy and the cleanliness of the fire will be promoted; for when the ashes are taken down without being sifted, a great deal of good cinders go into the dust-hole, in spite of the endeavours of the most careful servant. The best cinder sifter is made of tin in the form of a slop-pail, but larger; in the inside is a wire sieve that takes out. The ashes being put into this sieve, the lid of the pail is put on, and by turning round and shaking the latter, the ashes fall through, leaving the cinders alone in the sieve. The pail should now remain quiet for a few minutes till the ashes subside, and then the lid may be taken off, and the cinders used to put on the fire: or, if that is not required, they may be kept for other fires or coppers, and the ashes thrown into the dust-hole. A cheaper kind of cinder sifter is made of wood; but the principle is the same. Considering the great convenience of this little instrument, it is surprising that it is not employed in every family.

4667. *Bellows.*—The use of bellows is frequently declaimed against in good housewifery, and certainly the fires may be managed perfectly well without the use of this apparatus; but there are, nevertheless, occasionally cases where they are extremely convenient.

4668. *The common bellows for blowing the fire* is a very ancient and a very simple and ingenious invention.

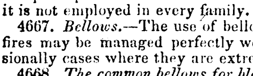


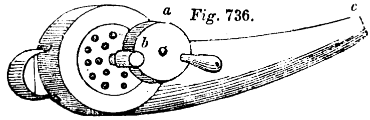
Fig. 735.

The principle on which it acts is its forming a vacuum, into which air rushes to fill it up, which is afterward expelled through the nozzle in a stream, by pressing the two boards together. It consists of two flat boards, *a* and *b*, *fig.* 735, united by a leather joint at *c*, and having leather nailed on the edges, so as to permit the boards being separated at one end. On the inside of the circular hole, *d*, in the lower board, a leather valve is fastened, which permits the air to enter when the upper board is raised, but shuts when the boards are brought together, and thus obliges the air to be driven out at the nozzle. This simple apparatus affords a good illustration of the fact that air is a substance as well as water; for having raised the upper board, as in blowing, and stopped up the nozzle, it will be found that it is impossible to shut the bellows, the air within resisting as much as if it were water, which could not be the case were the air not substantial matter.

4669. *The double bellows* is mostly used for the forge; but it is occasionally employed in a portable form in the same way as the single just described. In this there is another board in the space between the upper and lower ones; and there is a valve opening upward, likewise, in the middle board. By this means a continuous blast is produced; but this construction is generally too heavy for domestic use.

4670. *Clarke's patent blower*, *fig.* 736, is a great improvement on the double bellows, producing a continuous blast, but being at the same time very light and cheap.

Fig. 736.



It consists of a tin tube, having attached to it a barrel, in which is contained a circular fan like that used for winnowing, and which is driven round by a wheel, *a*, rubbing against a smaller one, *b*, fixed on the axis of the fan. The air enters at the holes on the sides of the barrel; and the leaves of the fan reaching close to the *interior* circumference of the barrel, the air is expelled in a continued stream through the tube, *c*. This apparatus blows up the fire much better than the common bellows, which, if used injudiciously, sometimes puts the fire out.

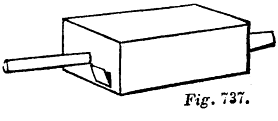


Fig. 737.

4671. *The Chinese bellows* consists of a box of wood about two feet long, *fig.* 737, and one foot square, in which a thick square piece of board, which exactly fits the internal cavity of the box, is pushed backward and forward. In the two ends of the box, and in the internal board, there are valves to admit and expel the air; it is, in fact, a kind of pump. *A single tube*, like a gun-barrel, was, perhaps, one of the first instruments for blowing the fire, and is still generally used in the cottages in the north of France.

4672. *Cast iron stands, with revolving tops, fig.* 738, are useful to place things on occasionally before the fire to keep hot; by the top being moveable, the several sides of the dish may be presented to the fire very conveniently.

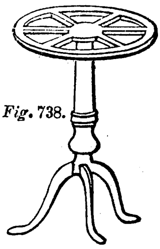


Fig. 738.

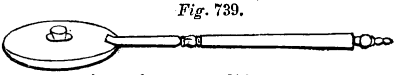
4673. *Brooms and brushes* are articles of furniture in daily use, and are made of various materials, as whisk, hair, cane, whalebone, &c., and of a great variety of forms, according to the uses to which they are applied. They are too well known to require particular description, but may be enumerated as *carpet brooms*, made of a strong white grass, termed whisk; *chamber brooms*, made of long hogs' bristles; *hand brooms; bannister brooms; Turk's head*, with a very long handle, for sweeping down cobwebs and dust from cornices, &c.; *feather brooms*, for dusting pictures and delicate articles; *hearth brooms*, both plain and ornamented, some of which are made with the handle to shut up short like a telescope, for drawing and bed rooms. There are brooms for offices, yards, and areas of birch, some of which are made for this purpose in the form of chamber brooms, but of the inside of the canes called ratan, after the outside has been stripped off for the seats of chairs; these are extremely effective and durable, as well as cheap. The bed-chamber brooms should be kept in a closet on the bedroom story for them and other similar utensils.

4674. *Brushes* are smaller, and have the hair shorter than brooms; they are usually made of hogs' bristles of different degrees of coarseness and fineness, and of various lengths. The hair is doubled and fixed into holes by wire, which is usually concealed by a thin plate of wood that covers it. In ill-made brushes, this covering is apt to come off and expose the wire, and when this fails the hair comes out; should this accident happen, the wood covering should be fixed on again securely. In some brushes the hair is merely fixed into the holes by some cement; these are generally worthless. The various brushes in common use may be enumerated as clothes-brushes of various kinds, hat-brushes, coarse and fine, shoe-brushes, nail-brushes, tooth-brushes, crumb-brushes, bottle-brushes, scrubbing-brushes, dry loaded rubbers for floors, black-lead-brushes for grates, furniture-brushes, dusting-brushes, water-closet-brushes, and filtering stone-brushes.

4675. *The common warming-pan* for beds is filled with live coals, and it requires care not to leave some smoke and suffocating fumes, independently of the danger of scorching the sheets.

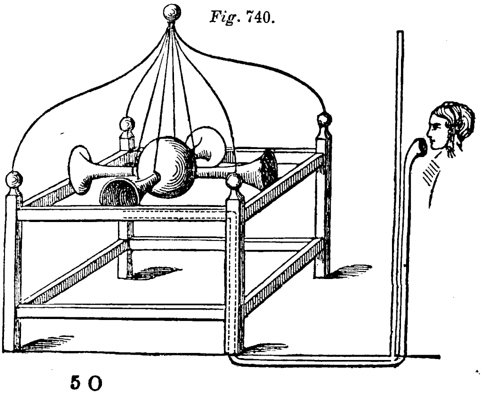
A superior warming-pan, fig. 739, is filled with boiling water, which is perfectly safe from all these accidents.

Fig. 739.



4676. *Tubes for speaking through*, so as to communicate between different apartments at some distance from each other, are at present much employed in shops and manufactories, and, as they instantly convey intelligence or orders to the remotest parts of an establishment, save an immensity of fatigue, and produce a great economy of time. They have not yet been much introduced into domestic establishments; but they would be found extremely advantageous in large houses, in conveying orders from the nursery to the kitchen, or from the house to the stable. Mr. Babbage observes, "their convenience arises, not merely from saving the servant or workman useless journeys to receive directions, but from relieving the master himself from that indisposition to give trouble, which frequently induces him to forego a trifling want, when he knows that his attendant must mount several flights of stairs to ascertain his wishes, and, after descending, must mount again to supply them. The distance to which such a mode of communication can be extended does not appear to have been ascertained; but it is probably much greater than is required in the largest mansion." The tubes are usually made of tin, and about an inch and a half in diameter, with a conical piece at the end for speaking into; the person spoken to puts his ear to the other end of the tube; and a bell is used, the ringing of which is a signal to listen. Tubes for this purpose have lately been made of India rubber.

Fig. 740.



4677. *These speaking tubes first came into use here in consequence of the singular exhibition*, about thirty-five years ago, of what was called the *Invisible Girl*. In an empty room was seen an apparatus resembling a large ball, having four speaking trumpets attached to it, the whole being suspended by silken strings in the middle of a frame-work, nearly of the form of that of a tent bedstead, *fig.* 740, in no part of which was it possible for a human being to be concealed. If a visiter applied his mouth to either of the trumpet mouths, and asked some question, a reply was given by a voice which seemed to proceed from the ball, which occasioned the name, the Invisible Girl. Although this illusion created much curiosity in the public, and the apparatus was examined for months by numerous ingenious persons, yet no one hit upon the mode in which the effect was produced, it not being then generally known that sound could be conveyed through tubes, and the tube through which the sound was really conveyed being concealed. The following, however, was the construction of the apparatus: the frame-work contained a metallic tube, indicated by the dotted lines, and this tube passed under the floor into an adjoining apartment. The person who gave the answer to a question put at the trumpets applied his mouth to the end of this tube, and the sound was conveyed by its means to the points in the frame opposite to the trumpet mouths, which they entered and were reflected back, and seemed, therefore, to issue out of it. When the effect of this conveying tube became publicly known, the exhibition ceased, and tubes have, since that time, been very generally employed to convey the sound of the voice, as above mentioned.

4678. *A clock* should never be omitted in a kitchen. For those who wish to be economical, a Dutch or German clock, with wooden wheels and ordinary weights, which may be had for 12*s*, and some of which perform remarkably well, will answer every practical purpose. The alarum which is frequently attached, and which can be set to go off at any required hour, may not be without its use.

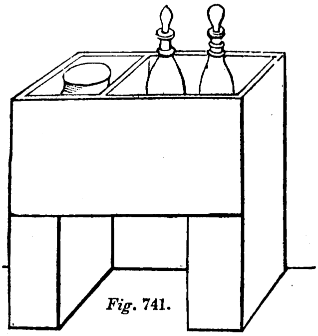


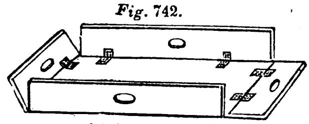
Fig. 741.

4679. *A wine and butter cooler* (*fig.* 741) is often useful in some cool place adjoining the wine-cellar or ice-cellar, into which a quantity of ice may be put for daily use, and to which access can be easily had, for cooling wine and butter. It may be of wood lined with lead.

Ice Preservers.—For the description of these, see Book VIII., Chap. VII., "On Cooling Liquors."

4680. *Dish covers, of metallic wire gauze,* are very useful for covering up meat, either raw or cooked, to keep off flies, and yet give a view of what is below.

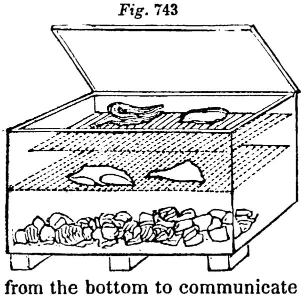
4681. *Butler's trays* are made of mahogany, and are more convenient to put away, occupying less room, when they are made to fold down, as in *fig.* 742. When used, the sides are turned up and fixed by bolts. It is recommended that, though the sides may be of common Honduras, the bottom should be of Spanish, as the soft wood is too easily stained.

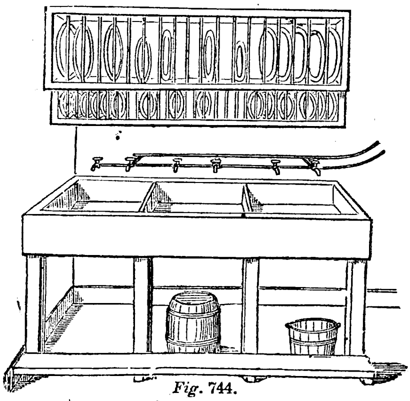
Fig. 742.


4682. *Knife trays* are made with a partition in the centre, which serves the purpose of a handle.

4683. *Safes* are necessary to keep meat in, whether raw or cooked, to defend it from flies and other insects, particularly where there is no regular larder. They are portable cupboards, generally of wood, with the panels of the doors and sides filled with some perforated substance to let the air in properly, but so as to preclude the entrance of flies, &c. The most usual material for this purpose is what is called *safe* canvass. Iron wire is also employed, not being liable to be gnawed by mice and rats; but this requires to be kept well painted in oil, otherwise it will soon decay by rust. The common wire cloth is woven by a machine; a stronger wire is woven by hand, but is more expensive, though more durable. Perforated zinc plates are likewise employed for this purpose; and safes made altogether of zinc are constructed for exportation to tropical climates, where the white ants frequently destroy those of wood. The comparative prices are: a small safe, with canvass, 15*s.*; one ditto, with iron wire, 18*s.*; one ditto, with zinc plates, 21*s.*; and one with wire woven by hand, 25*s.*

4684. *An ice cooler* (*fig.* 743) is a useful addition to a larder for keeping meat, fish, butter, or other things very cool. It consists of a strong chest, having the sides of thick wood, or, what is better, of two thicknesses of wood, with a space of an inch between, which may be filled with charcoal dust, to make it a good non-conductor of heat. A quantity of ice must be laid upon the bottom; and a little above this there should be an iron grating to lay the meat and other articles upon. If required, there may be two of these gratings, sufficiently apart to admit of joints, &c., lying on the lower one, and there should also be a contrivance for lifting out these gratings; a wooden cover shuts over the whole. To carry off the water that forms from the melting of the ice, there must be a waste-pipe from the bottom to communicate with the drain. This chest should not stand immediately upon the floor, but should be supported upon several small pieces of wood, that the heat may not be communicated from the floor to the bottom of the ice cooler. This will serve for vegetables as well as amimal food.

Fig. 743


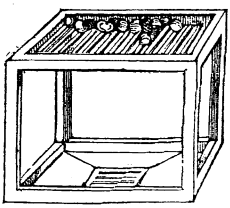


4685. *Fig.* 744 represents a *sink* in the scullery, with pipes and cocks for hot and cold water, with a plate-rack over it: the tubs for hog wash are placed beneath.

Fig. 744.

4686. *Fig.* 745 is a *potato drainer*, to lay potatoes on to drain after they are washed. A grating below carries away the wet.

Fig. 745.



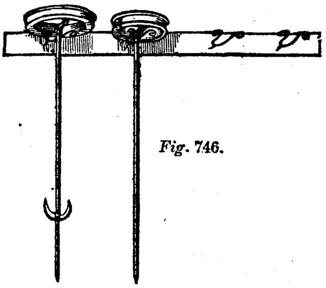


Fig. 746.

4687. *Fig.* 746 is a *spit-rack* to hang spits upon after they are cleaned, and are ready for use.

CHAPTER V.

EXAMPLES OF VARIOUS KITCHEN FIRE-PLACES.

4688. It may be useful, in illustration of what we have said, to give some examples of kitchen fire-places which have been fitted up and found convenient.

4689. *Fig.* 747 represents one of the smallest size ranges, the fire-bars one foot six

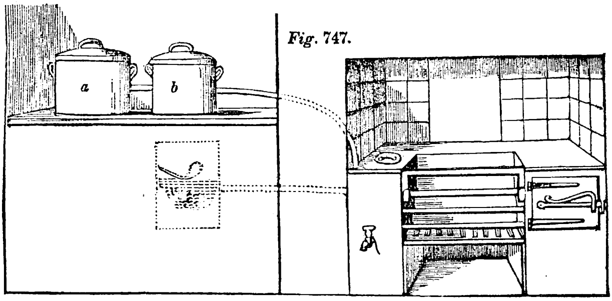


Fig. 747.

inches in length. On one side is an oven heated by the fire; and on the other side is a boiler, also extending behind the back of the fire, with a cock to draw off the water. The boiler may either be filled every day by the circular cover on the top, or, what is better, it may be fed by a cistern and a ball-cock, as represented by the dotted lines. This boiler may likewise furnish steam to the two tin steam vessels, *a* and *b*, placed over the cistern. The pipe which supplies the steam is indicated by the curved dotted line. The throat of this chimney should be made narrow, and the inside may be lined with Dutch or white delft-ware tiles, which gives a very clean and neat appearance.

4690. *Fig.* 748 is another arrangement on a larger scale. In the kitchen chimney

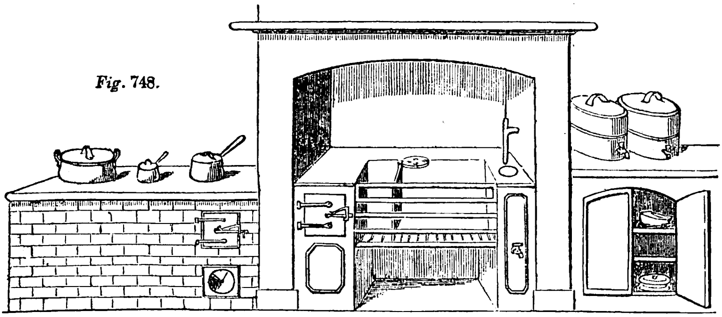


Fig. 748.

there is the usual range, with an oven on one side and a boiler on the other. Connected with the last, on the right, is a set of steamers, and a hot closet beneath heated by the steam. On the left of the chimney there is a hot plate, with a separate fire-place set in brick-work; and this is, in general, the best way of fitting up the hot plate, since the bricks confine the heat, and the kitchen is not made so warm as when the whole is of iron. The hot plate may be placed in any part of the kitchen where there is a possibility of having a flue.

4691. In some places they have tried to do away with the use of an open fire and kitchen range, and to depend upon hot plates, baking ovens, steam, and other modes lately introduced; but however economical these arrangements may be in point of fuel, and however well adapted to particular cases, we cannot recommend the banishment of the kitchen range, when we consider the frequent change of servants, their general want of intelligence, and the great attention and care which these new modes demand, though excellent in principle.

4692. When there is no flue to carry off the air heated by the hot plate and the steamers, the hot air comes into the kitchen, causing the place to be uncomfortably

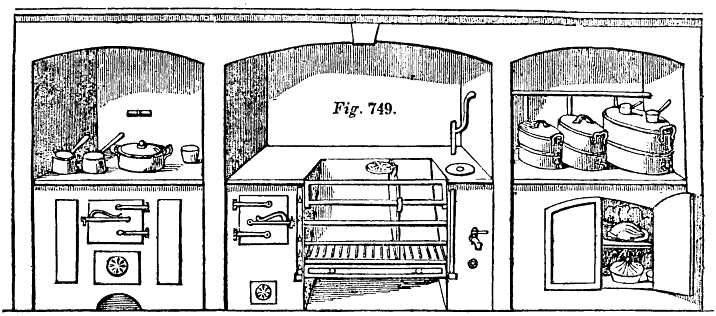


Fig. 749.

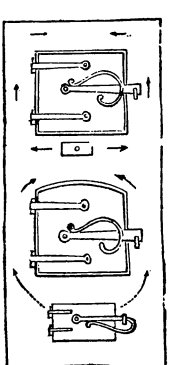


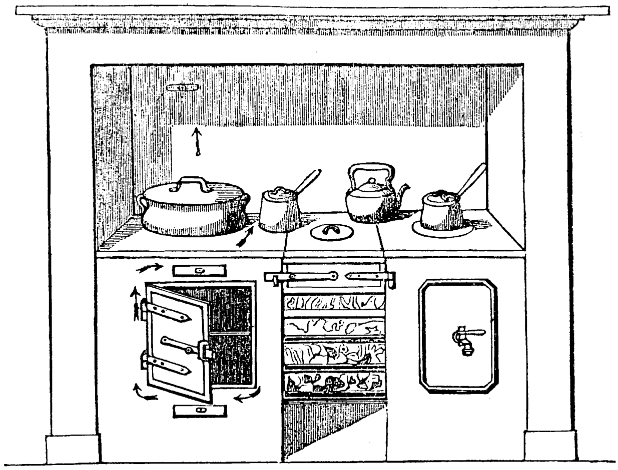
Fig 750.

warm; to prevent this effect, it is best, if possible, to place these parts of the apparatus in recesses in the wall like chimneys, the flues of which may either go to the top of the house, or join the chimney flue. This will add much to the healthiness of the kitchen; but the possibility of effecting this improvement must depend upon the locality; and a good light in these recesses is necessary. *Fig.* 749 represents such an arrangement, where the middle recess contains the range with its boiler and oven; in another recess is a hot plate; and in the third a set of steamers, with a hot closet beneath, also heated by steam.

4693. *Fig.* 750 *represents an oven and a hot closet* made of cast iron as a separate article of furniture, to be put up in any place where there is access to a flue. The oven may, if required, be a roaster or roasting oven; and it is heated by its own separate fire, which, after circulating all round the oven, goes round the hot closet in the direction of the arrows. Such an apparatus may often be useful, in addition to others of a similar kind. Proper places must be made for sweeping out the flues. This may be put into a recess in the brick wall, or project into the apartment with four or nine-inch brick-work on the sides, which will be proper to confine the heat.

4694. The following kitchen fire-places are upon the principle of having a hot plate immediately over the fire: *Fig.* 751 is a kitchen fire-place, which, we believe, first ap-

Fig. 751.

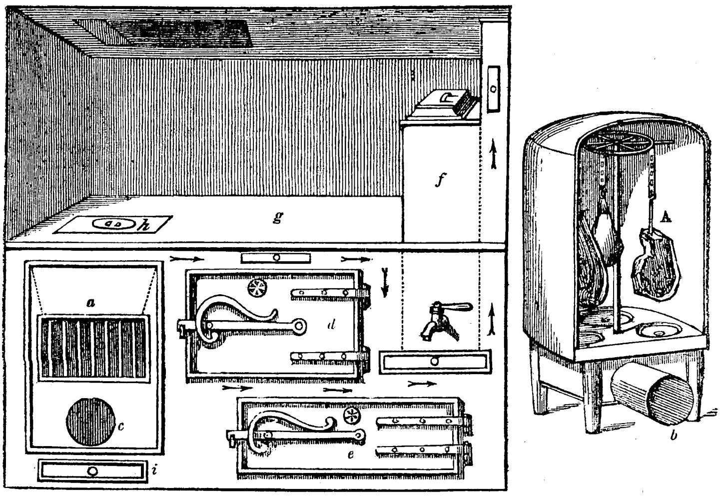


peared as the invention of the Marquis de Chabannes, about forty years ago. Here the fire in the range, instead of being open at top in the usual way, is covered by a plate of cast iron, and the smoke is made to pass into a flue behind the back of the chimney. By this mode the soot is prevented from falling upon the various vessels placed on the hot plate; and when the inside of the chimney is lined with white glazed tiles, it has a very neat and clean appearance. Immediately below the hot plate, and above the bars of the grate, there is a narrow door for throwing coals on the fire, and just over the fire there is a circular aperture, generally covered with an iron plate; but when this cover is left off, the aperture serves to cause anything to boil quick when placed over it. On the right of the range is a boiler, and on the left an oven; but the latter was only of the ordinary kind, and not furnished with a current of hot air like the Rumford roaster; it could therefore only bake, but not roast. We cannot recommend this arrangement, and present it rather to show from what some of the later kitchen fire-places have been derived.

Of late several kitchen fire-places have appeared, so constructed that the whole is connected together, requiring merely to be placed in the chimney, with very little setting by the bricklayer. We shall describe a few of them; but must observe, that though they have some advantage in point of neatness and compactness, yet the latter quality is productive of this inconvenience, that when any part wears out, or is out of order, the whole machinery is probably stopped; and that the difficulty of repairing is always great, often, from the locality, even impracticable. On account of repairs, it is best to have the several parts of kitchen apparatus as much as possible independent of each other. We must likewise state, in justice to our readers, that in all their descriptions of these kitchen fire-places, the ironmongers represent them as capable of doing much more than in practice they can perform with that convenience essential to the cook.

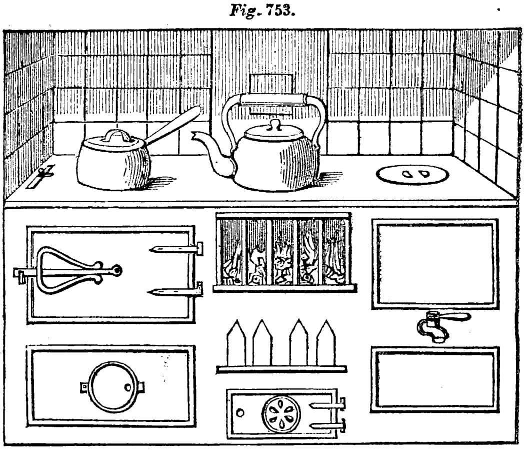
4695. *Brown's cooking apparatus* (*fig.* 752) is a late invention of this kind; and the roasting part has at least novelty and ingenuity to recommend it. The meat to be roasted is hung in a niche formed of a screen of tin, shown at A, and placed before the vertical bars of the fire, which are seen at *a*. The tube, *b*, of the screen is inserted into the circular aperture, *c*, below the fire; the meat is turned round by the current of air that feeds the fire; for when the fire burns, and is wanted for roasting, air enters by this aperture to supply it; but before it reaches the fire, it must pass through the tube *b*, and in doing so it acts upon a vertical fan wheel placed below the dripping pan, and sets it in motion; the axis of this fan acts upon another wheel, which has its axis upright, rising into the screen, and carrying upon its upper end a circular disk. To the circumference of this disk are suspended one or more pieces of meat, which, of course, revolve with the axis, and present their different sides to the fire in succession; and this motion must continue as long as the fire burns, because so long will a current of air enter by the tube, and act upon the fan wheel; the motion will be faster or slower, as the fire burns more or less briskly. The heat of the fire coming through between the upright bars, together with what is sent off by the heated iron front, and the strong reflection

Fig. 752.



from the inside of the screen, is said to be sufficient to roast the meat. Over the fire is a hot plate; *d* is an oven; *e* is a hot closet; *f* is a boiler, and *h* is a broiling place in the hot plate, all heated by the same fire. The flame and smoke pass entirely under the hot plate, and, of course, over the top of the oven in the direction of the arrows; part of it also passes beneath the oven; and they then turn downward and go under the bottom of the boiler, which extends down as far as the dotted lines. The smoke then ascends by the side of the boiler, *f*, as shown by the arrows, and finally passes into the chimney. The hot closet, *e*, is warmed by the hot smoke passing over it. When broiling and not roasting is required, the fire-door must be shut, and also the aperture *c*, while the aperture *h* is opened. The air to supply the fire then comes in through *h*, and, of course draws downward; over this aperture the gridiron for broiling is placed; or, if quick boiling be wanted, the kettle is put over it. Ordinary boiling and stewing are performed upon the hot plate; and it would be easy to add a steam apparatus. The throat of the chimney is closed, except a square aperture to let off occasional vapours; and this may be shut, when required, by a sliding plate. When neither roasting nor broiling is going on, the aperture *c* is closed, and a drawer, *i*, is pulled out a little; this supplies air to the fire, and will likewise serve to regulate the draught, so that the fire may be kept for a long time just a-light. Any kind of coal may be burned; but the best fuel is a mixture of anthracite and common coal.

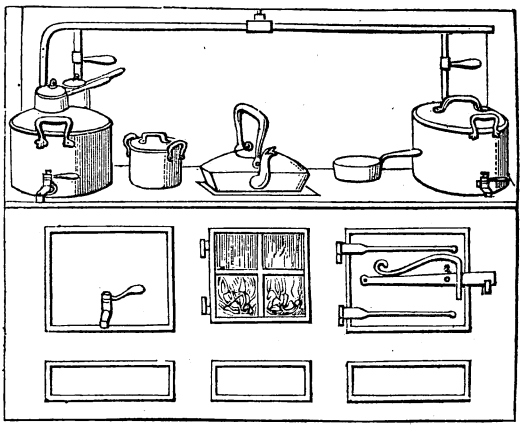
Fig. 753.



4696. *Wright's kitchen range* (*fig.* 753) has the fire enclosed by a door filled by plates of mica, improperly called talc. The heat comes through the mica, sufficient, *it is said*, to roast meat placed in a tin niche on a large Dutch oven, with a spring jack attached. The fire also heats a hot plate placed over it, having an aperture in the centre for boiling a square tea-kettle, or for broiling; on one side is an oven, and on the other a boiler, both heated by the flame and smoke passing round them in flues constructed in the iron-work, while meat and vegetables may be steamed in vessels supplied with steam from the boiler. A pipe may likewise convey steam to any other part of the kitchen for a similar purpose.

4697. *Figure* 754 is *Brown* and *Green's* kitchen fire-place, nearly on the principle of the last; but when roasting is to be performed, an iron plate is slid down before the fire-bars; and though at first sight it might not appear to be the case, the heat given out is greater than when the fire is exposed to view; for then the draught of air through the fire carries much of the heat up the flue; but when the aperture of the fire is closed, the fire being fed with air only from the registered opening below, it burns with great fierceness against the iron plate, which becomes red hot; and it is by the radiant heat thrown off by this that the roasting is effected, the meat being suspended in a tin niche screen Below the hot plate, on the right, is an oven, and on the left is a boiler, which supplies a set of steamers in another part of the kitchen.

Fig. 754.



4698. *Several other ranges, nearly similar*, are manufactured by various ironmongers, but not so different as to demand a separate description. It must be observed that we decline giving any opinion on the efficacy of these ranges, in which the fire is covered by a hot plate, as they require more trial than we have been able to give them. But it is very evident that they are very expensive in the first instance, and require the cook to be taught how to use them; they are also very apt to be out of order, the narrow flues requiring to be frequently cleaned out. The economy of fuel which they promise is, perhaps, not a set-off against these inconveniences; nevertheless, they have a very attractive appearance, and in some situations may be very useful with those who will take the trouble of managing them properly. For common English cooking and English servants, we can scarcely venture to recommend dispensing with a good open fire. Some of the best kitchens are to be seen in the London club-houses, which have been fitted up with all the modern improvements; and a visit to them will amply repay those who have taste and discernment enough to perceive the advantage of studying and improving this part of our domestic economy. In some of these steam is very successfully applied in a variety of ways; and the facility with which the culinary art is carried on is deserving of attention.

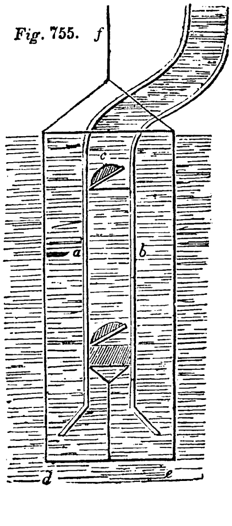
CHAPTER VI.

PUMPS, AND LIST OF FURNITURE.

4699. Pumps being machines in common use in many establishments, it is proper that their construction should be understood; and we proceed to explain their general principles. The different kinds may be reduced to three, the lifting, sucking, and forcing pump.

4700. *The lifting pump* (*fig.* 755) is the simplest, though not so frequently used in domestic economy for raising water as the common, or sucking pump. Its employment is chiefly restricted to such places as mines, where water is required to be raised in great quantities, and from a great depth. A cylinder, *a b*, descends into the water to be raised, and has a valve placed at *c*, opening upward. A piston, having a valve in it also, opening upward, is moveable upward and downward in the cylinder by means of iron rods, *d, e, f*. When the piston is pushed down in the water, its valve opens, and when it is raised the valve shuts, and as the water above it cannot descend, the piston lifts it as far as the length of its stroke, causing it, at the same time, to lift the valve *c*; on the piston descending again, the water that has been raised above *c* remains there, that valve falling down and preventing its descent. The same effect follows every stroke of the piston, more and more water getting above both valves,

Fig. 755.



which, by shutting each time, prevents its descent again. By a repetition of this action, water is at length lifted up as high as it is required; but it is to be observed that, as the piston has to support the whole weight of the water above it when the valve *c* opens, great power is necessary in raising water from considerable depths.

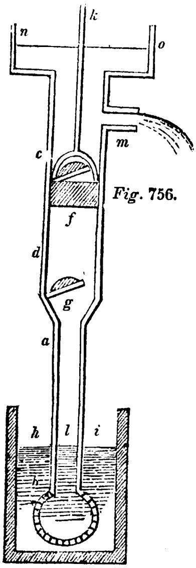
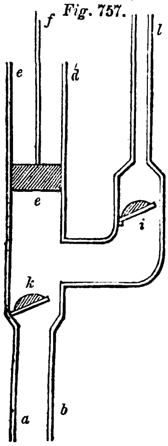


Fig. 756.

4701. *In the sucking pump* (*fig.* 756) the raising of water is assisted by the pressure of the atmosphere. It is known that this pressure is equal to the weight of a column of water about thirty-two feet in height, according to the height of the barometer; water can, therefore, be raised so high, but not higher, by taking advantage of this pressure. To effect this, a tube or cylinder is provided, thirty-two feet in length, *a*, *b*, called the suction pipe, which is plunged into the water to be raised, having some contrivance at the bottom to permit the water to enter, but keep back pebbles and dirt, and a valve opening upward at the top, *g*; on this is placed another short cylinder, *c d*, but of larger diameter; this has a piston, *f*, working in it upward and downward by means of the rod, *k*; when this piston, which must fit very exactly into the cylinder in which it works, is pushed down, its valve will rise, the air beneath acting in the same manner as the water in the lifting pump, and when the piston is raised, its valve will close, and it will lift up the air that is above it; but by this means a portion of air has been withdrawn from the space between the two valves, and the air in the suction pipe, by its elasticity, hastens to supply the vacuum thus formed, and opens the lower valve, *g*. Through the extraction of a portion of air by the upward motion of the piston, the whole of the air beneath it is in some degree rarefied, and consequently the pressure upon the water at *l*, in the inside of the suction pipe, is not now so great as before, and is less than that upon the surface of the water at *h* and *i*, on the outside, which has the undiminished pressure of the atmosphere. The consequence of this unequal pressure on the water within and without the suction pipe is, that water is forced into the interior of the latter, and rises at each stroke of the piston until it reaches it. On the next action of the piston, it works in the water, and the effect is the same as was described in the lifting pump, the piston lifting at each stroke the water above it; but as the piston is made to work near the top, and near the place of delivery, this weight is very little, the pressure of the atmosphere now always keeping up the water as high as the piston. The water so raised now runs out by a short pipe at the side, *m*. To provide for the constancy of this stream, a small reservoir, *n o*, is formed upon the top of the pump. It is scarcely necessary to observe that the piston rod is usually moved up and down by a lever called the pump handle.

4702. *The operation of the common forcing pump* is the following: *a b*, *fig.* 757, is a suction pipe descending into a well, tank, &c., containing water, and having in it a valve, *k*, opening upward. The piston, or working barrel, *c d*, *fig.* 757, contains, *e*, a solid piston without any valve, moved up and down by the rod *f*. We will suppose that, at first, all these are full of air only. When the piston, *e*, descends, it will condense the air below it, which will cause the valve *k* to shut; but the condensed air will find its way out through the valve *i*, placed in the branching pipe; as soon as the piston rises, the spring of the air in the suction pipe, *a b*, will force up through the valve *k*, to supply the partial vacuum between the piston and this valve, the air being now rarefied in that place. When the piston next descends, the same effect will be repeated, and more air will be driven out through the valve *i*. But the result of rarefying the air in the suction and piston barrels at each stroke of the piston will be, that the pressure of the atmosphere on the surface of the water outside the suction pipe will force the water up into it until it rises as high as the piston, in the same way as in the sucking pump; when this happens, on the next stroke of the piston downward it will force the water through the valve *i*, in the same manner as it before did the air, and by using sufficient force, and proportioning the size of the barrels and the pipes properly, the water may be forced as high as is desired through the pipe *l*.

Fig. 757.



4703. *A better construction of a pump*, to answer the same purpose as the last, is in this manner: *a b*, *fig.* 758, is the suction pipe, with its valve, *e*, and *c d* the branch pipe, with its valve, *f*. The top of the working barrel, *g h*, is closed, but allowing the piston rod to work through it in a collar of leather, so as to be air-tight. The piston here has a valve in it opening upward, as in the sucking pump. It is obvious that this piston with its valve, and the pipe *a b*, with its valve, *e*, is really a sucking pump, and acts as such, raising the water by the pressure of the atmosphere till it reaches the piston ; but when this happens, and the piston forces down through the water so raised, raising up the piston will cause it to act as in the lifting pump ; and since the water thus lifted cannot get out through the top of the working barrel, *g h*, this being closed, it will be forced out through the branch pipe, *c d*, and its valve, *f*, and afterward through the ascending pipe, *i*. This pump is, therefore, a combination of the sucking and lifting pumps ; and it is easy to conceive that a sucking pump may be converted into this machine with little difficulty. This construction has several advantages over the last. The greatest force on the piston rod is exerted in pulling it upward instead of forcing it downward, which is less apt to bend them.

Fig. 758.

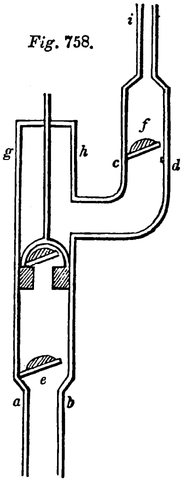
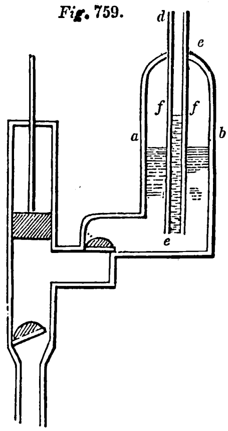


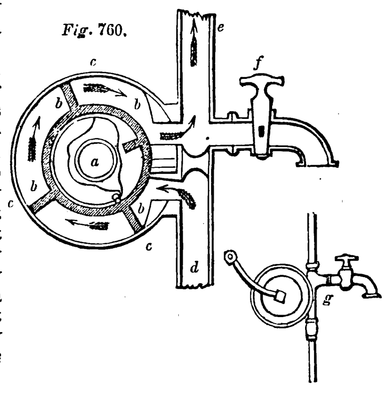
Fig. 759.



4704. *To obtain a continued stream of water*, instead of its coming in starts, an air vessel (*a b*, *fig.* 759) may be put on the branch pipe of *fig.* 757 or 758. This vessel may be of any form, but is closed at the top, and has a pipe, *d e*, descending into it. The water forced up into the branch pipe cannot escape at top, but is forced out through the small pipe, *d e*, the lower end of which is open ; and the air in the space *f f* being thus condensed there, will act constantly by its spring upon the surface of the water in *a b*, and force it out through the pipe *d e* in a constant stream, as in the fire-engine.

4705. *Siebe's rotatory pump* is found very convenient either for raising water from a tank or well, or for forcing it up to any height. This pump (*fig.* 760) operates by the rotation of a roller on its axis, *a*, having paddles or pistons, *b b b b*, by which, when the roller is turned, a vacuum is produced within the barrel, *c c c*. In consequence of this vacuum, the water flows up the rising break, *d*, into the barrel ; and as the paddles go round they force it into an opening, which conducts it wherever it may be wanted, and by that means produces a continual stream. By having an ascending tube, *e*, the water may be forced to any height ; and, by having a horizontal tube with a cock, *f*, it may be let out at pleasure, as in a common pump. By having several pipes branching from *e*, as many cisterns or reservoirs may be supplied. *g* is the external appearance of the pump.

Fig. 760.



LIST OF THE FURNITURE OF THE KITCHEN, AND OTHER OFFICES CONNECTED WITH IT.

Tables.
Chairs and stools.
Dressers.
Plate-racks.
Range, fender, and fire-irons.
Jacks for roasting.
Spits, stays, and skewers.
Bird-spits.
Meat-screen.
Sauce-pans and boilers.
Stew-pans.
Sauté-pans.
Braising-pans.
Frying-pans.
Soup-pots.
Jugging-pots.
Omelet-pans.
Patty-pans.
Digesters.
Gridirons.
Apple-roasters.

Argyles for gravies.
Steamers for ditto.
Basting-ladles.
Soup ditto.
Marrow-scoops.
Spoons of various kinds.
Beef-forks.
Cheese-toasters.
Cheese-trays.
Cheese-knives.
Bread-baskets.
Knife ditto.
Knife-boxes.
Plate-baskets lined with tin.
Bread-pans.
Cleavers.
Bone-saws.
Meat-choppers.
Hammers and other tools.
Hatchets.
Meat-knives.
Paste-cutters.
Oyster-knives.
Fish ditto.
Cucumber-slicers.
Carrot and turnip scoops.
Lobster-crackers.
Steak-beaters.
Steak-tongs.
Cooks' knives.
Cooks' scissors.
Bread-graters.
Beef ditto.
Nutmeg ditto.
Salt-strainers.
Larding-pins.
Rolling-pins.
Nut-crackers.
Lemon-squeezers.
Trenchers.
Butter-prints.
Jelly and blanc-mange moulds.
Baking-pans for bread.
Dutch and other ovens.
Iron and brass footmen.
Iron-stands.
Colanders.
Egg-coolers.
Egg-ladles.
Funnels.
Salt-boxes.
Flour and oatmeal tubs.
Flour-boxes.
Flour-dredgers.
Pepper-boxes.
Spice ditto.
Toast-racks.
Butter-forcers.
Venison-dishes.
Hash-dishes.
Dishes of various kinds.
Water-plates.
Wire meat-covers.
Coffee-pots.
Coffee-biggins.
Coffee-filterers.
Coffee-roasters.
Coffee-mills.
Sugar-canisters.
Sugar-nippers.
Sugar-dredgers.
Plate-warmers.
Sinks.
Water-filterers.
Filtering-stone brushes.
Salad forks and spoons.
Candlesticks, with snuffers and extinguishers.
Lamps, various.
Candle-boxes.
Lanterns.
Tinder-boxes.
Oil-bottles and cans.
Oil-filters.
Oil-cisterns.
Wire servants' lanterns.
Rushlight-shades.
Housemaids' gloves and leathers.
Emery, sand and glass paper.
Emery-box.
Rottenstone.
Hearthstone.
Bath bricks.
Flanders ditto.
Pipe-clay.
Masons' dust.
Silver and house sand.
Pumice.
Dust-pans, tin or iron.
Cinder and coal shovels.
Coal-scuttles, copper, iron, japanned, and wood.
Housemaids' slop-pails, tin and wood.
Cinder-pails.
Cinder-sieves.
Pumps.
Wash-hand basin.
Soap-dishes.
Soap-bowls.
Large elm bowl for washing China.
Dust-baskets.
Servants' scouring-mats.
Chafing-dishes.
Bellows.
Standing and folding steps.
Towel-horses.
Mouse, beetle, and rat traps.
Door-mats.
Warming-pans.
Stomach-warmers.
Pestle and mortars.
Plate-powders.
Plate-brushes.
Buckle and jewel ditto.
Plate-leathers.
Mahogany butler's trays for sandwiches, &c.
Stands for ditto.
Baized baskets for silver.
Decanter and cruet brushes.
Indian straw table-mats.
Punch ladles and strainers.
Plated decanter corks and labels.
India-rubber stoppers.
Crumb-brushes.
Wine funnels and strainers.
Leather aprons.
Leather and wood knife-boards.
Knife sharpeners.
Corkscrews.
Wine-coolers.
Japanned trays of various kinds.
Clothes-beaters.
Decanter-drainers.
Decanter-stands.
Boot-jacks.
Shoe-brushes.
Hair-brooms.
Carpet ditto, in whisk, hair, or whalebone.
Hearth-brooms.
Baluster ditto.
Furniture brushes.
Furniture brushes loaded.
Feather-brooms for pictures, &c.
Turk's head ditto.
Dry rubbers for floors.
Scrubbing-brushes.
Area and yard ditto.
Stove ditto.
Egg-beaters.
Packthread and twine
Paper.
Packthread boxes.
Packing-mats.
Drinking-horns.
Glove hands and stretchers.
Trimming-tray, &c., for lamps.
Bottling-machines.
Cork-drivers.
Wine-baskets.
Wine-casks.
Beer-funnels.
Beer-tilts.
Beer-stands.
Spigots and faucets.
Sawdust-shovels.
Mallets.
Clothes flaskets and baskets.
Clothes-horses.
Hair and white clothes-lines.
Washing and rinsing tubs and troughs.
Washing-benches.
Washing-trays.
Boards to stand on.
Copper-sticks.
Wash-hand bowls.
Draining-baskets.
Clothes-props.
Clothes-pegs.
Starch-sieves and whisks
Laundry-jacks.
Mangles.
Inkstands.
Horn and willow shaving for grates.
Bed-wrenches.
Bells and bell-pulls.
Table-bells.
Cash-boxes.
Tea equipages.
Napkin-presses.
White and black hair, lawn, and tammy sieves.
Drying, wire, and fruit ditto.
Wooden spoons of various sizes.
Paste-brushes.
Jelly bags and stands.
Stills.
Paste rollers and jaggers.
Biscuit-dockers.
Vegetable-drainers.
Vegetable-tubs.
Pickling tubs and trays.
Chopping boards and blocks.
Covers for dishes.
Chopping-knives.

BOOK XII.

PRACTICAL HOUSEHOLD DETAILS CONNECTED WITH COOKERY.

CHAPTER I.

MARKETING.

4706. The leading facts relative to each of the animals and vegetables used as food have been stated in Book VIII., and to that the reader is referred. The directions contained in the present chapter are intended more particularly for cooks and persons employed to market; and they ought not to be considered as unimportant, since novices in marketing and cooking must seek instruction in aid of inexperience.

Sect. I.—RULES FOR MARKETING.

4707. *In marketing, the first rule* is to purchase chiefly from known and respectable tradespeople, who are likely to go themselves to the best markets, and who have to support the character of their shops.

4708. *The second rule* to be observed is that of not purchasing inferior articles under the idea of being economical.

4709. *A bargain* is seldom a prize ; and this is especially the case in regard to butcher's meat.

4710. *The best meat and the prime parts* are unquestionably the cheapest in the end, although the first cost may be the greatest. In coarse and inferior joints there is always too great a proportion of gristle, bone, and hard meat to render them truly economic; these may serve as the basis of soups, gravies, or stews; but for roasting or boiling they are wasteful.

4711. *The criteria of bad meat*, by which must be understood meat that has been too long killed, or meat from animals killed in a state of disease, ought to be well known by those who market. no less than the value and economy of the different parts and joints.

Subsect. 1.—*Joints and Parts of Butcher's Meat enumerated.*

4712. *The bullock* is divided in the shambles as marked in *fig.* 761. The joints are not here given in the order in which they are estimated as prime or as inferior parts :

1. Sirloin; 2. Rump; 3. Edgebone; 4. Buttock; 5. Mouse buttock; 6. Veiny parts; 7. Thick flank; 8. Thin flank; 9. Leg; 10. Fore ribs; 11. Middle ribs; 12. Chuck ribs; 13. Leg of mutton piece; 14. Brisket; 15. Clod; 16. Sticking piece; 17. Shin; 18. Cheek.

Besides these parts, there are the tongue, palate, sweetbreads, kidneys, skirts, and tripe.

A baron of beef, now an obsolete joint, consisted of the two sirloins undivided.

Fig. 761.

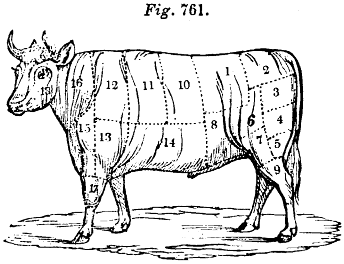
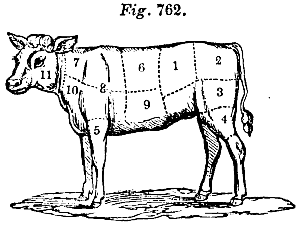


Fig. 762.



4713. *The calf* (see *fig.* 762) is divided into, 1. Loin (kidney end); 2. Loin (chump end); 3. Fillet; 4. Hind knuckle; 5. Fore knuckle; 6. Neck (best end); 7. Scrag; 8. Blade bone; 9. Breast (best end); 10. Brisket; 11. Head. To these joints must be added the *Pluck*, which includes the liver, lights, heart; sweetbreads, of which one is called the throat sweetbread, and is the largest of the two, the other the windpipe sweetbread.

4714. *Sheep, fig.* 763.—1. Leg; 2. Loin (best end); 3. Chump end of the loin; 4. Neck (best end); 5. Scrag; 6. Shoulder; 7. Breast. The loins not separated form what is termed the saddle of mutton.

4715. *The lamb* is usually divided into four parts, called the fore and hind quarters. Each fore quarter consists of a shoulder, with part of the neck and breast. Each hind quarter consists of a leg and loin. By the target of lamb is meant the ribs, when the shoulder is separated from them.

The lamb's head is generally sold with the *appurtenances*; in which last are comprehended the *liver, lights, heart, suet,* and *melts*.

The fry of the lamb contains *lambstones, sweetbreads*, and skirts, with a part of the liver.

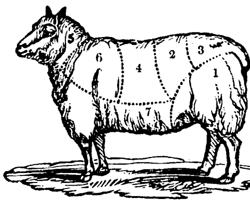
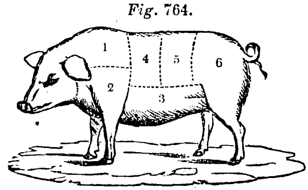


Fig. 764.



4716. *The hog*, see *fig.* 764.—1. The sparerib; 2. Hands; 3. Spring; 4. Fore loin; 5. Hind loin; 6. The leg. The head and the haslet must also be mentioned; the latter includes the liver, kidneys, and skirts. The chitterlins and guts are cleaned for sausages.

A porker is a small pig fed for eating fresh, and not for curing.

Of a bacon pig, the legs are reserved for curing, and when cured are called *hams;* when the shoulder blade and bones are separated from the meat and cured, it is called *bacon.* The bones, with part of the meat left on them, are divided into spareribs, griskins, and chines.

SUBSECT. 2.—*Choice of Meat, Fish, and Poultry.*

4717. *Beef.*—The grain of *ox beef*, when good, is loose, the meat red, and the fat inclining to yellow. *Cow beef*, on the contrary, has a closer grain, a whiter fat, but meat scarcely as red as that of ox beef. *Inferior beef*, which is meat obtained from ill-fed animals, or from those which had become too old for food, may be known by a hard, skinny fat, a dark-red lean, and, in old animals, a line of a horny texture running through the meat of the ribs. When meat pressed by the finger rises up quickly, it may be considered as that of an animal which was in its prime; when the dent made by pressure returns slowly, or remains visible, the animal had probably passed its prime, and the meat, consequently, must be of inferior quality.

4718. *Veal* should be delicately white, though it is often juicy and well-flavoured when rather dark in colour. Butchers, it is said, bleed calves purposely before killing them, with a view to make the flesh white; but this also makes it dry and flavourless. On examining the loin, if the fat enveloping the kidney be white and firm-looking, the meat will probably be prime and recently killed. Veal will not keep as long as an older meat, especially in hot or damp weather; when going, the fat becomes soft and moist, the meat flabby and spotted, and somewhat porous, like sponge. Large, overgrown veal is inferior to small, delicate, yet fat veal. The fillet of a cow calf is known by the udder attached to it, and by the softness of the skin; it is preferable to the veal of a bull calf.

4719. *Mutton.*—The meat should be firm and close in grain, and red in colour, the fat white and firm. Mutton is in its prime when the sheep is about five years old, though it is often killed much younger. If too young, the flesh feels tender when pinched; if too old, on being pinched it wrinkles up, and so remains. In young mutton, the fat readily separates; in old, it is held together by strings of skin.

In sheep diseased of the rot, the flesh is very pale-coloured, the fat inclining to yellow, the meat appears loose from the bone, and, if squeezed, drops of water ooze out from the grains; after cooking, the meat drops clean away from the bones.

Wether mutton is preferred to that of the *ewe;* it may be known by the lump of fat on the inside of the thigh.

4720. *Lamb.*—This meat will not keep long after it is killed. The large vein in the neck is bluish in colour when the fore quarter is fresh, green when becoming stale. In the hind quarter, if not recently killed, the fat of the kidney will have a slight smell, and the knuckle will have lost its firmness.

4721. *Pork.*—When good, the rind is thin, smooth, and cool to the touch; when changing, from being too long killed, it becomes flaccid and clammy. Enlarged glands, called kernels, in the fat, are marks of an ill-fed or diseased pig.

4722. *Bacon* should have a thin rind, and the fat should be firm and tinged red by the curing; the flesh should be of a clear red, without intermixture of yellow, and it should firmly adhere to the bone. To judge of the state of a ham, plunge a knife into it to the bone; on drawing it back, if particles of meat adhere to it, or if the smell is disagreeable, the curing has not been effectual, and the ham is not good; it should, in such a state, be immediately cooked. In buying a ham, a short thick one is to be preferred to one long and thin. Of English hams, Yorkshire, Westmoreland, and Hampshire are most esteemed; of foreign, the Westphalia.

4723. *Venison.*—When good, the fat is clear, bright, and of considerable thickness. To know when it is necessary to cook it, a knife must be plunged into the haunch; and from the smell the cook must determine on dressing or keeping it.

4724. *In choosing poultry*, the age of the bird is the chief point to be attended to.

4725. An old turkey has rough and reddish legs; a young one smooth and black. Fresh killed, the eyes are full and clear, and the feet moist. When it has been kept too long, the parts about the vent begin to wear a greenish, discoloured appearance.

4726. *Common domestic fowls*, when young, have the legs and combs smooth; when old, they are rough, and on the breast long hairs are found instead of feathers. Fowls and chickens should be plump on the breast, fat on the back, and white-legged.

4727. *Geese.*—The bills and feet are red when old, yellow when young. Fresh killed, the feet are pliable, stiff when too long kept. Geese are called green while they are only two or three months old.

4728. *Ducks.*—Choose them with supple feet, and hard, plump breasts. Tame ducks have yellow feet, wild ones red.

4729. *Pigeons* are very indifferent food when they are too long kept. Suppleness of the feet show them to be young; the state of the flesh is flaccid when they are getting bad from keeping. Tame pigeons are larger than the wild.

4730. *Hares and rabbits*, when old, have the haunches thick, the ears dry and tough, and the claws blunt and rugged. *A young hare* has claws smooth and sharp, ears that easily tear, and a narrow cleft in the lip. *A leveret* is distinguished from a hare by a knob or small bone near the foot.

4731. *Partridges*, when young, have yellow legs and dark-coloured bills. Old partridges are very indifferent eating.

4732. *Woodcocks and snipes*, when old, have the feet thick and hard; when these are soft and tender, they are both young and fresh killed. When their bills become moist, and their throats muddy, they have been too long killed.

4733. *Turbot*, and all flat white fish, are rigid and firm when fresh; the under side should be of a rich cream colour. When out of season, or too long kept, this becomes a bluish white, and the flesh soft and flaccid. A clear, bright eye in fish is also a mark of being fresh and good.

4734. *Cod* is known to be fresh by the rigidity of the muscles (or flesh), the redness of the gills, and clearness of the eyes. Crimping much improves this fish.

4735. *Salmon.*—The flavour and excellence of this fish depend upon its freshness and the shortness of the time since it was caught; for no method can completely preserve the delicate flavour it has when just taken out of the water. A great deal of what is brought to London has been packed in ice, and comes from the Scotch and Irish rivers, and, though quite fresh, is not quite equal to Thames salmon. For many particulars respecting this excellent fish, see Book VII., Sect. III.

4736. *Mackerel* must be perfectly fresh, or it is a very indifferent fish; it will neither bear carriage, nor being kept many hours out of the water. The firmness of the flesh and the clearness of the eyes must be the criterion of fresh mackerel, as they are of all other fish.

4737. *Herrings* can only be eaten when very fresh, and, like mackerel, will not remain good many hours after they are caught.

4738. *Fresh-water Fish.*—The remarks as to firmness and clear, fresh eyes apply to this variety of fish, of which there are carp, trench, pike, perch, eels, &c. See Book VII., Sect. III.

4739. *Lobsters*, recently caught, have always some remains of muscular action in the claws, which may be excited by pressing the eyes with the finger; when this cannot be produced, the lobster must have been too long kept. When boiled, the tail preserves its elasticity if fresh, but loses it as soon as it becomes stale. The heaviest lobsters are the best; when light, they are watery and poor.

4740. *Crab and cray-fish* must be chosen by observations similar to those given above in the choice of lobsters. Crabs have an agreeable smell when fresh.

4741. *Prawns and shrimps*, when fresh, are firm and crisp.

4742. *Oysters.*—If fresh, the shell is firmly closed; when the shells of oysters are opened, they are dead, and unfit for food. The small-shelled oysters, the Pyfleet, Colchester, and Milford, are the finest in flavour. Larger kinds, called *rock oysters*, are generally considered only fit for stewing and sauces, though some persons prefer them.

Subsect. 3.—*Purchase of Grocery.*

4743. *In the purchase of grocery at a retail shop*, it does not appear that any advantage in price results to the housekeeper from laying in large stores at once, though the practice may, in some situations, be convenient. The retail grocer being compelled to market for his goods with ready money, and finding also great competition in his trade, is induced to put at once on his goods the lowest profit he can afford to ready money customers. To those requiring yearly or half yearly credit, he adds such a per centage as may remunerate him in the end for the slow return of his capital, and for the risk incurred of making bad debts; this additional charge is only just, and is done in every other retail business. Thence the economy, in most cases, of ready money purchasers.

4744. *In purchasing grocery from the wholesale dealer*, a family may occasionally gain some advantage in price; but to do it uniformly would not be convenient or desirable, either to the buyer or the seller. A quick consumption is desirable of the finer articles of grocery, especially those with aromatic properties, which exposure to the air dissipates. Thence family stores, which are slowly consumed, are daily impairing in quality, excepting only some few articles, which are supposed to improve by that exposure. By purchasing from the retail dealer this inconvenience is avoided. With some other articles of family consumption, besides grocery, the case is different, and of these it is best to keep a quantity in the store-room.

4745. *Tea.*—For the genuine characters of tea, under the two principal classes of Souchong and Hyson, together with those of coffee, in its division into the various kinds, and also chocolate and cocoa, we refer the reader to Book VIII. As a security against the adulteration of tea, many persons have purchased, through the means of brokers whole chests of tea; but there is a risk of the tea losing its flavour by exposure to the air when so much is purchased, and should the whole chest prove indifferent, there is no power of exchange. The tea market has, however, undergone great changes of late in consequence of the gradual opening of the tea trade; these changes are still going on, and, until the markets are more settled, little can be said on the subject of price.

As a rule, it may be here laid down, that whatever articles can be purchased in an unground state, such as coffee, rice, ginger, pepper, and spices, are better than those purchased ground, not entirely from the suspicion of buying adulterated articles, but because all these articles lose their flavour more rapidly when ground than when whole.

4746. *Sugar.*—For the full account of this we refer the reader to Book VIII., where the different kinds are described. *Loaf or refined sugar, when good,* is of a close texture, of a fine, white gloss, and simply sweet to the taste, without other flavour; when inferior, it is coarse and loose in grain, crumbles easily, is a little yellowish in colour, and its sweetness has something of the taste of moist sugar. *Moist sugar,* when good and unmixed with adulterating articles, is bright, and composed of crystallized grains. A dull-looking moist sugar is always one of an inferior and doubtful quality. Casks of moist sugar are sometimes procured, by families whose consumption of sugar is great, of the wholesale grocer, at a reduction of 2*d.* per pound. The price of sugar, as well as many other articles of grocery, is too fluctuating to be stated usefully.

4747. Of *rice,* there are several kinds in the market. East India rice is generally small in grain, and yellowish in colour; but some of it is excellent. The *Carolina* is large in grain, and perfectly white in appearance. Of rice it is rarely desirable to purchase large quantities. The larvæ of a fly sometimes infests old rice, and injures it materially. *East India* rice is generally lower in price than that of West India.

4748. *Raisins, currants, figs, French plums,* are dried fruits, which ought to be clean and dry, yet fresh in appearance. When adhering together in lumps, they cannot be regarded as good in quality, and in use would prove wasteful. For a description of the various kinds, see Book VII., Chap. IX.

The Muscadine raisins are dried in large bundles, and have a dry surface with a slight bloom upon them. They are chiefly used for dessert, and are sold at the grocers' under the term "table raisins." The jar or sun raisins are separated from the stalks when dried; and, as well as the Malaga, are chiefly in domestic use for puddings, cakes, &c.

Currants should be new when purchased for stores. They are to be bought new generally in September or October. When currants are offered at a very low price, it may be fairly suspected that they are of the last year's importation, or are of Spanish growth, and not the product of the genuine vines of Zante or Cephalonia.

4749. *Arrow-root.*—In the purchase of this article it should be observed that when very smooth and floury it may be suspected to contain some portion of the starch either of wheat or potatoes; which, although not injurious, does not possess all the valuable qualities ascribed to the genuine arrow-root, in thickening and jellying properly the liquid with which it is prepared for use. A tea-spoonful of real arrow-root will thicken a tea-cupful of hot water or milk, while double the quantity of adulterated arrow-root would be required to jelly the same quantity of liquid. The pure arrow-root is from 2*s.* 6*d.* to 3*s.* 6*d.* per lb.

4750. *Ginger* is of two kinds: the superior is called *white ginger,* the inferior *black.* (For the difference between them, see Book VII., Chap. X.)

4751. *Pepper* should not be purchased in large quantities by any one who has not a quick consumption of it, as the strength of it, especially when ground, is constantly lessened by exposure to the air.

Cayenne pepper is sometimes adulterated; see Book VII., Chap. X. *Of cloves,* such should be selected as have a strong fragrant odour, and a hot, aromatic, yet pungent taste. *Nutmegs* are chosen by weight, the heaviest being the best. *Mace,* when good, is very unctuous to the touch, flexible, and thin; it resembles the nutmeg (of which it is the outer coating) in odour and taste, but is not equally pungent. In the purchase of *cinnamon,* it is necessary to know that a spurious kind is often sold, called *cassia.* The distinctive marks between cinnamon and cassia are chiefly these: cinnamon is pliable, and breaks in long splinters; cassia is brittle, and when broken, the fracture is not splintered, but closes, and reveals two distinct coatings, the inner one of which is dark, and possesses a fragrance similar to that of the cinnamon, the outer coating being paler in colour, and utterly tasteless. Cinnamon is thin as paper, cassia thick and spongy.

4752. *Candles,* excluded from the light, and stored in a cool, yet dry place, are generally improved by a year's keeping.

Moulds are of various thicknesses; *three* to the pound are the largest usually made for domestic use; *short fours* are the next size; then follow in thickness *long fours, short sixes, middling sixes, long sixes,* and *eights.* These last are chiefly used as bedroom lights, or to carry about a house.

The dips are from four to sixteen to the pound. The moderate size of the tens or twelves are such as serve best for kitchen and pantry use, and to carry about a house where oil and lamps are not used.

Wax candles improve by keeping; and exposure to the light, which is injurious to tallow, blanches them. *Spermaceti candles* are considerably cheaper. See the different kinds of candles described in Book IV., Chap. III.

4753. *Soap* is an article better bought wholesale than retail. It improves in quality by being kept. It is seldom bought in a dry state. The dealer in soap is aware of the advantage he gains by storing it in damp places from the moisture, which adds materially to its weight. Soap, when in a proper state, should contain no more than thirty parts in a hundred of water; by nefarious management, an unfair dealer will make it to hold sixty; consequently, when the purchaser has it cut into pieces and laid on open shelves to render it dry and hard, it sustains a considerable loss in weight. For the laundry and household use there are three kinds: the *hard yellow*, the *soft*, and the *hard mottled soap*. On the subject of Soaps, see Books XIX. and XXII.

Sect. II.—Style and Management of the Table.

Subsect. 1.—*Carving.*

4754. *Carving*, in primitive as in modern times, was the office of the master of a feast. In the days of Roman refinement, carving became a distinct office in each distinguished family. In modern times the office of carver has not been unknown; and in royal establishments it has, in some instances, been hereditary. In France, skill in carving, from the description of the dishes served, is scarcely necessary; and thence the task has fallen on the principal attendants at table, a custom gradually finding its way into distinguished and fashionable circles in this country. Fifty years ago the art of carving was regarded by the most polished society in this country as the indispensable accomplishment of every lady who had to preside at the head of her table. It was a reflection upon her fitness for that post to say that she managed the carving-knife with little skill, or was ignorant of the choice parts of each dish. A different opinion has since been introduced by fashion; and the office of carving is assigned to gentlemen chiefly, on the ground that, in good society, of which right feelings should be the spirit, all trouble and inconvenience should devolve in every possible case on gentlemen rather than on ladies, who, on their part, should be disengaged, and ready to sustain and direct the conversation of the company. This order of the table is now universal; gentlemen are the carvers, except in those families already noticed, in which the carving is done at the side tables, by the principal attendants. Carving should not be considered as confined to the cutting up, according to certain rules, the different joints and dishes, but as consisting also in a judicious distribution of the same. To carve neatly is an economical as well as an agreeable art; a truth evident to those who have seen good joints of meat so hacked and cut to pieces as to afford scarcely half the supply of slices which, in the hands of skilful carvers, they would have yielded.

4755. *The carving-knife* should be of good steel, capable of having its sharp edge renewed; for unless it be sharp, to carve well would be impossible; neither should it be heavy to handle. The haft should be firmly grasped, though in carving strength is not, in many cases, so necessary as skill and a good knife, especially if all joint bones be properly dislocated by the butcher. The dish must not be too distant from the carver, or the arms will be too much extended, which will give an awkward appearance to the person, and render the task before him less easy in its accomplishment.

Subsect. 2.—*Directions for Carving.*

4756. Fish should be carved with a fish trowel, by which the flakes may be separated without being broken.

4757. *In a cod's head and shoulders*, the first piece may be taken off, *a*, *fig.* 765, in the direction of *a b*, by putting in the fish trowel at the back of the thick part of the fish; other slices may be taken off in a similar direction. A small portion of the sound should be given with each slice; it will be found lying close to the back bone, on raising the thin flap, *d*, and known by its being transparent, and of a darker colour than other parts of the fish. Almost every part of a cod's head is considered as good eating; such as the palate, tongue, and the jellied as well as the firm parts, *e e*, upon and immediately around the jaws and bones of the head. The green jelly of the eye alone is never eaten.

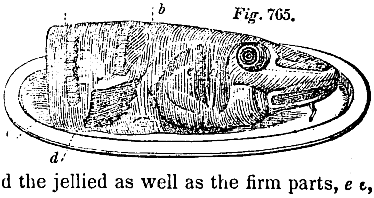


Fig. 765.

4758. *In a piece of boiled salmon*, *fig.* 766, the under part is richer and fatter than the upper and thick parts of the fish; a slice of each is usually sent on each plate. The slice from the thick part is taken in the line *a b*, and the thin slice in the direction *d c*. The skin is always sent with each slice, both of which must be cut thin.

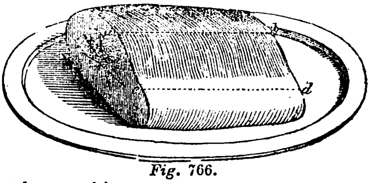


Fig. 766.

4759. *In turbot* the fish trowel is to be entered at the head, and passed along the back bone to the tail; the slices are then taken from the back bone to the fins on each side, those from the centre being considered as prime. When the upper side is thus disposed of, the back bone must be lifted up with the fork, and the under part divided in the same manner. *Of the fins*, the most prized parts of the fish, a portion is given with each slice.

4760. *Mackerel* is usually slit down the back, and the whole side taken off at once, with the exception of the part near the gills, which is generally black and ill-flavoured. The tail end of this fish is by some considered the choice part, the middle pieces by others. With the exception of cod and carp, the palate of which last-mentioned fish is esteemed as a great delicacy, the heads of fish are seldom liked. The roe of the male mackerel is soft; that of the female hard and full of eggs.

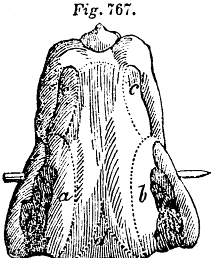
4761. *Eels* are cut into pieces through the bone, the thickest pieces of which are considered as the best.

4762. Of the *lobster* the tail is thought to be the prime part; the claws rank next to it.

4763. *Carving poultry and game* requires more practice and skill than any other dishes which are brought to table.

Fowls, either roasted or boiled, whichever way they are dressed, are cut up in the same manner. The fork (*two-pronged*) is fixed firmly into the breast, on each side of which a cut is made the whole length of the fowl, and parallel with the legs and wings. The wings are taken off in the direction *a* and *b*, *fig.* 767, by dividing the joint with the knife, and drawing it away with the fork. After cutting the ligaments at the joint of the leg, *c*, the bone may be easily twisted out of the socket, and removed from the body of the fowl. The wings and legs being thus separated from the rest of the fowl, the knife must then be entered at the breast, in the direction *d*, by which the merrythought may be displaced, after the knife has been slipped under it, and the bone lifted up, and pressed backward towards the dish. The collar-bones, *e e*, lie on each side of the merrythought, and must also be lifted up by the knife at the broad end, and forced towards the breast bone till the part breaks off to which they are fastened. The breast is cut off by cutting through the ribs on both sides. The back bone is then turned upward, and the knife passed firmly across it near the middle, the fork being, at the same time, employed in raising up the lower end towards the knife, and thus dislocating the back almost in the centre. The lower end of the back is then turned from the carver, that the bones on each side may be taken off; the exact place in which these side bones are joined to the vertebræ will be easily found by the point of the knife. The prime parts of a fowl are the wings, breast, and merrythought. The legs, except of young fowls, are considered as coarse. The thigh part, when separated from the drumstick, is sometimes preferred by those who consider the whiter meat of the fowl as insipid.

Fig. 767.



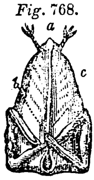
4764. *Ducks* are cut up like fowls, and have the same prime parts. The wing and leg of *ducklings* are sometimes taken off without being separated, if both together do not form too large a portion for one serving.

4765. *Turkey and goose* have slices cut from the breast lengthwise. In carving either of these kinds of poultry, the chief art consists in cutting as many slices as possible, no attempt being usually made at table to separate the joints of these large birds. By beginning to cut the slices at the wing, and proceeding upward towards the ridge of the breast bone, many more slices may be obtained than by the more usual plan of cutting them from the breast bone down to the wing. No parts of the turkey are considered as prime except the slices from the breast. The legs are dark-coloured, and have none of the delicacy of the breast; but, when *devilled*, they are relishing and generally liked.

4766. *Of a goose* every part is juicy and good; the breast, however, is the most esteemed.

4767. *Pigeons* are cut through the neck, *fig.* 768, straight through the whole bird, dividing it into two equal parts. They may also be divided, and it is the more modern way, from *b* to *c*. The *croup*, or lower part, with the thigh, is preferred to the upper half of the pigeon.

Fig. 768.



4768. *Game.—The breast of the pheasant* is sliced like that of the turkey, and the rest of the bird is cut up like the common fowl. In taking off the wing a little difficulty sometimes occurs, and is caused by attempting to enter the knife too near the neck bone. from which the wing has to be separated: but here practice only can enable the carver to find out readily the precise point which his knife is to attack. *Breast, wings*, and *merrythought* are the prime parts; the brains are also prized by the true lovers of game.

4769. *The partridge* is cut up like a fowl, with the exception of the breast, from which the merrythought is not separated unless the bird is larger than common. The wing is the prime part, the tip of which is considered as particularly delicate. Of almost all birds the breasts and wings are the prime parts, except in the woodcock, the heathcock, and gray hen, of which the legs are esteemed the most delicate part.

4770. *Hare* may be carved in two ways: when young, the knife may be entered near the shoulder, at *a*, *fig.* 769, and cut down to *b* on each side of the back bone. This done, the hare will be in three parts. The back is to be again divided into four parts according to the dotted lines in the cut. These divisions of the back are, with the legs, the best parts, although the wings (shoulders), called the sportsman's portion, are prized by some. They are taken off easily in the direction of *c d c*. The parts, each laid neatly on a plate, are served with stuffing, gravy and currant jelly, and melted butter. In an *old hare* the division down the back cannot be attempted, as the hardness of the bone would turn the edge of the knife; instead of which fillets of meat are cut away from the sides, and distributed in moderately-sized pieces. The legs and wings are then cut off; the neck separated from the trunk, which may be divided, at different parts of the vertebræ, into three parts. From the tail end division of the back two side bones may also be separated. If the brains are asked for, the head must be cut off from the neck, and, with the fork, it must be fixed firmly to the dish. Then the point of the knife may be entered at a vulnerable part of the head, which it will readily cleave in two. In the cavity the brains will be seen and easily taken out.

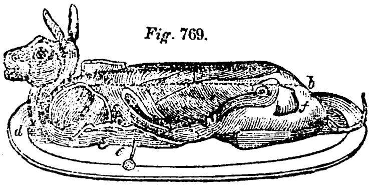


Fig. 769.

4771. *Rabbits* are carved in the same manner as hares, with the exception of the back, which is divided into two parts only, and which, with the legs, is considered as the most delicate part.

4772. *Butcher's meat*, in carving, chiefly requires a good carving-knife and a little practice. The general custom is to cut slices of beef (particularly boiled beef) and veal rather thin; mutton and pork somewhat thicker.

4773. *In a sirloin of beef* the inside meat should be cut across the joint; the outside, lengthwise with the bones. Meat from ribs of beef is cut in thin slices lengthwise with the bones, unless the meat is boned and rolled, when it is cut as a round of beef.

4774. *Of a leg of mutton* the first slice should be taken out, as at *a*, *fig.* 770, between the knuckle, *b*, and the thick end. Other slices may be cut in the same direction, till the knife is stopped by the cramp bone, *c*. The leg is then turned round, and slices are taken lengthwise from the thick end towards the knuckle. The best slices in a leg of mutton are from the upper end, although the parts about the knuckle are sometimes preferred, and which it is desirable should be eaten while hot, being hard, dry, and less agreeable when cold.

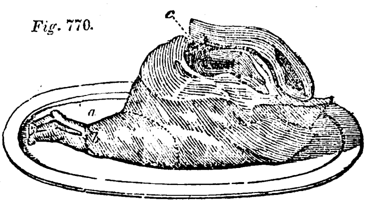


Fig. 770.

4775. *A haunch of mutton and a haunch of venison* are sent to table with the outside of the leg uppermost, and are each carved alike, being cut down to the bone in the direction of the line *a b c*, *fig.* 771, by which means the gravy escapes into the dish. The broad end is then turned towards the carver, who cuts deep in from *b* to *d*, and gives with each slice a due proportion of fat, which lies chiefly on the left side of the line *b d*. The fat of venison is esteemed as a great delicacy.

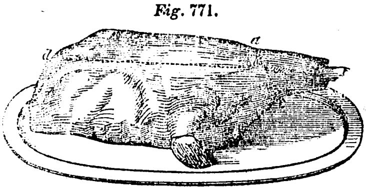


Fig. 771.

4776. *The saddle of mutton* is considered as a prime joint, but not an economical one, much of it consisting of fat and bone. It is carved in slices taken lengthwise with the bone.

4777. *In a fore quarter of lamb* the shoulder is first separated from the ribs or target, upon which a small piece of butter, some lemon juice, pepper and salt, are sometimes put, and the shoulder is then replaced for a time. The brisket is cut off from the ribs, and divided into small pieces; according to the choice of those to be served, the different parts of the quarter are distributed. The ribs under the shoulder are the choicest parts.

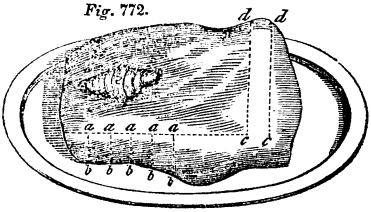
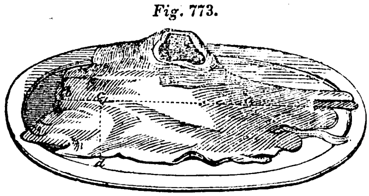


Fig. 772.

4778. *A breast of veal* (roasted) should be cut down quite through in the first line on the left of *d c*, *fig.* 772, and then in the line *a c*, thus separating the two parts of the breast, *brisket* and *ribs*. The brisket is again divided in the lines *a b*. It is preferred by some to the rib bones, which last are separated from each other in the lines *d c*. With this joint the *sweetbread* is often roasted, and is distributed in small portions with the meat.

4779. *In a boiled calf's head* there are many choice parts. The first cut, in the direction *c b*, *fig.* 773, is along the cheek bone in the fleshy part. At the end of the jaw bone lies the *throat sweetbread*, esteemed the best part of the head, and to be cut out in the direction *c d*. The *eye part*, also a delicacy, is cut out from its socket, *a*, by forcing the point of the carving knife down to the bottom on one edge of the socket, and cutting quite round, keeping the point of the knife slanting towards the middle. *The palate*, another choice part, is found on the under side of the roof of the mouth, a crinkled, white, thick skin, which is easily cut away from the bone. Some good meat and fat (of which many are fond) may be met with on the under side, covering the under jaw, and near the ear. The tongue and brains are usually served in a separate dish, but are eaten with the meat. The root end of the tongue is reckoned the best.

Fig. 773.



4780. *A ham* is generally cut in the direction *a b*, *fig.* 774, down to the bone, and through the prime part of the ham. Another mode is to cut a small hole at *c*, and to pare out of it thin circular slices. The best part of the ham is thus begun upon immediately, without the gravy escaping into the dish, the loss of which is the cause of cold ham eating dry.

Fig. 774.

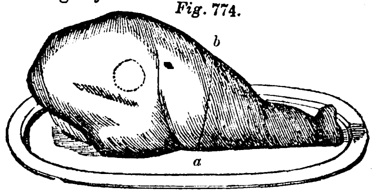
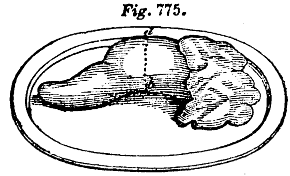


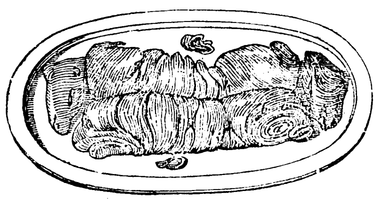
Fig. 775.



4781. *A beef tongue*, *fig.* 775, is cut across in the line *a b*, whence slices of moderate thickness are taken on each side, those midway between the root and tip being most juicy. The feet and kernels, liked by many people, are cut away from the under side.

4782. *A roasted pig* is never sent whole to table, but cut up and laid on the dish, in the manner represented in *fig.* 776, and the dish garnished with the chaps and ears. The shoulder and leg, at each end of the ribs, must be separated from them by passing the knife under each in the circular direction of the dotted lines *c d e*. The triangular piece of the neck, to be cut off in the line *f g*, is the most approved part; next to which are the ribs, divided in the lines *a b c*; and to these, some parts of the leg and shoulder.

Fig. 776.



4783. *In helping to fruit tarts*, it is usual to cut the pastry into triangular pieces; and care should be taken that, in distributing the fruit and sirup, an equal portion be given to each piece of crust.

4784. *A trifle*, composed of layers of sweetmeats and cakes, should be cut with a spoon down to the bottom of the dish, and the mass should be lifted up and laid on the plate, without disturbing it or shaking it up, as is frequently done.

SECT. III.—ARRANGEMENT OF THE TABLE AND ORDER OF THE COURSES.

4785. *In treating of the management and arrangement* of the table, it will be requisite to propose bills of fare, to determine the number and order of the courses, and the position of each dish on table, according to the prevalent style of the day.

It may be imagined that the different circumstances in which the various circles of social life are placed call for standards as to expense and style appropriate to each; but on such it would be difficult to determine. Every principal of a family must decide for himself as to the limits of his table expenses. Here the design is to describe the general style of the day, without neglecting to give such details as in practice may be adopted or rejected, limited or extended, according to the taste and judgment of the different individuals who may consult this work.

4786. *The general style of the table*, in fashionable circles, is lightness and elegance, variety in the dishes, and delicacy to the eye and the palate. The table no longer "groans under the weight of barons and sirloins of beef," nor does it present in one view the same crowded picture of substantial fare as in olden times. The variety and number of dishes of which, in the present day, a dinner is composed may not be inferior to those of former days, but they are not exhibited at once; they are presented at different intervals of the dinner in the form of courses and removes.

The style of the table, in the houses of the affluent and fashionable, is the same every day, no variations occurring but such as the seasons, or the fluctuations in the numbers of the daily party, render necessary or desirable. In such houses, cooks regularly trained to the business of the table, accustomed to draw up bills of fare for each season, as well as to prepare the principal dishes, and to superintend the whole kitchen department, are indispensable members of the household. To such the directions, observations, and receipts here given may be of less value than to cooks living in families whose table, on ordinary days, is simply and plainly served, but which is distinguished, when dinner parties are given, by more display, and by choicer cooking and arrangement.

4787. *The style of the daily table*, in families of the middle rank, is determined often by circumstances of choice, convenience, and economy, rather than by considerations of elegance and style, although, in many cases, attention to these might be given without additional expense being incurred; and, by increasing the comfort and refining the habits of a family circle, it might be one means of giving a tone to its taste and manners consistent with the cultivation of mind now generally attained. Attention to the every-day style of the table is an improvement to servants also, rendering less instruction and prompting necessary when any extra attention to propriety and nicety is called for.

Order of the Courses.

4788. *Dinners in good style* consist of either two or three courses: the first, fish and soup; the second, of meats variously prepared, and of which the side and corner dishes are called *entrées;* the third of game, when in season, with flank and corner dishes, called *entremêts* by the French, consisting of jellies, creams, pastry, and other confectionery; vegetables, dressed *à la François*, are also sometimes introduced as *entremêts.*

4789. *In a dinner of two courses*, *fish* and *soup* are often brought in with the entrées at the flanks and corners, and are removed by dishes of meat or poultry. In the most fashionable dinners there are generally two removes of the principal dishes in each course; each must consist of the same number of dishes; for instance, if in the first course there are six entrées, in the second there must be six entremêts.

4790. *In the first course the principal dishes* are usually of English cookery, *the entrées* of French. A centre dish, such as cold game pie, or other savoury pie, may, without impropriety, remain on the table till the removal of the second course; when it is to be left during the course, it is called in the bill of fare a *dormant.*

Symmetry in the order of the dishes must be preserved. Thus, puff pastry on one side should have a corresponding dish on the other of short pastry. In all cases opposite corners should have corresponding dishes.

4791. *In second courses* the flank or side dishes may have vegetables prepared in the French style, and be removed by fondus soufflé, &c.; or, in smaller dinners, when flank dishes are omitted, two of the corners may consist of vegetable entremêts, the other two of sweet dishes.

4792. *The bill of fare* of each course should be neatly drawn up on a porcelain slate, and placed at the head of the table for the convenience of the presiding lady.

4793. *The butler* should also be provided with a bill of fare, as on him devolves the charge of removing and placing properly each dish.

BILLS OF FARE.

TABLE FOR 14, 16, OR 18 COVERS.

First Course.

	Potage à la Condé. 1st remove, Turbot (lobster sauce). 2d remove, Beef à la Flamande.	
Casserole of minced fowl. Sauce au velouté.		Oyster patties.
Fillets of rabbits à l'Espagnole.		Partridges, aux choux à l'essence.
Potage à la Brunoire. 1st remove, Slices of broiled salmon. 2d remove, Fowl à la Montmorenci.	Plateau.	Purée of hare. 1st remove, Fillets of fried soles. 2d remove, Ham glazed à l'essence.
Scolloped fillets of fowl (and Truffes).		Rissole of game.
Patés en timbale.		Croustade of woodcock.
	Potage à la Reine with vermicelli. 1st remove, Slices of cod. 2d remove, Loin of veal roasted and glazed.	

Second Course.

	Roasted fowl (garnished with cresses). Remove, Fondu of cheesecake.	
Maccaroni (à l'Italienne).		Poached eggs (clarified gravy).
Spinach (à la crême).		Broccoli (au velouté).
Roasted snipes.	Plateau.	Roasted woodcocks.
Remove, Soufflé (of arrow-root and citron).		Remove, Soufflé (of rice à l'orange).
Jelly (de Noyeau rouge).		Italian cheese (à l'orange).
Charlotte of apples and apricots.		French tourte.
	Larded pheasant (roasted). Remove, Rameguires (au Parmesan).	

TABLE FOR 12 OR 14 COVERS.

First Course.

	Potage à la Condé. 1st remove, Brill (shrimp sauce). 2d remove, Turkey (boned and stuffed with a tongue).	
Cotelettes (à la soubise).		Salmi de perdrix.
Vol au vent d'escalopes de cabilleau (à la crême).	Dormant.	Casserole au ris d'un hachier de gibier (au fumez).
Escalopes de la preaux (à la Conté).		Cotelettes de fillets de poulets gras (en epigramme).
	Potage (la Brunoire). 1st remove, Slices of salmon (broiled). 2d remove, Saddle of mutton (venison sauce).	

Second Course.

	Two woodcocks (roasted).	
Truffes entieres (au vin de Champagne).		Lobster salad.
Les epinards au consommé (garni do croutons).	Dormant.	Cardons à l'Espagne à la Moelle (à l'essence).
Gateaux (à la Polonaise) garni de confitures.		Jelée d'orange.
	Two partridges.	

TABLE FOR 8 OR 10 COVERS.

First Course.

	Slices of cod (oyster sauce). Remove, Curry of veal.	
Cotelettes de poulardes.		Oyster patties.
Spinach (au consommé).	Plateau.	Beans (à la Lyonnaise).
Vol au vent (with ragout).		Rabbits sauté.
	Clear gravy soup. Remove, Haunch of Welsh Mutton.	

Second Course.

	Three quails. Remove, Soufflé (de fleur d'orange).	
French tourte d'abricot.		Madeira wine jelly.
Curdons (in essence of marrow).	Plateau.	Mushrooms croutés.
Italian jelly.		Beignets de framboises.
	Pheasant. Remove, Maccaroni.	

TABLE FOR 6 OR 8 COVERS.

First Course.

	Potage Printanniere. Remove, Calf's head (du prits certain).	
Fricassée of chicken.		Fillets of fowl (sauté au sauce suprême).
	Plateau.	
Casserole of rice, with brown ragout.		Patties or vol au vent.
	Fillets of fried soles, shrimp sauce. Remove, Saddle of small mutton.	

Second Course.

	Fowl, roasted (garnished with capers). Remove, Soufflé (with lemon peel).	
Asparagus, plain butter.	Plateau.	Cauliflower, sauce velouté.
Blancmange.		Orange jellies.
	Three quails, roasted. Remove, Rameguires.	

ANOTHER TABLE FOR 6 OR 8 COVERS.

First Course.			Second Course.		
	Vermicelli (white soup). Remove, Salmon (lobster sauce).			Fowl à la Tergue. Remove, Savoury omelettes.	
Beef palates (purée of cucumbers).	Plateau.	Sweetbreads (sauce à la financiere).	Vol au vents of sweetmeats.	Plateau.	Beignets d'Abricot.
Granadins de veau.		Cotelettes à la soubise.	Jelée de frais framboises.		Italian cheese.
	Asparagus soup. Remove, Braised leg of mutton.			Neck of venison (roasted). Remove, Soufflé de citron.	

FAMILY DINNERS FROM 8 TO 12 IN NUMBER.

First Course.			Second Course.		
	Soup (vermicelli). Remove, Boiled fowl (white sauce).			Maccaroni pudding.	
Pease.		Cauliflower.	Custard and codlings.		Stewed pears.
Ham (glazed).	Plateau.	Beef palates (and cucumbers).	Cheese cakes.	Plateau.	Puffs.
Mashed potatoes.		Young potatoes.	Jelly.		Rice, Blanc-mange.
	Roast haunch of mutton (sweet sauce).			French tourte of currants and raspberries.	

FAMILY DINNERS FROM 8 TO 12 COVERS.

First Course.			Second Course.		
	Clear gravy soup. Remove, Cod's head and shoulders (oyster sauce).			Omelette.	
Beef palates.		Rissole of game.	Jelly.		Custards.
Fowl, or rabbit curry, with rice.	Plateau.	Mutton chops (à la Maintenon).	Lobster salad.	Plateau.	Rissole of potatoes.
Sweetbreads (fricassèe sauce).		Minced veal (and mushrooms).	Apple fritters.		Cheesecakes.
	Roast beef.			Roasted pheasant.	

SECT. IV.—PREPARATION OF MEAT, ETC., FOR COOKING, AND DIRECTIONS FOR COOKING PROCESSES.

SUBSECT. 1.—*Instruction for young Cooks.*

4794. *Instruction* in the elementary details of cooking must always be essential to young cooks, who, in the outset of their life of service, require some quicker mode of obtaining the knowledge of their duties than their own experience could give them. Young servants have not, in the present day, so much practical instruction from their mistresses as was the case in former times, when all ladies, except those of the highest rank, superintended and assisted in the preparations for " well-served tables."

The chief processes in English cooking are *boiling*, *stewing*, *roasting*, *frying*, and *broiling*. Directions for each will be found in the following subsection :

SUBSECT. 2.—*Particular Directions for Cooking Processes.*

In Book XI., Chapter II., we gave the rationale of the several processes employed in cooking. We now proceed to give particular directions for the cook.

4795. *Boiling.*—Meats, whether salted or fresh, should be put, when they are to be boiled, into sauce-pans of cold water, that the meat may gradually grow warm as the water increases in heat. The quantity of water in which meat is boiled should be sufficient to cover it, but no more ; and as it wastes away in boiling, the cook should frequently renew the quantity by adding a cup of warm water to it. If she add cold water she checks the boiling of the water considerably, and the time allowed for boiling it is thus wasted. Water in which meat is boiling throws up a scum, which must be skimmed off as fast as it rises. If this be not done, the neglect will be apparent in the black streaks which will settle on the meat in serving.

As soon as the water boils, the sauce-pan or kettle containing it should be drawn off the fire, but placed near enough to it to keep it *simmering*. Meat is more thoroughly cooked by gentle than by fast boiling, which hardens it.

The allowance of time for boiling meat, and for roasting also, is, in the summer, at the rate of a quarter of an hour to one pound of meat ; in the winter, twenty minutes to the pound.

Salt and dried meats, such as briskets of beef, hams, and tongues, require very slow boiling ; and hence much more time must be allowed for them than for fresh meats. Old meats, such as beef and mutton, require a less allowance of time both for roasting and boiling than do the young meats, such as veal and lamb. The reader is referred to p. 863 for a table of time for boiling, roasting, &c.

4796. *Stewing.*—The water into which the meat has been put to stew should be allowed to boil, and should be kept boiling until the scum ceases to rise, and has been carefully removed. The sauce-pan must then be covered closely and placed near enough to the fire to keep the contents simmering, or to one regular, moderate temperature, until the meat is become as tender as the nature of the dish of which it is to be the basis requires.

4797. *Roasting.*—Slow roasting is as desirable as slow boiling; and, that the process should commence gradually, it is desirable to put the joint down to roast very soon after the fire has been supplied with the quantity of fuel which the roast in question will require to be consumed before it is sufficiently done. By putting down the meat before the whole mass of fuel is ignited, the heat, increasing by degrees, communicates itself to the meat in the same gradual manner, and in due time reaches the interior of the joint.

The fire should always be proportioned to the size of the joint to be roasted: that which is but just sufficient to roast a noble sirloin will parch up a lighter joint.

Before the meat is put down, the lower bars of the fire should be raked and cleared of every smoky coal in front.

The distance at which meat should be put from the fire is from nine to twelve or thirteen inches. At the farthest point it should be put at first, and brought closer by degrees.

The fat, as well as those parts of a joint in which there is no great thickness of meat, should be protected from the full force of the fire requisite for the other parts, by having paper skewered over them, or by covering them with a coarse paste of flour and water, fastened on with paper and string. This latter mode is very commonly employed by professed cooks, and taken off only in time to brown and froth the meat. When a paper cover is used, it should be fastened on with twine rather than skewers, which allowing it to start from the meat toward the fire, it becomes scorched, and distastes and colours the surface of the joint.

4798. *The time allowed for roasting* varies according to circumstances; *old meats*, beef and mutton, require less roasting than young.

Fat meat requires more roasting than lean. The usual allowance of time is a quarter of an hour to each pound of meat; but Dr. Kitchener recommends twenty minutes to be given, and it is desirable to add five minutes to this allowance when cold weather affects meat, or when meat is too recently killed.

4799. Other details respecting roasting must here be noticed. *Basting*, *browning*, *frothing*, and *dredging* are each of importance to the success of roasting, whether of meat, poultry, or game.

Basting is the act of moistening meat, while before an open fire, with certain ingredients which assist the roast, prevent its juices from being dried up, the meat from becoming insipid, and its surface from being scorched. Meat should be basted about every ten minutes at first, and towards the close of the roasting still more frequently. Beef and mutton, while roasting, yield generally sufficient dripping, with which they may be basted. Veal and poultry being of a dry nature, require an addition of butter, dripping, or suet, in order to have a sufficient basting for them.

To some meats flavoured bastings are used. Mutton and lamb are sometimes basted with claret and sweet herbs and butter. *A hare* is basted usually with salt and water, or with milk for the first half hour; afterward this is poured away, and butter substituted. *For basting pig*, Dr. Kitchener recommends cream and melted butter. *For veal* and other white meats, the yolks of six eggs, grated biscuits, and the juice of an orange. For all common roast, butter, clarified suet, or dripping are the most usual bastings.

4800. *Browning meat* should commence when the meat is half done by stirring the fire and making it brisker. When a good brown is not obtained, the appearance of the joint will be improved by the addition of a glaze.

4801. *Frothing* is done a few minutes only before the meat is served. As soon as the steam of the roast draws towards the fire, showing that the meat is sufficiently roasted, the cook should lightly, but uniformly, dredge with flour the whole surface of the joint, and immediately baste it with butter or dripping. The briskness of the fire should be increased by stirring, and in three minutes the meat should be taken down and served. *Poultry*, *game*, *veal*, and *lamb* should be frothed with butter; for beef or mutton, dripping answers as well. The object of *frothing* is to plump up the skin of meat or poultry, by which the appearance of the joint is much improved.

4802. *The dredgings* used in frothing are sometimes composed of other ingredients besides flour, as a means of giving some particular flavour to the meat. Of dredgings, there are, 1st, flour and grated bread; 2d, sweet herbs, dried, powdered, and mixed with flour; 3d, sugar finely powdered, and mixed with pounded cinnamon and grated bread 4th, lemon peel, dried, pounded, and mixed with flour; 5th, fennel seed, corianders, cinnamon, and sugar, finely beaten, and mixed with grated bread.

In roasting joints of which the meat is thick, it is desirable that heat should be only gradually applied. But in broiling the case is different; the quicker the process the better. Drying up the juices is to be avoided, as it hardens also the fibres of the meat; hence the degree of intensity of the fire must be attended to, and adapted to the particular kinds of meats about to be broiled. Beef and mutton, for instance, require a brisker fire than veal or pork, fish or poultry. *Uniform thickness* of the steak or chop is desirable, that the whole may be equally done. *Beef-steaks* should scarcely exceed in thickness half an inch. *Mutton* may be, without disadvantage, somewhat thicker.

Salt should not be sprinkled on chops or steaks either before or while broiling, as it draws out the gravy. Pepper may be used, if approved.

Steaks or Chops.—When steaks or chops are broiled or fried, they should be turned with steak tongs. If a fork be used, it opens courses for the juices of the meat to escape from it.

4803. *Frying*, like broiling, is a species of quick roasting done in an iron pan: in regard to the uniformity of the thickness of the steaks, and as to the degree of heat to be given to the different meats, nearly the same directions will serve as in broiling. In frying, the pan requires to be made hot by boiling in it either dripping, oil, or butter; the substance to be dressed is put into this boiling liquid, the depth of which should not be sufficient to immerse it, but only to cover completely the bottom of the pan, and to keep moist the surface of the meat. The latter should be frequently turned from one side to the other, and when nearly done, it may be more deeply browned by pressing it firmly for one or two seconds against the bottom of the pan. *Fish* is best fried in oil or lard. *Meat* is fried in beef dripping or suet.

Subsect. 3.—*Allowance of Time for Cooking Processes.*

TABLE I.

Allowance of Time for boiling Butcher's Meats, Poultry, and Dried Meats.

		Lbs.	Hours.
Beef.	The round	25	4½
	Edge bone	12	3
	Brisket	10	4 to 5
	(A hard part requiring long and slow boiling.)		
		Lbs.	Hours.
Mutton.	Leg	9	3
	Neck	6	2
Lamb.	Leg	5	2
Pork.	Leg	8	3½
	Hand	4	1½
	Pig's feet and ears		3
Poultry.	Turkey, according to size, from an hour to two hours.		
	Fowls, from half an hour to three quarters of an hour.		
	Chickens, twenty minutes.		
	The time of reckoning begins from the time the water begins to boil.		
Boiling dried Meats.		Lbs.	Hours.
	Ham	16	4
	Bacon	2	1
	Pig's face		2
	Beef tongue		2 to 4

TABLE II.

Allowance of Time for roasting Meats and Poultry.

		Lbs.	Hours.
Beef.	Sirloin	16	4
	Ribs	14	3½
Veal.	Fillet	12	3½
	Loin	10	2½
	Breast	8	2
	Neck	8	2½
	Shoulder	10	3
Mutton.	Saddle	12	3
	Leg	10	2½
	Shoulder	7	2
Lamo.	Hind quarter	10	3
	Fore quarter	9	2½
	Leg	4	1½
	Loin	3	1
Pork.	Leg	8	3
	Loin	7	2½
	Sparerib	6	2
	Little pig		1½
Poultry.	Turkey		1½ to 2
	Fowls		½
	Chickens		15 min.
	Ducks		20 min.
	Ducklings		10½ min.

Subsect. 4.—*Preparing Fish for Cooking.*

Fish, in London, is prepared for the cook by the fishmonger from whom it is purchased; but in the country, all that is necessary to be done in trimming and cleaning it devolves on the cook, or on her subordinate assistants. Fish requires to be well washed; but it should not be long soaked in water, or the flavour will be impaired.

4804. *Salmon, herrings*, and other scaled fish must be scraped carefully with a blunt knife, until every scale is loosened and can be washed away. The smooth-skinned fish must be more carefully handled. They require washing only; but whether scaly or smooth, fish is considered as disfigured if, either in cleaning or in cooking, the skin be broken. The inside of fish requires to be well cleansed, to effect which a small slit must be made with a knife on the under side, through which the entrails may be drawn. Within these, in cod and salmon, will be found the roe and liver, which must be separated from them, washed and laid on a clean dish ready to be cooked with the fish. The roe of all fish is considered as a delicacy, and as a proof of the fish being in season; it is therefore always dressed with the fish.

4805. *Eels*, and other fresh-water fish, *pike, carp*, and *tench*, are slimy when first caught, and require the utmost care to cleanse them well, or there will be in them a muddy taste and smell, which is strong enough even to overpower the flavour of the ingredients with which some of these fish are usually cooked. Washing them, or, perhaps, scalding them in salt and water, is better still for removing the slime adhering to them, but if scalded, the fish must be perfectly dried again before it is cooked.

Subsect. 5.—*Preparing Poultry, Game, and Wild Fowl for Cooking.*

4806. *The feathers of poultry* should be plucked as soon as possible after it is killed. When it becomes cold a stiffness takes place, which renders it difficult to draw out the quills without tearing the skin, which, after cooking, is considered as a disfigurement. *The down* which remains after the feathers are removed is afterward singed off with lighted paper. From some birds it is requisite to draw out the sinews of the leg, which is effected by binding the joint close to the claw, and fastening the claw in a vice. The bird is then pulled strongly until the sinews give way.

The crop is next to be emptied; a slit cut in the back of the neck opens into the crop, and allows the contents to pass through it.

The vent is then opened that the entrails may be cleaned out; in doing this, the gall-bag must be carefully removed; if broken, its contents will impart a bitterness to the flavour of the liver which washing will scarcely remove. When the bird is drawn, the liver and gizzard are separated from the rest of the entrails, and put into cold water to be cleansed.

The necks of fowls, geese, and ducks are always cut off close to the body. Before this is done, the skin which hangs loosely upon the neck is pushed up above the part at which it is to be cut off, that it may be afterward drawn down and wrapped over the end of the neck to hide it from view. Before it is fastened down, cold water should be poured through the body of the fowl, a practice not observed by the poulterers when they truss fowls, but to which it is very proper to attend. The backbone and the two bones which lead to the pinions are afterward broken. All this done, the bird is then to be *trussed*.

4807. *Trussing for roasting fowls* is done by cutting off the first joint only of the legs, and by turning them down close to the sides towards the vent, and fastening them by a game skewer passed from one to the other. Another slight skewer is passed through the joint of one wing into the body, and through to the opposite wing. The liver and gizzard are placed one under each wing.

In trussing fowls for boiling, the whole of the leg, except the thigh, is cut off, the end bones of which are tucked into the apron. The breast is set up to look plump; the wings, with the liver and gizzard, are placed the same as for roasting. The whole is tied in proper form with a slight string, which, upon serving, is cut and removed.

In trussing a goose, the legs, feet, and pinions are cut off; and these, with the neck, head, liver, and gizzard, form what are termed *giblets*. *Of a turkey, pheasant, partridge*, and *moor fowl*, the heads, in trussing, are not cut off, but are twisted round one of the wings, generally that under which the liver is put.

4808. *Boning poultry* is become fashionable, and, indeed, it is requisite when French dishes are to be formed out of it. It is an art that professed cooks practise; but in London it is generally done by poulterers, who have the proper instruments for performing it cleverly.

4809. *To truss fowls, en poule*, as described for French dishes, a hole must be made above the joint of the leg, and the claws skewered into the body. A string is passed from the head to the skewers, which preserves the form of the chicken while it is cooking; but it is to be removed on serving.

4810. *Woodcocks, snipes, and other birds living by suction*, are never drawn. The trail, as the inside is termed, is considered as the most delicate part of these birds. *Woodcocks*, in being plucked, must have the feathers most carefully drawn, as the skin is peculiarly tender, and if torn, these birds, when cooked, are much disfigured.

Moor fowl are trussed like the domestic fowl, except that it has, as well as the pheasant and partridge, the legs twisted together at the tail end, and the head twisted under the wing.

4811. *A hare* is prepared for cooking in the following mode: It is first to be *paunched*, by which is meant, as is well known, the removal of the entrails. This is sometimes done by the sportsman in the field as soon as the animal is killed; but if not, the cook should do it when it is brought into the house. If left in, it soon begins to spoil, which becomes apparent by the swelling of the body. When paunched, the inside should be kept dry; and it may also be proper to pepper it, if the hare is to be kept more than four or five days. As soon as the flesh becomes dark in colour and soft to the touch, it is time for the hare to be dressed.

To skin a Hare.—The legs must be cut off at the first joint; the skin on the back is then raised and drawn over the hind legs, and stripped away from the tail. It is afterward slipped over the fore legs, and cut away from the neck and head. The ears are carefully extricated from the skin, and left on the head. When the hare has been well soaked and washed after skinning, it is ready to be trussed. The sinews of the hind legs it will be requisite to cut, in order to turn them towards the head, and to fasten them to the sides of the hare. The fore legs are also turned to meet the hind legs, and are fastened with slight skewers to the body. The head is thrown rather back, and a skewer, if passed through it towards the tail, keeps it in place while it is cooking. A stuffing is put into the hare, to keep which within the skin is sewed up. A string ties the whole compactly together, keeping the legs in place.

4812. *Rabbits* are skinned, drawn, and trussed in the same way as hares. The ears of the rabbit are, however, cut off, whether they are to be roasted or boiled. If two rabbits are roasted together, their heads are skewered outward towards the shoulder.

SUBSECT. 6.—*Scalding and Singeing Pigs.*

4813. This is a business belonging chiefly to domestic life in the country. It is there usually performed by butchers, or by men employed in the out-door work of country families. In towns, it is always done by the butchers. It will therefore not be necessary to describe the mode in this place.

SUBSECT. 7.—*Preparing Vegetables for Cooking.*

For the general principles of treating vegetables when kept a short time previously to being cooked, we refer the reader to Book X., Chap. IV.

4814. *Plants of the cabbage tribe* must be immersed in water for more than one quarter of an hour previous to their being dressed. Long immersion renders them flavourless, although it may tend to renew the crispness they have lost since they were cut, and the toughness when eaten.

4815. *Leguminous plants*, as the pease, beans, and scarlet-runners, require less to be done than any other plants to preserve them moist. The pods for a considerable time keep the seeds from becoming dry. When pease and Windsor beans are shelled, the cook has only to put them into a colander, and to pour over them plenty of cold water. French beans and scarlet runners are cut into short, thin shreads, and then immersed for half an hour or less in cold water.

4816. *Of the esculent plants* the potato is the most important. When they are taken from the winter store, they should be put into cold water for ten or twelve hours. This immersion prepares them by a gradual transition from a low temperature to that of boiling water. For turnips and parsnips, the same practice of soaking hem in cold water should be resorted to, turnips being previously peeled; carrots and parsnips are generally scraped.

Spinach leaves must be washed in cold water, frequently changed, to remove all sand and dust from their surface. Spinach in boiling requires no more water than that which adheres to its leaves after it has been thus washed.

Asparagus, after the scaly covering on the heads have been scraped off with a blunt knife, and the stalks have been cut of a convenient length, must be put into cold water before it is tied up for boiling.

The artichoke is rather improved by being cut a few days before it is cooked; before they are cooked they should be well washed; they require long boiling, and a change of water in boiling.

Salad plants must not be kept long, nor will any continued immersion in water do them any good when they have been so long cut as to be flaccid.

SUBSECT. 8.—*Management of the Contents of the Larder.*

4817. For the construction of the larder, and the general principles for the management of the meat in it, see Book X., Chap. II. We add a few directions for the cook.

4818. *Butcher's meat*, when brought in from market, should be examined and trimmed before it is hung up. All moisture should be wiped off from its surface; all bloody veins should be cut out, at least at the surface of the meat; kernels from the fat and pith from the bones should also be removed. Uncooked butcher's meat should also be examined daily, that no "fly-blow" remain long enough undisturbed to injure it. The cook will generally find fly-blows, if there be any, between the folds of the skin and fat, or in other somewhat concealed parts. If possible, the part attacked should be cut away, but if not, it must be carefully washed off, and the part well dried. *Roasting beef* should, in the summer, have a little salt sprinkled over its surface, and if a dusting of black pepper be added, the surface will be rendered too pungent to allow the meat fly to settle upon it. *Mutton* and *veal* should be taken down and wiped each day with a clean, dry kitchen cloth. *Venison* is always hung a length of time before it is cooked. It should be frequently wiped with a dry cloth, or first washed with cold milk and water, wiped perfectly dry, and dredged with powdered ginger or pepper, to prevent the fly from settling on it; but these must be wiped off before the venison is cooked. To ascertain when it is in a condition fit to be cooked, plunge a clean knife into the fleshy part, and the smell will show the condition of the joint.

4819. *Fish*, when to be kept uncooked for a day or two, should be placed on the coolest spot which can be found in a cellar, or stone floored larder, or on a heap of moist sand, and turned twice a day. *Ice*, when it can be obtained, is, perhaps, the best preservative of the freshness of fish; but on removing it, the fish must be cooked immediately, or it will be spoiled.

For other particulars respecting the keeping of meat, the reader is referred to "Preservation of Food," Book X.

SUBSECT. 9.—*Hints respecting Dripping, Suet, &c.*

4820. *Soups, sauces, gravies, and made dishes* brought from table, and to be reserved for future dinners, ought to be poured out of the tureens and dishes in which they have been served into clean vessels, and immediately removed into the cool larder.

Soups, broths, &c., should have all vegetables in them strained off before they are set apart in the larder; for vegetables after they are cooked soon become acid, and then they injure the taste and quality of the soup or other dish of which they form a part.

Neither soup nor anything which is to be eaten should be suffered to remain till cold in copper utensils, the danger of which has already been pointed out.

4821. *Dripping* is the fat which drops from meat while roasting. If properly managed, it may be employed in frying, in basting, or in making common pastry. In cooking poultry, game, and fish, other ingredients are usually preferred to dripping, such as butter, lard, or Florence oil; but in many instances, especially in preparing plain family and economical dishes, beef-dripping would answer the same purpose, if cooks would only prepare it properly.

As dripping is too often a cook's perquisite, her interest in this matter is opposed to that of her employers, and she is seldom disinterested enough to make the best use of it, when she is not herself to benefit by it. When, however, she is so disposed, she should, when a joint of roasting beef is done, pour the melted fat in her dripping-pan into a basin of clean cold water; any heavy particles in the dripping will sink to the bottom of the basin, the melted fat will float on the surface, and when cold will form a clear cake of fat, free from taste, and fitted for any purpose of cooking in which such a kind of ingredient is requisite. In a cool larder dripping so clarified will remain fit for use for nearly a fortnight. Also, a little dripping may be made to go in use a good way, for after it has had anything fried in it, except fish and pork, or after it has basted veal or poultry, and has not been burned, it may be again poured in its melted state into cold water, and be used a second time.

4822. *Beef suet* cut into shreds, and melted in a slow oven, or in a tinned sauce-pan over a moderate fire, may be employed in frying when dripping is not to be had, and will save the more expensive articles of butter, lard, or oil. It must be slowly rendered, or it may acquire a burned taste; and when melted, it must be passed through a sieve into cold water: when it is caked it must be put into a jar, covered slightly, and placed in a cool spot.

4823. *Top pot* is the skimmings of soups and gravies, and it is spoken of by French cooks as preferable to dripping or suet for incorporating with flour in thickenings, soups, and gravies, and some even recommend its use in frying. In using everything up, the French cooks are more economical than the English cooks.

BOOK XIII.

RECEIPTS FOR ENGLISH COOKERY.

It is necessary to advertise the reader that in Book VII., Chaps. I., II., and VII., the general nature of food and principles of nutrition have been treated of; in Chaps. III., IV., V., VI., VIII., IX., and X , the various substances, both animal and vegetable, used as food have been described, and in Book X. the various methods of preserving food by salting, smoking, &c., are considered In the following receipts for actual cookery, occasional directions for salting particular parts will be added, as well as other processes intimately connected with the methods of dressing them. In Book XI., the rationale of the several processes in cookery has been explained, and a description given of the various apparatus employed.

Sect. I.—butcher's meat.

Subsect. I.—*Beef.*

In England, beef is almost always salted a little before it is boiled, and is then usually termed *corned* beef. The general principles for salting meat have been described in Book X., Chap. III., to which we refer the reader; but we here add the usual modes of salting it in this manner for a family.

For a round of beef, a pound and a half of salt, dried before a fire, must be rubbed into the meat; it is then put into a salting pan in a cool place, and the brine that melts should be returned upon the meat every day. The length of time it is to remain in salt will depend upon the degree of saltness desired, usually from three to ten days.

If the beef is required to be red, saltpetre is used. A pickle is made for twenty pounds of beef, of three pounds of common salt and one ounce of saltpetre, with two large table-spoonfuls of brown sugar. After having been well rubbed with salt, the beef is kept in this pickle for ten days or a fortnight.

Beef, to be boiled, should be put into lukewarm water, if the salting is just sufficient, but if it is thought to be too salt, then it should be put into cold water. The time of boiling allowed is a quarter of an hour for every pound of meat. The boiling should be steady, and the skimming carefully performed. The brisket requires somewhat more time than the round.

Boiled beef is served up with greens, carrots, or turnips.

4824. *Beef bouilli* is sometimes made of the rump, but it is equally good, and less expensive, if made of brisket. Put nine or ten pounds of it into a kettle with three carrots, one turnip, an onion, and some celery, all cut small; cover with cold water and set it on to boil; as the scum rises remove it carefully. Keep it gently simmering, take off the lid partially, and, as the water boils away, add as much hot water as will keep the meat covered. After thus simmering for four or five hours, draw off most of the soup and place it to cool, that the fat may be more easily removed. To the soup more vegetables, previously cut small and boiled by themselves, may be added, or it may be served in a tureen with vermicelli. The beef, from which the bones should be removed, may then be served and garnished with the vegetables boiled with it.

A sauce is sometimes served with it made of some of the soup, thickened with flour and butter, and flavoured with a thick-made mustard and the vinegar of pickled walnuts.

4825. *Rump of Beef stewed in its own Gravy.*—Boil a boned rump about eight or nine hours over a very slow fire, the pan being just covered with water. Put in a little parsley, a laurel leaf, a clove of garlic, two eschalots, a small bunch of thyme, four cloves, half a nutmeg, pepper, and salt. When done, withdraw the gravy, and cool it till the fat can be cleared away. Boil it up again, and pour over the beef when served.

4826. *Stewed Rump Steaks.*—Four pounds of rump, or, if tender, of common beef-steaks, cut very thick, must be peppered and fried brown in their own fat. Fry, also, in two ounces of butter, some carrots, cut into dice or shapes, a large bunch of parsley, and some eschalots coarsely chopped; add to these three large onions shredded, a handful of small mushrooms, and some celery cut small. Dredge the vegetables with flour, and when they begin to be tender, moisten them with a wine-glass of port wine, a pint of beef gravy, and two table-spoonfuls of strong vinegar; season these with pepper and salt, and put the steaks in them, after which the whole must simmer, but never boil, for three hours. The gravy must first be poured away from the meat and vegetables into a deep dish, and the fat must be removed from its surface; the meat and vegetables must then be added to it, and it is ready for table.

Ox Cheek Stewed.—Blanch (see terms explained) a cheek to cleanse it thoroughly; braise the cheek with thin slices of bacon, and flavour the gravy by putting in one onion, twenty peppercorns, some allspice, three slices of lemon (not peeled), and as much gravy or broth as will keep it stewing without covering it, and as this boils away more must be added. Five hours must be allowed for stewing it; and when done, the bones may be easily removed; the head being neatly trimmed and glazed, must be served with a sharp sauce, or sauce of roots.

4827. *Sirloin of Beef, roasted.*—Fifteen or twenty pounds in weight will require from three and a half to four hours' roasting. As the upper, or *outside*, as it is called, has seldom the same depth of meat as the under, or inside, it should be papered over for a couple of hours, and the fat also on the inside. Garnish it with hillocks of horseradish.

The rump of beef is sometimes roasted, and is excellent.

4828. *Ribs of beef, roasted*, should have the long thin parts papered, or the beef will be unequally roasted. A quarter of an hour to a pound of meat will allow sufficient time for roasting it, unless the weather be frosty, when an additional twenty minutes should be given to it. In hot weather, or when the meat is ripe, so much time need not be allowed. *Sauce*—horseradish, and vinegar, and water, served in a tureen.

4829. *Ribs of Beef boned and rolled like a Fillet of Veal, roasted.*—A stuffing of bread, egg, and sweet herbs is sometimes rolled up with the meat; but more frequently it is dressed simply as roasted before a brisk fire, and having an allowance of time longer than that given to the sirloin of equal weight, in consideration of the solid mass into which the beef thus prepared is formed.

4830. *Broiled Rump Steaks.*—Rump steaks should always be chosen from the best part of the rump, after it has hung a length of time sufficient to render it tender. If the weather is unfavourable for hanging meat, it is customary, after cutting off the steaks of the thickness of half an inch, to beat them with a rolling-pin. Lay the fat part of the steak towards the handle of the gridiron, and turn it with a pair of steak-tongs.

If more gravy be desired than that which the meat yields of itself, it may be procured by broiling a thick piece of gravy meat (such as part of the chuck), and when three parts done, by putting it on a dish, scoring it with a knife, and sprinkling salt upon it; this draws out a quantity of pure gravy, which being collected and kept hot, may be divided between each dish of steaks successively sent to table.

Among the condiments usually served with broiled beef-steaks are minced eschalots, scraped horseradish, walnut-pickle, or hot pot, and oyster sauce, served hot in a tureen.

4831. *Beefsteaks Fried.*—The *fat* and *lean* should be done separately. A hot dish should be in readiness to receive the lean while the fat is frying. Both being done, the butter or fat in the pan must be poured away, and some beef gravy, an anchovy, a small onion, some pepper, and salt must be put into the pan, boiled up in it, and while hot poured into the dish.

4832. *Cold roasted Beef dressed like Beefsteaks.*—Cut off the outside of the meat, and divide it into slices about half an inch in thickness. Slice two or three onions, and fry them in some butter till they are of a light brown; be careful not to burn them, or the gravy will be spoiled. Take them out of the pan, and then fry the beef of a light brown also. If too much fried, it will be hard and dried; but when sufficiently done, remove it from the pan to the dish on which it is to be sent to table; pour away the fat from the frying-pan, and put into it a small lump of butter into which some flour has been worked, some water or gravy, two tea-spoonfuls of mushroom and two of walnut ketchup, one of anchovy essence; to this a table-spoonful of red wine may be added or not, according to taste. The fried onions must be boiled up in this gravy, and the whole poured over the beef.

4833. *Beef Tongues.*—A salted tongue, if dried, must be soaked for some hours previous to being dressed. It must then be put into *cold* water, and gently brought to boiling; when, after the surface of the water is cleared from the scum, the sauce-pan must be removed from the fire only so far as to reduce the boiling to a gentle simmering. If dried, a tongue will require four hours', if simply salted, only three hours' boiling. While hot, the outer skin of the tongue must be peeled off, and it may be sent to table either glazed or plain. Boiled turnips are a usual accompaniment of boiled tongue.

4834. *Boiled tongue*, if to be eaten cold, may be rolled, bound by a tin band, and pressed down into a solid mass. When boiled and skinned, the small gristly bones near the throat must be removed, the root end must form the centre, and the tip, being brought to the outside, is kept in place by the tin bandage; weights are then placed upon it, and it is suffered to remain thus for ten or twelve hours; and on removing the bandage the whole will form a compact fillet, whence slices of fat and lean together may be conveniently cut.

4835. *Roasted Tongue.*—Parboil a tongue that has only been salted about ten days; roast, baste it with red wine, and frost it at last with butter. Serve it with a rich gravy and sweet sauce.

4836. *Stewed Tongue.*—Simmer it for two hours in water only sufficient to cover it; then peel it and put it back into the water, adding to it, tied up in a piece of muslin, some pepper, mace, and cloves. Cut some turnips and capers very small, slice some carrots, and add these also to the liquor, with half a pint of beef gravy, a wine-glass of white wine, and a bunch of sweet herbs. Stew all together very gently for an hour and a half longer, then take out the spice and sweet herbs, and thicken the gravy with flour worked into a small piece of butter.

4837. *Beef Tongue may be dressed in various Ways.*—Slices of hot tongue may be pared, glazed, and neatly arranged round a dish, the centre of which may be filled with any vegetable pulp or mash, as turnip, spinach, green pease, sorrel, &c. Slices of tongue pared and highly seasoned may be dipped in egg and bread crumbs, fried, and served up with any of these pulps, or eaten with bechamelle sauce. A layer of the white meat of cold roasted fowl may be included between two thin slices of tongue fried in the same manner, and sent up with the same sauce, or placed on an artichoke bottom dressed with melted butter, consommé, and pepper.

4838. *Beef Palates.*—Take half a dozen beef palates, rub them with salt, and let them simmer a few minutes in any broth, that the external skin may be removed; then divide them into convenient portions. Melt in a stew-pan some butter and flour, and moisten with beef gravy; when of a proper consistence, put in the palates, and let them stew till sufficiently tender. Season according to your taste.

There are many ways of dressing palates; they may be served up with bechamelle sauce and pickled mushrooms; or they may be rolled up and contain forced meat, brushed over with egg, dipped in bread crumbs, fried and served in any rich sauce. In the same manner, they may be rolled up and include thin slices of ham and truffles, and sent to table with cucumber, tomato, or celery sauce under them.

4839. *Cow's udder* is usually roasted with a tongue that has been in pickle not more than three days. They are both parboiled, and then tied together and roasted. They are served with good gravy and currant-jelly sauce.

4840. *Cow's Heel.*—Get one that has only been scalded, not boiled till the jelly has been extracted. Boil it for seven or eight hours in a quart of water, which, if required, may be afterward made into jelly or soup. The heel, cut into handsome slices, and covered with egg and bread crumbs, must be fried of a light brown, and laid round a dish, in the centre of which some onions sliced and fried also must be put.

SUBSECT. 2.—*Veal.*

4841. *Fillet of Veal, boiled.*—Fill the centre, the bone being removed, with stuffing similar to that used for boiled turkey. Allow one quarter of an hour to a pound, and twenty minutes over, for the boiling of this joint. After the water boils, scum carefully, and let it only simmer, keeping the meat covered by adding hot water, or it will become brown. The beauty of this dish depends on delicacy in the colour of the meat. A sauce must be formed by taking out a pint of the broth which has been made in boiling; this must be thickened with good cream, butter, and flour, and flavoured with mushroom catsup and mushroom powder, or mushroom buttons. If cream be not at hand for thickening the broth, a sauce may be made by mingling the yolks of two eggs with flour, butter, and broth.

4842. *Boiled Knuckle of Veal.*—As veal is insipid, it is a meat seldom boiled. The knuckle, however, being chiefly composed of cartilage, is occasionally boiled, and requires stewing to render it fit for eating. It is sometimes boiled with rice, and the gravy drawn from it is flavoured with onions, a little mace, and a few peppercorns. With the broth half a pint of cream or milk may be mixed, and the whole, meat, rice, and broth, served together in a tureen. If sent up separately, the veal will require a sauce of parsley and butter, as well as the accompaniment of boiled bacon, on a separate dish.

4843. *Veal Stewed.*—Divide part of a breast of veal into portions, and fry it of a nice brown in clarified butter. Put a quart of green pease into a stew-pan, pour on them some melted butter, and let them gently stew with some green onions, parsley, and cabbage lettuce; when sufficiently tender, add some veal gravy, put in the pieces of veal, and stew them gently. Season with salt, pepper, or cayenne, and add a tea-spoonful of powdered sugar. If you prefer it, you may pass the vegetables through a tamis, reduce the pulp, add the yolk of an egg and a spoonful of cream; in this case the pieces of veal may be glazed, and fried bread served round the dish.

4844. *Stewed Veal Cutlets.*—Cut a piece of the fillet into three parts, and trim from them all the skin. Stew all the trimmings with carrots and onions, to make a light gravy, then add a little broth or warm water; add spice, if approved, put in the pieces of veal, and stew them for two hours. Thicken the gravy, and pour over them.

4845. *The fillet of veal* is most commonly roasted, being previously stuffed either in the flap or in the space in the centre from which the bone has been taken. Veal, being a dry meat, requires constant basting, either with butter, beef dripping, or suet. It must be roasted *thoroughly* (under-done veal being neither wholesome nor agreeable) and of a nice brown. When dished, half a pint of melted butter, sometimes mixed with a brown gravy, is poured over it. Curry sauce in a tureen may also be served with it. Bacon, or fried pork sausage balls, with greens, are among the accompaniments of roasted veal.

4846. *Loin of Veal, roasted.*—The loin is never stuffed, but simply roasted and served with melted butter poured over it, with bacon and greens as separate dishes. The fat at one end and the chump at the other should both be protected for an hour from the full heat of the fire by being covered with paper.

4847. *Shoulder of Veal, roasted.*—The knuckle is taken off just above the joint, and on the upper side a stuffing, such as with the fillet, is laid under the loose skin, and skewered down. The joint is then roasted, and served with gravy or melted butter.

4848. *Breast of Veal, roasted.*—Cut off the thin end, and roast scarcely more than according to the common allowance of time. Baste constantly, or the skin becomes dry and hard. When served, pour melted butter or gravy over it, and put toasted bread under the kidneys. Accompaniments—bacon, greens, French beans, &c.

4849. *Breast of Veal, roasted, with Oyster Sauce.*—Roast a breast of veal in a caul; when nearly done, remove the caul that it may become lightly brown, glaze it, and serve it up with oyster sauce seasoned with cayenne pepper and lemon juice.

4850. *Broiled Veal Cutlets.*—Let the veal be cut of an equal thickness, and divide it into portions convenient to help at table. Dip the pieces into beaten egg, and cover them, but not too thickly, with chopped herbs, as parsley, mushrooms, and a little grated lemon peel; strew over them crumbs of bread, and broil them of a fine brown. Broil some thin slices of bacon. Make ready a sauce with butter and flour melted brown, moisten it with veal gravy and a little cavice; when it is intimately mixed, throw in some pickled button mushrooms, and pour the sauce quite hot over the cutlets; let the slices of bacon be placed round the dish. If lemon juice be required, it may be added at table.

4851. *Veal Chops.*—Cut the chops from the loin with a slice of the kidney and a portion of the fat. Broil of a light brown, and send it up very hot, but not burned. By many, veal alone is considered insipid, and this dish is considerably improved by the following method: Beat some lean of dressed ham in a mortar, with a little of the kidney fat; add chopped parsley, some parings of mushrooms, and an eschalot, with pepper and salt; when intimately beaten, bind it together with the yolk of an egg. Secure this forced meat, and broil it with the chop in buttered paper. For sauce, melted butter, button mushrooms pickled, and a tea-spoonful of lemon juice.

4852. *Veal Olives.*—Cut some thin slices of bacon or ham, and lay on them slices of veal of the same size and thickness; rub the veal over with yolk of egg, and pepper it; prepare some forced meat of a thinner consistence than usual, that it may be spread over the veal. Roll them up, and secure them in that position with some thread; run a lark spit through them, and roast them. Prepare a sauce of veal gravy, a spoonful or two of cream, and a little cavice.

4853. *Italian Collops.*—Mince a quantity of lean, undressed veal; add a little flour to prevent the divided pieces from sticking together, with half the quantity of young, green onions, a little parsley, button mushrooms, all chopped together, with a very little grated lemon peel. Put the chopped veal and herbs into the pan with a piece of butter, frequently stirring, that the whole may be equally done. Moisten to a proper consistence with veal gravy, and a spoonful of cream. Add sufficient salt and pepper; lemon juice, if required, may be used at table.

4854. *Fricandeau of veal* is cut from the fat side of the leg, about nine inches long, and half as thick and broad. Beat it with the rolling-pin, take off the skin, and trim it with the rough edges. Lard the top and sides, cover it with fat bacon, and then with white paper. Lay it in the stew-pan with pieces of undressed veal or mutton, four onions, a carrot sliced, some sweet herbs, four blades of mace, four bay leaves, a pint of good veal or mutton broth, and four or five ounces of lean ham. Cover the pan close, and let it stew gently for three hours. Take up the meat, remove all the fat from the gravy, and boil it quick to a glaze; then glaze it. Serve with sorrel sauce.

4855. *Veal Cutlets* (fried).—*Cutlets* are generally cut from the fillet, in neat, small pieces, about half an inch in thickness. They are sprinkled over with bread crumbs, yolk of egg, sweet herbs finely broken, lemon peel grated. The cutlets must be fried in butter of a light brown. When done, the butter must be poured away, and a little gravy made in the pan with warm water or broth; some lemon juice and peel, and some mushroom catsup, thickened with flour and butter.

4856. *Calves' Brains in various Ways.*—Let the brains first steep in cold water, to extract the blood, and separate all the filaments and membranes; then pour on them boiling water, in which they are to remain a quarter of an hour. Afterward drain them, and fry them in clarified butter, and let them be served with cream and bechamelle sauce. Another way of dressing them is by beating the brains, when parboiled, to a paste in the mortar, with some chopped parsley, green onions, and chopped mushrooms; work this together with some cream and veal gravy; when properly seasoned, it may be served up with slices of tongue glazed, and neatly arranged round the dish; the French term it *en miroton;* or it may be spread on a toast, and divided into convenient pieces.

4857. *Sweetbreads done in various Ways.*—Trim them properly, and let them soak in cold water to extract the blood; afterward pour on them boiling water to blanch. Lard them, and roast them till thoroughly done. Serve them up on a square piece of toasted or fried bread, with clarified veal gravy in the dish properly seasoned. Sweetbreads may also be simply boiled, and served up with butter and flour, brought to the proper consistence by the addition of cream and a few pickled mushrooms, with seasoning. Another method is by cutting them into slices, covering with beaten egg and bread crumbs, and frying of a nice brown. These slices may be served with a sauce composed of cream, veal consommé, lemon juice, and cayenne pepper, with sufficient salt.

4858. *Boiled Calf's Head.*—Cut it in two, and take out the brains; wash the head in several waters, and soak it in warm water for a quarter of an hour. Put it into a sauce-pan of cold water, and when it comes to a boil, scum it carefully. Half a head, without the skin, will require boiling from an hour and a half to two hours and a quarter, according to its size; with the skin, an hour longer. It must be stewed very gently till tender. Boil tender eight or ten sage leaves, or parsley, or both; chop them fine, and set them ready on a plate. Wash the brains well in two waters; put them into a basin of cold water, with a little salt in it, and let them soak for an hour; then pour away the cold, and cover them with hot water; then put them into a stew-pan with plenty of cold water, and boil very gently for ten or fifteen minutes. Now chop them (*not* very fine), put them into a sauce-pan with the sage leaves, and a couple of table-spoonfuls of thin, melted butter, and a little salt (some add a little lemon juice), and stir them well together. As soon as they are well warmed, skin the tongue, trim off the roots, and put it into the middle of the dish, the brains round it; or chop the brains with an eschalot, a little parsley, and four hard-boiled eggs, and put them into a quarter of a pint of bechamelle, or white sauce. A calf's head is usually attended by a pig's cheek, a knuckle of ham or bacon, or pickled pork; greens, cauliflowers, broccoli, or pease, and always by parsley and butter. If you like it FULL-DRESSED, score it superficially, beat up the yolk of an egg, and rub it over the head with a feather; powder it with a seasoning of finely-minced, or dried and powdered winter savory, or lemon thyme, or sage, parsley, pepper, salt, and bread crumbs, and give it a brown with a salamander, or in a tin Dutch oven: when it begins to dry, sprinkle a little melted butter over it with a paste-brush. You may garnish the dish with broiled rashers of bacon.

4859. *Calf's Head, hashed.*—Soak the head in water, boil it, not thoroughly, but until the meat may be cut clean from the bone. Take the meat off the bone on the best side; lay it in a dish, and cover it with crumbs of bread, among which are a few herbs cut very small, with some pepper, salt, and nutmeg, and the yolk of two eggs. Set the dish before the fire, and keep turning it occasionally, that all parts of the meat may become brown. Slice the remainder of the head, peel and slice also the tongue. Put a pint of good gravy, or of the liquor in which the head was boiled, into a pan with an onion, a small bunch of sweet herbs, some salt, Cayenne, eschalot, a glass of sherry, and a little oyster liquor. Boil these together for a few minutes; then strain it on the meat, which should have been previously dredged with flour. Fresh, or pickled mushrooms, truffles, morels, and two spoonfuls of catsup should be added. Half the brains, beaten up with flour and butter, should be added, and the whole simmered together. The other half of the brains are to be beaten up with lemon peel and parsley finely chopped, some nutmeg, mace, and an egg. These are to be fried in small cakes; also some oysters dipped in yolk of egg; with these, and some good forced meat balls, the dish must be garnished.

SUBSECT. 3.—*Mutton.*

4860. *Leg of Mutton, boiled.*—Cut off the shank bone and trim the knuckle. Put the leg into milk-warm water for ten minutes and wash it clean; cover it with cold water in a sauce-pan, and boil, scum, and simmer gently for two hours and a half or three hours, according to its weight and to the time of the year. Serve with boiled turnips and caper sauce.

4861. *The neck of mutton* is also boiled, and served with mashed turnips and caper sauce. It should be boiled in the skin; but this should be stripped off before it is served.

4862. *Stewed Leg of Mutton.*—This is larded with bacon on the upper side, and put into a stew-pot with either water or broth, two or three carrots, one turnip, an onion, and a few black peppercorns. After the water boils it must be allowed to simmer for two hours and a half; the broth and vegetables are then taken out, the meat dredged with flour, and put again on the fire to brown, with the cover left off. The vegetables are pulped through a sieve, and boiled up with the gravy, to which a table-spoonful of vinegar has been added. Part of the sauce is poured over the meat, and the remainder sent up in a tureen.

4863. *Hotch Potch.*—Stew together, in a small quantity of water, some pease, lettuces, and onions, with a ham or beef bone. Season with pepper and salt, and fry of a good brown some mutton chops; lay them in a stew-pan and cover them with the vegetables, and stew them all together for three quarters of an hour. Serve them in a tureen.

4864. *Stewed Loin of Mutton to eat like Venison.*—The bones are taken out and boiled for gravy, which is put into the stew-pan with the mutton rolled up and tied, and half a pint of red wine, an onion, and some dried mushrooms. A seasoning of pepper and salt having been strewed on the inside of the mutton before it was rolled, the mutton must be stewed for two hours, and when taken out, a little mushroom catsup must be added to the gravy, and a thickening of butter and flour.

4865. *Shoulder of Mutton stewed with Onion Sauce.*—Hang it up for three or four days; salt it for two days. Bone it, sprinkle it with pepper and pounded mace, lay some oysters on it, roll it up and tie it. Stew it gently for two hours, closely covered, and in a very little water, and a few peppercorns. Prepare some good gravy with oysters stewed in it, and which must be thickened with flour and butter, and when the tape is removed from it, pour the sauce over it.

4866. *Haunch of Mutton, roasted.*—To roast a haunch of mutton, the fire must be sharp and brisk. The haunch should be entirely covered with paper till half an hour before it is to be served, when the paper should be removed, in order that the browning and frosting may be effected. The haunch is usually served with currant jelly, mutton gravy in a tureen, and with broccoli sprouts or spinach; the knuckle is usually ornamented with white paper cut in strips.

4867. *Saddle of Mutton, roasted.*—Saddle is one of the most favourite joints of mutton. It is always roasted. The fat on its surface is scored in squares; the skin, previously separated from the fat by the butcher, is generally skewered on by the cook as a preservative of the fat, but which is removed in time to froth and brown the surface. The juice of the meat that flows on carving is by many esteemed as the best gravy; but it is usual to have a tureen of mutton gravy and some jelly sauce served with the joint.

4868. *Loin of Mutton, roasted.*—Done as the last.

The Neck, dressed as Venison.—Have a neck of good four or five years' old Southdown wether mutton (cut long in the bones) hung for nearly a week. Two days before dressing it, pound together a quarter of a pound of allspice and the same quantity of black pepper, and rub the mutton well with it twice a day. Then wash away the spice, cover the meat with coarse paste, and roast it, as directed for venison. Serve with it mutton gravy and currant jelly.

The neck roasted, and served with mutton gravy and boiled spinach, is a very good dish.

4869. *Broiled Mutton Chops.*—Cut the chops from either the loin or the best end of the neck, trim them neatly, and take off some of the fat if requisite. Pepper them lightly; put them on the gridiron over a clear fire. Turn the chops three or four times with a proper pair of tongs. When sufficiently done, remove them to a hot water dish, sprinkle a little salt over them, and lay upon them a few small bits of butter. One of the principal points to be observed in dressing chops and steaks is the sending them hot to table. Mutton gravy in a tureen is sometimes also served.

4870. *Fried mutton chops* are generally inferior to broiled, though, if done well, they do not differ much. After turning the chops in the pan frequently, remove them to a hot dish, and pour away the liquid fat in the pan; boil up in it a few table-spoonfuls of broth or warm water, with a table-spoonful of mushroom catsup, or any other flavouring sauce; and when hot pour it into the dish with the chops, or serve it in a sauce tureen.

4871. *Mutton Chops in disguise.*—Sprinkle each chop with pepper, salt, and chopped parsley, and roll them separately in white paper, of which the inside must be buttered; close the ends of the paper securely, and fry the chops until they appear brown. Do not disturb or break the papers, but let all the fat of the pan drain from them before put-ing them on the dish; cover them plentifully with parsley fried crisp, and send in a tureen some good mutton gravy flavoured with mushroom catsup.

4872. *Maintenon Chops.*—Cut and trim some mutton chops of an equal thickness; rub them over with butter, and cover them with a mixture of eschalots, parsley, and sweet herbs, chopped fine; fry them gently till three parts done, take them from the pan, and let them cool; then rub them over with egg, some more of the herbs, if sufficient does not adhere to them, and over all sift a few bread crumbs. Put each chop into a separate oiled paper, and broil them over a slow fire. For sauce, heat some of the liquor in which they have been fried, the fat being removed, with an equal quantity of veal gravy, and, when quite hot, remove it from the fire, and add some lemon juice or strong vinegar. They may likewise be eaten with whole capers, with some of the vinegar in which they are preserved, with a little Cayenne.

Subsect. 4.—*Lamb.*

4873. *Leg of Lamb, boiled.*—Cover it with cold water, and when it boils scum it. When the scum ceases to rise, set the kettle to keep it only gently simmering for an hour and a half or two hours, according to the size. It may be served with parsley, or with gooseberry sauce and spinach, broccoli, or cauliflower. The loin is sometimes cut into chops, fried, and put on the dish, round the boiled leg, garnished plentifully with crisp parsley.

4874. *Leg of Lamb, stewed.*—Put it into a stew-pan and cover it with mutton gravy, a bunch of sweet herbs, some pepper, salt, and beaten mace; stew gently for three quarters of an hour. Pour out the liquor and cover the meat close to keep it hot, while the gravy is prepared by straining it, thickening it with flour and butter, and flavouring it with mushroom catsup or a few mushrooms, as well as some lemon juice; the whole boiled together must be poured over the lamb when it is dished.

4875. *Lamb Chops stewed with Cucumbers.*—Fry the chops of a light brown, and stew them for half an hour in good gravy; thicken and flavour the gravy, and add to it some cucumbers thickly sliced and previously stewed. Boil them up together, and put the cucumbers first on the dish, the chops on them.

4876. *Roasted Lamb.*—Either quarter of lamb in roasting is papered and frequently basted with beef suet or beef dripping until an hour before it is to be served, when the paper must be removed, and the meat basted with butter, and afterward frosted. Neither lamb nor veal is agreeable when underdone; neither should be taken from the fire until the gravy which drops from it appears perfectly colourless. The time for roasting a fore quarter of 10 lbs. weight will be two hours. A hind quarter of the same weight, two and a half hours. The fore quarter may be improved by the cook cutting off the shoulder and lifting it up with a fork, throwing underneath it some pepper, salt, a small slice of butter, and a squeeze of the juice of lemon or Seville orange; then neatly replacing it. Roasted lamb is served with green mint sauce and salads; also asparagus, pease, and spinach are considered as its suitable accompanying vegetables.

4877. *Broiled Shoulder of Lamb.*—First roast the shoulder till it is more than half done, and let it become quite cold; then score it to the bone, especially in the thicker parts. If it were scored while hot, all the gravy would be discharged, and the dish rendered dry and insipid. Mix up some butter with the yolk of a raw egg, chopped parsley, and a little black and Cayenne pepper, with a tea-spoonful of soy, and introduce this into the parts that have been scored. Place on it the gridiron over a clear fire, and allow each side about a quarter of an hour. When in the dish, have ready two pickled cucumbers coarsely chopped, and a table-spoonful of whole capers; strew these equally over the lamb, and, at the same time, pour over it the following sauce: Incorporate some butter and flour over the fire till it acquires a fine brown, work it into a minced eschalot, and moisten it with strong gravy. When it has acquired the proper consistence, it is finished.

4878. *Lamb Chops from the Loin.*—Trim them neatly, and season them with very little pepper; add to some grated bread marjoram, thyme, parsley, and lemon peel, all finely chopped; having wetted the chops with the yolk of egg, cover them with these mixed, and fry them in butter of a light brown. On serving the chops, garnish them with crisp parsley.

Subsect. 5.—*Pork.*

4879. *Boiled Pork.*—If a leg of pork is bought ready salted, observe whether the knuckle is slit; if it be, the "Cook's Oracle" warns against purchasing it, as in all probability the juices of the meat will thereby have escaped into the pickle.

Pork requires a fuller allowance of fire in cooking than any other meat; if underdone, it is disagreeable and unwholesome. After boiling it, according to the allowance of a quarter of an hour's time to a pound of meat, allow a full half hour beyond that time. If the pork be allowed to soak in cold water for half an hour before it is put into the kettle, its colour will be improved. The boiling should be moderate; fast boiling hardens it. When the meat is taken out of the kettle it should be laid on a dish, that all particles adhering to it may be scraped off; it must then be removed to a hot dish, and served with pease pudding, parsnips, or mashed potatoes.

Pease pudding is considered to be a very oldfashioned accompaniment of boiled pork, but it is one more generally liked than any other.

There are many other parts of porkers which are salted and boiled; the *hand*, the *flank*, and the *neck*.

4880. *Roasted Leg of Pork.*—A leg of eight pounds will require about three hours' roasting. Score the skin in narrow stripes, and, if approved, transversely also; stuff the knuckle with sage, onion (minced small), grated bread, and a seasoning of pepper and salt: rub some salad oil over the skin with a brush or feather, and do not at first put it too near the fire, which would blister the skin. The *crackle*, as the roasted skin is called, should be crisp and brown: the oil will cause this crispness, and give the crackle a better colour than if dripping were used as a basting. Apple sauce is uniformly served with roasted pork.

Roasted loin, neck, and sparerib are dressed as the last.

4881. *Roasted Griskin.*—In a griskin there are several nice pieces, but also some that are hard and dry, therefore, instead of roasting it like the sparerib, boil it up quickly in water sufficient to cover it. As soon as it boils, take it out, dry it carefully, rub butter over it, flour it well, and put it into a Dutch oven before a brisk fire: a few minutes will brown it, when serve it with apple-sauce, like other roasted pork.

4882. *Rolled Pork.*—Bone a neck of pork; have in readiness a forcemeat of chopped sage, bread crumbs, allspice, salt, and pepper; put this forcemeat within the meat, and roll it up lightly. Roast it gently, putting it at first some distance from the fire; froth it with butter, and flour a few minutes before it is served.

4883. *Pork Chops.*—Take some chops from the loin or neck of pork; after peppering, broil them, turning them frequently. When nearly done, throw a little salt on them, and rub on some butter. If eaten in perfection, it must be immediately on their being taken from the gridiron.

4884. *Broiled Blade-bone.*—This is taken from a bacon pig: it is generally broiled, as above described, but is seasoned with a tea-spoonful of made mustard, as well as with pepper and salt.

4885. *To roast a Porker's Head.*—Choose a fine head, clean it well, and stuff it with sage and bread; tie it up tight, roast it like a young sucking pig, and serve it with the same kind of sauce.

4886. *To cook a sucking Pig.*—Let the pig be, if possible, fresh killed; after the first day it loses every hour it is kept some of the firmness and flavour of the meat. Baked sucking pig is better than roasted, because every part is then equally done; but if it be inconvenient to bake it, then it will be requisite, while roasting it, to shelter for a time the middle part from the fire. A pig-iron hung before the middle of the bars, and the fire kept fiercest at the sides, will be the best protection; or if a pig-iron be not at hand, a common flat-iron may be used as a substitute. For *stuffing*, take five ounces of grated stale bread, two ounces of powdered sage, and a large onion chopped fine; season these with pepper and salt, and mix them together with an egg. After filling the inside with this stuffing, sew it up, and lay it before a clear, brisk fire; baste it with salad oil. Remove the pig-iron from the centre when about half done. According to the size and age, a sucking pig requires to be roasted an hour and a quarter or an hour and a half. Before taking it from the fire, cut off the head, and divide it into two parts; cut also the body down the middle into two parts; chop the brains and some boiled sage leaves finely; mix them with either veal or beef gravy. Lay the two sides of the pig back to back on the dish, and garnish the sides and ends of the dish with the split head and the two ears. Serve the gravy in a tureen.

4887. *Pork Sausages.*—Sausages are made from a bacon pig. In making sausage meat, the art consists in chopping it finely, and in flavouring it agreeably with a mixture of crumbled sage leaves, pepper, and salt. If the meat so chopped be not put into the skins taken from the pigs, it may be potted down in a jar and covered. When any part is to be used, it must be rolled up in balls and fried in butter. Pork sausages are usually served with roast fowl or turkey; if alone, they are sent up on a toast, on mashed potatoes, or on stewed red cabbage.

4888. *Oxford Sausages.*—Chop small a pound of lean pork, with an equal quantity of veal, and three quarters of a pound of beef suet. Steep in water a penny roll, and, with sage, pepper, and salt, mix it with the mince; roll it in balls, and fry them of a light brown, or enclose some of it in a light paste in the form of puffs, which must be baked.

4889. *Chawl, or Pig's Cheek.*—Cut off the snout, clean the head, and divide it; take out eyes and brains, and sprinkle the head with salt; let it drain for twenty-four hours. Mix to half a pound of salt half an ounce of saltpetre, and rub the head with it. Let it lie in this pickle for eight or ten days, rubbing it for the first few days, and turning it daily afterward. It may then be cooked, or hung up near a hot chimney to dry, or smoked as bacon. Before it is cooked, it should be soaked in water for some hours, provided it has been dried, otherwise it will not require it. An hour and a half of slow boiling will be sufficient to cook it.

4890. *Ham, to boil.*—If a ham be highly dried, it will require twelve hours soaking in cold water; then scrape it with a knife till clean and free from rust. Set it on in cold water, and after it boils, and the scum has been removed, let it simmer for four or five hours. When boiled, the skin must be peeled off and the ham be glazed, or have raspings of bread sifted over it.

4891. *To boil Bacon.*—If highly dried, soak it for an hour or two, changing the water once; then pare off the rusty parts, and trim it on the under side; scrape the rind clean, put it into the pot, cover it with cold water, and boil it gently for an hour; if more than three pounds in size, an hour and a half. Remove the skin before it is dished, sprinkle over it some rasped crust of bread, and put it for a few minutes before the fire.

SUBSECT. 6.—*Venison.*

4892. *Haunch of Venison, roasted.*—One of buck venison, weighing from twenty to twenty-five pounds, will require four hours and a half roasting; *doe venison*, weighing from fifteen to eighteen pounds, three hours and a half; it is better to have it under than overdone. To preserve the fat, cover the haunch, especially where the fat lies, with white paper, buttered, and over this lay a paste of flour spread upon coarse paper, previously rubbed with dripping to prevent it being scorched. Fasten this last covering over the whole of the haunch with string; baste the joint as soon as it becomes warm, and continue to do so, that the covering may not take fire. About twenty minutes before it is done, cut away the strings and remove the covering; empty the dripping-pan from the first bastings, and put some butter into it, to baste the haunch with after it has been lightly dredged with flour. Garnish the knuckle with white paper cut with a ruffle. Serve it with unseasoned mutton gravy and currant jelly, either cold or melted over the fire, and send it up in a tureen. In the autumn, French beans are served with venison.

4893. *Neck or Shoulder of Venison, roasted.*—These having less fat than the haunch to be preserved, they need not be covered with paper, and they require less time before the fire. When a spit is used, pass three small skewers through the neck, that the spit may be passed on the outside instead of through the joint.

4894. *Stewed Venison.*—Bone and beat a shoulder of venison in order to make it tender. Soak some slices of mutton fat for a few hours in port wine, and lay them on the under side of the shoulder. Sprinkle on them some pepper and finely-powdered allspice. Then roll up the shoulder with the slices within, and tie it tightly together. Put it into a small stew-pan, and cover it with a weak mutton or beef broth, and half a pint of port wine. Cover it closely, and simmer it as slowly as possible for four hours. When done, open it, and lay the meat flat on a dish. Strain the gravy over it, and serve it with currant-jelly sauce. Very fat venison should not be thus dressed, but in some mode less rich.

4895. *Hashed Venison.*—Cut into slices underdone venison, and put them into a stew-pan. Roll up half a pound of fresh butter in flour, and put it with two eschalots, finely chopped, into another stew-pan over a slow fire for about ten minutes. Then add to it half a pint of port wine, a pint of veal stock, and some venison gravy, lemon peel, salt, Cayenne, and one squeeze of lemon juice. Boil all these together for a quarter of an hour, and put it to the slices of venison. Simmer the whole together for ten minutes, when it will be ready to serve.

4896. *Venison Chops.*—Divide a neck of venison into chops, trimming and boning them. Of the bones make gravy. Fry the chops of a light brown, and put them, when done, on a hot dish, while a gravy is made for them in the pan, consisting of a few spoonfuls of that made from the bones, with an ounce of butter rolled in flour. Stir this all together in the pan until it becomes brown and begins to thicken. Add to it half a pound of sifted loaf-sugar, a wine-glass of port, and a squeeze of lemon juice. Made hot in the pan, and of the consistency of cream, it is poured over the chops and served.

SECT. II.—POULTRY AND GAME.

SUBSECT. 1.—*Poultry.*

4897. *Boiled Fowls.*—Choose white-legged fowls for boiling. Poultry loses weight in boiling, owing to the boiling water extracting from them a considerable portion of nutritious matter. For this reason, put no more water to them than will barely cover them. If they are boiled in veal stock, the nutriment extracted from them will be less than if boiled simply in water. The veal broth gains something in strength, and may be afterward employed as soup or stock. Never boil poultry in cloths; prefer to secure their good appearance by carefully scumming. Accompaniments of boiled fowl: ham, bacon, tongue, and turnips; oyster sauce, parsley and butter, or liver sauce.

4898. *Roasted Fowls.*—The art of roasting poultry in perfection depends much on the management of the fire. If the fowls are placed too near they will be scorched and blistered, which lets out the natural gravy, and leaves them dry and insipid. Put buttered paper over the breasts, which is to be removed before they are done, that they may acquire a fine brown. Baste them with butter as soon as they are put down. Roasted fowls require gravy. By some they are eaten with egg sauce.

4899. *Fowls roasted in Batter.*—Bone the fowls and stuff them with a ragout, and their breasts with a force, lard or not; or simply roast the fowls, without forcing or larding. Put the boiled gizzard and blanched liver under each wing; they should not be papered, as they must be brown. When half roasted, baste them with batter till a surface is formed of nearly an inch in thickness. When crisp and brown, serve them on a sauce piquant.

4900. *Broiled Fowl with Mushrooms.*—Slit the fowl down the back; and in the thicker parts, as the thighs and breast, score it to the bone, that it may be equally done. Brush over the inside and places where it is scored with some catsup, then pepper it and broil it over a clear fire. When it is done, have ready the following sauce to pour over it: Melt some butter and flour, and when it becomes of a fine brown, moisten it with a spoonful of veal *consommé* and two spoonfuls of cream or milk; work it well together, add a little Cayenne; and a couple of minutes before you remove it from the fire put in the pickled button mushrooms. Lemon, if approved, may be added at table. Instead of the mushrooms, some persons substitute capers put whole into the sauce.

4901. *Boiled Turkey.*—The same directions as for boiling fowls apply to this bird, and it will only be necessary to show how to prepare the forcemeat with which it is to be stuffed. Beat in a mortar a slice of ham that has been boiled, fat and lean together, or slices of boiled tongue pared, with some of the fat and kernels; pound them into a smooth paste; scald some crumbs of bread with hot milk, and afterward drain the milk entirely from it; add chopped parsley, a little eschalot, and some grated lemon peel, pepper, and salt. Incorporate all these well together, with the yolk of one egg and the whites of nearly two. Introduce this stuffing under the skin of the breast, and confine it from passing out. Prepared in this manner, it will not crumble when brought to table, but cut firm. Boil it for an hour and a half or two hours, according to the size. The usual accompanying dishes are, ham or tongue, oyster, celery, or liver sauces.

4902. *Roasted Turkey.*—The same directions as for roasting fowls apply to turkey. For the previous management, let it be emptied and picked a few hours after it is killed, and introduce into the belly some parings of fresh truffles, or dried, if the fresh are not to be procured; afterward stuff the belly with clean hay, and let the turkey hang by the legs for a week before it is dressed. When the hay is withdrawn, collect the truffle parings, and wash them in warm water, and put a portion of them to stew in the gravy that is sent up with the turkey. For the stuffing, sausage meat, beat together with yolk of egg, is most proper, or, if you prefer it, the same as directed for boiled turkey. According to the size, roast from an hour to an hour and a half. Serve with gravy and bread sauce in tureens, sausages, ham, &c.

Another Way.—If a turkey be large and coarse, cut off the legs below the knee, take off the head, cook the gizzard entirely, and blanch the liver if not larded. Rub the breast with lemon juice, and cover it with slices of peeled lemon; over these lay slices of bacon. Wrap the turkey in paper, and prepare a clear, brisk fire, to which lay the turkey, though not too near till heated through, then bring it nearer. Remove the paper and coverings a quarter of an hour before it is done; brown it highly, and frost it. Dish it over plain gravy into which a slight flavour of garlic has been given. Garnish with Bologna sausages, and with curled bacon, cresses, lemon, &c.

4903. *Boiled Goose.*—Singe a goose well, pour over it a quart of boiling milk; let it lie in this a whole night; take it out and dry it well; cut into small pieces a large onion and some sage; put it into the goose, and close the openings in the usual way. Put it into a pot of cold water, let it boil gently for an hour, covered very close. Serve with onion sauce.

4904. *Green Goose, roasted.*—This is not stuffed, as the Michaelmas goose, with sage and onion, but has merely some pepper, salt, and a lump of butter put into the inside. Baste it with butter, and froth it well. Serve with a good gravy in the dish, and a green sauce in a tureen. Three quarters of an hour is sufficient time for roasting it.

4905. *Roasted Goose.*—Let it be stuffed with sage and onion, finely minced and well peppered. Roast it with an equal fire, and when the fat begins to drop it will only require occasional basting. Send up good gravy free from fat, and also a sauce composed of two tea-spoonfuls of fresh-made mustard, half a tea-spoonful of salt, sufficient Cayenne, and a large glassful of port wine.

4906. *To roast Ducks.*—For the stuffing, boil together one ounce of onion, and half an ounce of green sage; chop them very small, and mix them with a breakfast-cupful of bread crumbs, with butter about the size of a walnut, and a little black pepper and salt. Bind these together with the yolk of an egg, and stuff with the mixture one of the ducks about to be cooked. There are many persons who object to the flavour of onions. The time for roasting ducks must be varied, according to their size, from half to three quarters of an hour. The feet, crisply roasted, are considered by some persons as dainties. A good meat gravy in one tureen, and sage and onion sauce in another, are usually served with ducks, as well as green pease.

Roasted ducklings are never stuffed with sage and onion, but are roasted from a quarter of an hour to twenty minutes, during which time they ought to be carefully basted with butter and frothed.

4907. *Pigeons.*—Roasted pigeons require a brisk fire, and to be well done, but still to afford gravy when cut into. Let them be roasted with stuffing in the belly, prepared in the following manner: Take the hearts and livers of the pigeons, and nearly double the quantity of the fat of ham or bacon, beat them in a mortar to a smooth paste; moisten some crumbs of bread with milk, and press out the milk through a napkin; add chopped parsley, grated lemon peel, black pepper, and salt; unite these with white and yolk of egg beat together, divide this into equal portions, and stuff the pigeons. As these birds possess hardly any fat, they are to be often basted with butter while roasting. For sauce to them, melt some butter with a little flour, moisten with veal consommé, and stir in some chopped parsley; pour this over the pigeons, previously sprinkling them with a little salt. The same sauce is used for broiled pigeons.

4908. *Broiled Pigeons.*—Clean the pigeons well, split the backs, pepper and salt them; broil them quickly over a clear fire, and pour over them a sauce of stewed or pickled mushrooms in melted butter. Serve them as hot as possible.

4909. *Stewed Pigeons.*—Make a stuffing with pigeon livers parboiled and bruised in a mortar; add to them bread crumbs, butter, pepper, salt, pounded cloves, parsley, sweet herbs chopped small, and the yolk of an egg; fill the pigeons and tie them up at both ends. Half roast or fry them; put them into good gravy or beef broth, with an onion stuck with cloves, a bunch of sweet herbs, and a slice of lemon. Let them stew *very gently* for twenty minutes; strain the same and skim off the fat; add to it pickled mushrooms, hard yolk of egg balls, and forcemeat balls. Larding the pigeons improves them.

Subsect. 2.—*Wild Birds and Game.*

4910. Wild birds, being less fat than domestic fowls, require more copious and frequent basting with fresh butter. Also, after they are killed, they require longer keeping. When the colour of a bird begins to change near the vent it is time to dress it.

4911. *In roasting pheasants or partridges,* make a clear fire, but not too fierce. Thirty minutes will be a sufficient time for a young bird to roast; forty, or even fifty, for a full-grown pheasant, and twenty for partridges. Game is spoiled if overdone. As an improvement to the flavour of pheasant, "The Cook's Oracle" recommends a piece of beef steak to be enclosed in it, and roasted with it. Serve both pheasant and partridge with a clear, brown gravy of beef, and with bread sauce.

4912. *Broiled Partridges.*—Partridges broiled are quickly done, and are excellent. Cut them in half, and trim them neatly. Dip them in butter melted previously, and cover them thickly with bread crumbs. About a quarter of an hour before they will be wanted broil them over a clear, brisk fire, and serve them with sauce, *à la Diable*. See "Sauces."

4913. *Moor game, grouse, and black cock* are all dressed like partridges. The black cock will require as long a time roasting as the pheasant; moor game and grouse, as the partridge. Serve them with currant jelly and fried bread crumbs.

4914. *Woodcocks* are never drawn, and the entrails add much to the flavour of the bird. Cut as many slices of bread as there are birds, and toast or fry them of a delicate brown. Put them in the dripping-pan under the birds, so as to catch the "trail" which, as the roasting proceeds, drops from them. Roast them for twenty minutes, and baste and froth them with butter and flour. Put the toast on a hot dish, and lay the birds on it. Pour a very little but good gravy in the dish, and send up more in a tureen. Garnish with lemon.

4915. *Wild ducks* should be stuffed with seasoned sage and onion, and roasted before a clear fire, and basted, so as to abound with red gravy; they should then be carved, put into a covered silver dish heated with a spirit lamp, and gently stewed about five minutes in strong, clear gravy, with some Cayenne pepper; an instant before the lamp is blown out add a table-spoonful of lemon juice. Serve it up very hot.

4916. *Widgeons and teal* are dressed as wild duck, but require less time in roasting; not more than ten minutes for the widgeon, nor more than seven or eight for teal. Pour a good gravy over widgeons, and serve with eschalot sauce in a tureen.

4917. *Snipes* differ little from woodcooks except in size; they are dressed in the same way, but require about five or seven minutes less in roasting. Serve with orange gravy sauce.

4918. *Larks and plovers* require simply to be roasted on a small bird spit, and to be served up with gravy and fried bread crumbs.

4919. *Roasted Hare.*—A hare is dry meat, requiring abundance of stuffing, gravy, and sauce to render it palatable. But the common practice of soaking in warm water previous to dressing it is injudicious. Prepare the stuffing in the following manner: parboil the liver in a little salt and water, and beat it in a mortar with a slice of fat ham boiled. When beaten to a smooth paste, add some bread crumbs, chopped parsley, thyme, and marjoram, grated lemon peel, and a little black and Cayenne pepper. Incorporate these with an egg well beaten. Put the whole within the body of the hare, and sew up the skin. When the hare is laid to the fire, put into the dripping-pan three pints of milk, and constantly baste the hare with it for three quarters of an hour. The rest of the time baste it with butter; and before it is taken up, froth it highly by dredging it with flour, and basting it a few times longer. It will require an hour and a half's roasting, unless it be very small. Serve it with gravy and melted currant jelly.

4920. *Rabbits, boiled.*—Put them into a pan of warm water for ten minutes; then boil them for twenty minutes, or half an hour if they are very large; if they appear to be old, they will require nearly three quarters of an hour's time to boil them sufficiently. Smother them with white onion sauce, and with the liver minced garnish the dish, unless the liver be required to chop and mix with the sauce.

4921. *Rabbits, roasted.*—Young rabbits will require to roast for thirty minutes; old ones nearly forty. They are stuffed like hare, and should be dredged with flour and basted with butter. The liver, boiled and chopped with parsley, must be put into melted butter and served in a tureen.

4922. *Rabbits to be broiled* are split down the middle, and laid flat on the gridiron; the inside being previously seasoned with pepper and salt. Liver and parsley, and butter sauce, or a grill sauce, is usually served with them. Part of the liver is sometimes removed to garnish the dish alternately with slices of lemon.

SECT. III.—FISH.

SUBSECT. 1.—*Sea Fish.*

4923. *Boiling Turbot.*—M. Ude says, "I have ascertained, by many years' observation, that a turbot kept two or three days is better than a very fresh one." If it is to be kept, let it be drawn, washed, rubbed lightly with salt, and laid on ice or sand in a cool place. An hour before it is to be dressed, soak it in water with some salt in it. Score the skin across the thickest part of the back, to prevent it breaking on the breast, which will happen if this precaution be not observed, by the swelling of the fish. Put into a fish-kettle of cold water a large handful of salt, lay the fish on a drainer in it. When coming to a boil, skim it, and afterward set the kettle on the side of the fire to boil as gently as possible from 15 to 20 minutes. *Fast boiling* will break the fish to pieces. This allowance of time is for a fish weighing from 8 to 9 lbs. Rub through a hair sieve a little of the inside red coral spawn of the lobster, to sprinkle over the fish after it is dished. Have a fish napkin properly arranged on the fish drainer, and carefully dish the fish. Garnish it with slices of lemon and finely-scraped horseradish. Serve with lobster sauce. *Turbots* are sometimes garnished with fried smelts, or fried gudgeons, laid so as to form a fringe round the turbot. A sole cut into strips and fried is also occasionally served with turbot.

4924. A turbot kettle should be 24 or 25 inches long, 22 wide, and 9 or 10 deep. Fish requires more cooking in cold than in hot weather.

4925. *Broiled Turbot.*—It is both difficult and inconvenient to broil a large turbot. A small one succeeds much better, or slices of a large one detached from the bone. When dressed in this manner it must be previously *marinated*, that is, soaked in sweet oil with salt and pepper. The broiling should be conducted slowly over a clear fire. It may be served up with chopped capers and melted butter, or with Dutch sauce.

4926. *Brill* is dressed and served in the same way as boiled turbot. It is a delicately flavoured fish. Any other mode of cooking it could not improve its flavour; even sauces, if strong, are too overpowering accompaniments.

4927. *Cod's head and shoulders* should be tied up closely and put into cold salt and water sufficient to cover it entirely. It will require from fifteen to twenty minutes' boiling, or longer if very large. Great care must be taken to serve it without any speck of scum. Garnish it with horseradish and walnut pickle, and with the melt, roe, and liver. *Fried smelts* are sometimes added. Oyster, or shrimp and anchovy sauce, scollops, and scolloped oysters are sometimes sent up with it.

4928. *Crimped cod* may be either boiled, fried, or broiled.

4929. *Baked Cod.*—Open and clean the fish well, and put in the inside a stuffing made of two ounces of beef suet, some chopped parsley and sweet herbs, an egg, and pepper and salt, nutmeg and grated lemon peel. Sew up the fish when stuffed, enclose it in a buttered paper, and put it in a dish into the oven; baste it occasionally, while baking, with melted butter.

4930. *Salted cod* must be well soaked in cold water for one or two nights before it is used; each day taking it from the water and putting it into a cold place. The Doggerbank cod are reckoned the best. They cut into large flakes, and are not stringy, like the north country cod, which have been longer salted. Salted cod must be put into a kettle with cold water, and simmered, not boiled. If the water boils, the fish will be hard and thready. It is served with egg sauce, parsnips, or mashed potatoes, and garnished with hard-boiled eggs cut in quarters.

4931. *Cod Sounds, boiled.*—Soak them in warm water half an hour, then scrape and clean; and if to be dressed white, boil them in milk and water: when tender, serve them in a napkin with egg sauce. The salt must not be much soaked out, unless for a fricassée.

4932. *Cod Sounds, broiled.*—Scald them in hot water, and rub them well with salt; pull off the dirty skin, and put them to simmer till tender; then take them out, flour and broil them. While this is being done, season a little brown gravy with pepper, salt, a tea-spoonful of soy, and a little mustard. Give it a boil with a bit of flour and butter, and pour it over the sounds.

4933. *Boiled Haddocks.*—Put them into cold water with some salt in it. When the water begins to boil draw them away from the fire, and allow them to simmer for ten minutes. Strain them well from the water, and serve with anchovy sauce. Garnish with horseradish and lemon.

4934. *Fried Haddock.*—Skin the fish, and cover it with egg and bread crumbs seasoned with salt and pepper. The pan should be moderately hot, with boiling lard or butter.

4935. *Baked Haddock.*—Fill a haddock with a stuffing of bacon, beef suet, sweet herbs chopped fine, bread crumbs, and an egg to bind these ingredients together. Chopped oysters and a tea-spoonful of anchovy catsup will improve the stuffing. Sew up the fish, cover it with bits of butter, and bake it for half an hour.

4936. *Whitings* are often used, when fried, as a garnish to salmon and cod, and are then skinned, curled, with the tail entering the mouth, and fried in lard or butter. If they form a dish by themselves, they are served with shrimp sauce or anchovy essence in melted butter.

4937. *Soles, boiled.*—The largest soles are usually chosen for boiling. After they are well cleaned, rub them over with lemon juice, and set them in cold salt and water on the fire. When they begin to boil, let the water be scummed, then simmer them only, from ten to fifteen minutes, according to their size. Fish should be boiled till the meat separates readily from the bone, and has lost all appearance of redness. An error equally to be avoided is over-boiling fish. If over-boiled, a sole cuts woolly, and has, in fact, lost all its flavour. Serve it with anchovy sauce, and garnish with parsley.

4938. *Fried Soles.*—There is a considerable art in frying fish properly. The great secret consists in employing sufficient lard or oil, and also in not exposing the pan to a too fierce fire, which turns the lard brown or black. Frying is best conducted over charcoal. Before the soles are fried, beat up two eggs with a little salt; and when well mixed, rub some of this over them, and sift on them some bread crumbs. Fry them till they acquire a bright brown. When soles are very large and thick, it is better to divide them into two or three portions, or score them down to the bone. Proceed in the same manner to *fry whitings* (which must be previously skinned), and also flounders, smelts, &c.

4939. *Broiled Soles.*—They must be previously marinated, or soaked in salad oil, with some salt and pepper, and then broiled over a clear fire. When dressed thus, they should be served with anchovy sauce, which is prepared in the following manner:

4940. *Stewed Soles.*—Take the fillets of soles (the fleshy parts on both sides of the fish removed are so named), rub them over with beaten egg, and strew on them, finely chopped, and mixed together, parsley, eschalot, a little thyme, and button mushrooms. When covered with these, roll the fillets round, and retain them in that position with a piece of thread. Fry them of a light brown; drain the fat from them, and keep them hot. The sauce should consist of the yolks of two boiled eggs, pounded with a little butter and flour; dissolve this in veal consommé over a gentle fire, and when of a proper consistence, add some cavice, lemon juice, and Cayenne pepper. Pour this sauce into the dish, and arrange the fried fillets.

4941. *John Dory.*—This fish is best boiled and served with lobster or shrimp sauce; but if brought from a distance, and rather stale, it should then be marinated in oil, salt, and pepper, and afterward broiled; it then requires Dutch, or Quin's sauce, with melted butter.

4942. *Crimped skate* is to be boiled in salt and water, to which some vinegar may be added. When the pieces are of unequal size, the thicker may be put in before the others, that they may be done together. Shrimp sauce is the usual appendage.

4943. *Skate, fried.*—Divide pieces of skate in fillets, and dry them on a clean cloth; beat the yolk and white of an egg thoroughly together, and dip the pieces of fish into it, and then into fine bread crumbs. Fry them in hot lard or oil till delicately brown; lay them to drain on a sieve; garnish with crisp parsley; serve with caper sauce, with an anchovy in it.

4944. *Salmon* must be boiled with the same precaution as directed for turbot. On account of its thickness, it is more equally dressed when split, or cut into moderately-sized pieces. When boiled, it is accompanied with lobster or shrimp sauce. Put some salt into the water; when it boils, take off the scum; boil it very gently. Salmon requires almost as much boiling as meat, viz., a quarter of an hour to a pound of fish; but the *thickness* must be considered.

4945. *Salmon, broiled.*—Cut slices of salmon an inch and a half thick; marinate them in oil, and have a clear fire, and the gridiron rubbed over with lard. Turn the salmon on both sides, as in broiling meat.

4946. *Fried salmon* may be eaten with a sauce composed of finely-chopped eschalots, catsup, and vinegar, highly seasoned with Cayenne. To these, fried smelts, when in season, form an elegant garnish.

4947. *Mackerel* may be plain boiled, but caution must be used that they do not boil too violently, as they are easily broken; when the roes are very large, especially the hard, they will frequently be underdone when the fish are sufficiently: a small aperture made in the belly, with slow boiling, will remedy this inequality. They are served up with parsley and fennel sauce. This is best prepared by washing these herbs well, and chopping them unboiled, when they are to be added to the butter while melting, and allowed to simmer for a couple of minutes. In this manner the sauce will be strongly impregnated with the flavour of the herbs, and also come up beautifully green.

4948. *Mackerel, broiled.*—The fish should be split down the back, and a little salad oil be laid on the inner surface with a feather, to prevent it sticking to the gridiron, and to retain the salt and pepper with which it must be seasoned. Serve with parsley and fennel sauce, or with boiled green gooseberries. The acid flavour is given sometimes by the juice of lemon squeezed on the fish at table.

4949. *Fillets of Mackerel, fried.*—Take the fillets of four mackerel, remove the skin, dip them in beaten egg, strew on them some chopped parsley and fennel, and afterward some bread crumbs; fry them. For the sauce, pound the soft roes with some thick cream, which afterward pass through a tamis. Melt some butter with a little flour and some veal consommé, stir in the strained roe and cream, season with salt and Cayenne, and then add some catsup, or a little cavice and lemon juice, and while hot pour it over the fillets.

4950. *Other Ways of dressing Mackerel.*—When mackerel are abundant, choose a dozen with soft roes, which take out and preserve. Six of the fish may be boiled in as much water as will cover them, putting in some allspice, a bay-leaf, whole pepper and salt; when done, take them out and place them regularly in a deep dish. Add a cupful of strong vinegar to the liquor in which they have been boiled, and, while hot, pour it over them. They are to be eaten cold, as pickled salmon. The other six may be nearly split on the inside. Contrive to keep the sides extended by a splinter of wood, and when sprinkled with salt and pepper, let them hang a day in the sun; afterward remove them into the shade. In this state, when brushed over with a little salad oil, they may be broiled and eaten with caper sauce. The reserved soft roes will make patties in the following manner: Pound them with a fourth part of their weight of butter, and add sufficient cream to give them a proper consistence; season this well with salt, black and Cayenne pepper; distribute it into the patties, and gradually bake them.

4951. *Red mullet* are not to be emptied, but broiled as fresh as possible in buttered paper, and served very hot. There is but one sauce for them, and this is made at table by mashing the liver on your plate with some oiled butter, likewise very hot, Cayenne pepper, and the squeeze of a lemon.

4952. *Herrings* must be perfectly fresh; the soft roes are esteemed most delicate. They are to be broiled, and sent to table as hot as possible. Their sauce is melted butter, incorporated with mustard, salt, and pepper. In order to eat them properly, cut off the head and tail, pinch the middle, and at the head part draw out the bones.

SUBSECT. 2.—*Fresh-water Fish.*

4953. *Trout.*—The sooner a trout is dressed after it is caught the better; its firmness is improved by crimping. A large trout should be boiled in salt and water, but not with vinegar, which would destroy the colour. It is served with lobster sauce. Small trout are better *broiled*, but served with the same sauce as the boiled. When trout have been kept for a day or two, they are excellent if marinated, broiled, and eaten with Dutch or Quin's sauce.

4954. *Eels.*—The river eel is always to be selected, as those taken from ponds are muddy, and possess a disagreeable taste. They may be simply boiled, either whole or crimped, and eaten with parsley and butter sauce. Another method is, by placing them to the fire on a steel wire, or fine spit, usually called *spitchcocked* (a term evidently corrupted from spit-cooked). With large eels, which always abound with oil, this is the preferable method, as the oil is drained out by the fire. When done in this manner, they may be served with catsup, anchovy, caper, Dutch, or Quin's sauces. Eels are also fried, when they are to be dipped in beaten egg, and covered with crumbs of bread and chopped sweet herbs. These may be eaten with any of the above-mentioned sauces; but capers, coarsely chopped and served in some of their own vinegar, without butter, is the most appropriate sauce.

4955. *Matelotte of Eels.*—To prepare this dish properly, let the pieces of eel intended for the matelotte be spitchcocked till three parts done. In the mean time, prepare the following sauce: beat a couple of anchovies in a mortar with the yolks of two boiled eggs, a little grated lemon peel, half a tea-spoonful of minced eschalot, and two tea-spoonfuls of chopped mushrooms; moisten this with veal stock, or consommé, till the mixture acquires the thickness of cream. Put this in the stew-pan, with sufficient additional stock to cover the eels, which are to be gently stewed till done. At the bottom of the dish lay pieces of fried bread, moistened with lemon juice; add to the sauce sufficient Cayenne pepper and salt, a glass of port wine, and a table-spoonful of Quin's sauce; pour this over the fish. *N.B.*—If any oily matter extracted from the eels should float on the surface of the sauce, let it be carefully skimmed. For ordinary occasions, eels may be stewed with less trouble and expense by boiling them in little water till three parts done, and employing this liquor as the basis of the sauce; to which may be added some chopped parsley and minced eschalot, a table-spoonful of reduced catsup, sufficient pepper and salt, with some thickening of flour and butter.

4956. *Collared Eels.*—After large eels are skinned, take out the bones; season them on the inside with salt and spices, and strew over them parsley, eschalot, and lemon peel, finely chopped; then roll them up, and bind them tightly with some tape. Stew them till sufficiently done in veal broth; afterward reduce the broth, add some isinglass, two table-spoonfuls of white wine, and the same quantity of vinegar, with a little Cayenne pepper. When the isinglass has dissolved, skim the liquor free from all fat, and clear it with an egg; pass it hot through a strainer, and, when cold, it will be a savoury jelly. Remove the tapes from the eels, and serve them up, surrounded and covered with the jelly broken into pieces.

4957. *Pike* may be plainly boiled, or cut into junks, marinated, and fried. They may be eaten with any sauce.

4958. *An excellent Method of cooking them.*—Take two pikes, weighing from six to eight pounds each; after they are scaled and emptied, dissect out the flesh and bone, leaving the head and tail attached to the skin; pick off the flesh from the bodies of both, avoiding all the small, forked bones, which in this fish are very numerous. When this is done, beat the separated flesh in a mortar, with three anchovies, the yolks of four eggs, and a pound of butter; mix in a good quantity of chopped parsley, some few sweet herbs, minced eschalots, black pepper, and salt, and form the whole into a mass, with sufficient white and yolk of egg. Introduce this into the skin of one of the pikes, and sew it up neatly. Prick the skin in a few places with a sharp fork, and roast it till done before a brisk fire; it will require nearly an hour. Put into the dripping-pan a pint or pint and half of cider, with which it is to be frequently basted, and the remainder of this will be the proper sauce for the fish, with a little Cayenne.

4959. *Perch.*—Like all fresh-water fish, perch may be simply boiled and fried. They are, however, most esteemed when dressed as *water-souchy.* Where perch are abundant, pick out the smallest fish, and when they are cleaned, cut them into pieces, and boil them slowly with some parsley roots, whole pepper, and salt, until you obtain a strong broth. Strain this through fine muslin, pick out the parsley roots, slice them, and return them to the strained liquor, in which the larger perch, previously crimped, are to be boiled. Towards the end of the process introduce a few bunches of parsley that have been scalded in salt and water to preserve their green colour. They require no sauce, the broth being, with the addition of some salt and pepper at table, fully sufficient. Serve them in a deep dish, and send up with them slices of brown bread and butter.

4960. *Flounders* are prepared in the same manner as water-souchy.

4961. *Carp.*—Carp, though occasionally simply boiled and served with a sauce of anchovy, parsley, and butter, is considered to be a fish requiring stewing in rich gravy to make it worthy of a place on the table. It must be first carefully cleansed through a small opening made in the belly without damaging the scales. The gills are then taken out, the tongue kept in its place. Place the carp in a kettle that will just hold it, and sprinkle it with hot, red vinegar, to give it a blue colour. Fry with butter, and till brown, two or three carrots, two onions, and some parsley; to these add a bottle of port and half as much water. Tie up a bunch of parsley, a bay-leaf, a sprig of thyme, and some basil. Stew all together for an hour; strain off the gravy, dish the carp on a napkin, and serve it with anchovy sauce.

4962. *Tench* may be cooked in the same way.

Subsect. 3.—*Shell-fish.*

4963. *Lobsters.*—Fill a fish-kettle with salt and water, the proportion of salt being a table-spoonful to a quart of water; when boiling hot, put in the lobster, and, according to its size, boil it briskly from half an hour to an hour. When it is done, wipe off the scum from the shell, and rub over it a little butter or sweet oil. When cold, break off the claws, and crack the shell in each joint, but do not shatter the meat; split the tail down the middle; set the body upright in the dish, and place around it the claws and tail.

4964. *Cray-fish* are boiled in the same manner.

4965. *Broiled Lobster.*—When boiled, split the tail and chine; crack the claws, pepper and salt them; take the body out of the shell, and clear the head of the part called the lady. Replace the body within the shell, then, with the claws and tail, put them on the gridiron; while broiling, baste them with butter, and serve them with melted butter in a tureen.

4966. *Lobster Curry.*—Put the meat of two lobsters into a stew-pan with a blade of mace, four spoonfuls of veal gravy, and four of cream; rub together very smoothly two tea-spoonfuls of curry powder, one of flour, and one ounce of butter; add these, with some salt, to the lobster, and simmer the whole together for an hour; stir gently into the gravy the juice of half a lemon, and serve it.

4967. *Lobster Salad.*—Make a salad of two or three well-washed lettuces, cutting away the stalks, and shredding the leaves moderately. Slice some boiled red beet-root and one good-sized cucumber; wash, and cut in long shreds, four anchovies; add to these some tarragon and chervil, chopped fine. Make a salad mixture of the yolk of an egg (boiled for ten minutes, thrown into cold water, and rubbed with a wooden spoon through a sieve), a table-spoonful of cream, one of sweet Florence oil, a tea-spoonful of made mustard, a little salt, and two table-spoonfuls of vinegar. Put this mixture into the salad bowl, and lay the lettuce upon it (not mixed with it) in the centre, and the meat of the lobster and the other ingredients around it, according to fancy; and, to ornament the whole, rub through a sieve some of the red spawn over it.

4968. *Shrimps.*—Shrimps, in the first instance, are always boiled for ten minutes in salt and water, into which they are not put until it is boiling.

4969. *Stewed Shrimps or Prawns.*—When the shrimps are boiled, remove the shells, and put them into a meat gravy with a small piece of butter, a tea-spoonful of flour, and a seasoning of nutmeg, salt, and pepper. In this simmer them for three or four minutes, and serve them with small bread sippets. If a white dish be preferred, cream must be used instead of gravy.

4970. *To boil Crabs.*—Boil them the same way a slobsters, which see. When cold, crack and empty the shell, in the largest of which mix some vinegar, salt, white pepper, and Cayenne; put the meat to it and mix altogether. Some add a very little sweet oil; but crab, being of itself rich, scarcely requires it.

4971. *Hot Crab.*—The great shell must be left whole for the meat to be served in it. Chop and fry some parsley, mushrooms, or truffles, and a small portion of young onion; mix these with the meat, and fill the shell with them; add a little good gravy, some lemon juice; shake over the surface some flour; brown it with a salamander, or in a Dutch oven. Glaze it, and serve it very hot.

4972. *Stewed Oysters.*—Take a dozen of oysters; strain the liquor from them, remove the beards, and boil them and liquor together to form the stock for the stew. The liquor must then be strained away from the beards, and, being thickened with cream, flour, and butter, it must be again made hot over the fire, the cook stirring it gently the whole of the time. The oysters must then be put into the gravy, and gently warmed (not boiled) for ten minutes. This dish is often served with veal collops.

4973. *Scolloped Oysters.—Take from a dozen oysters* the beards, and boil them in the liquor; which, when done, strain, and reserve to moisten with it the bread crumbs on which layers of the oysters are placed, either in an earthen dish called a *scollop*, or in a real scollop-shell. In laying the fish, season it with white pepper and salt; fill the shells high, and in the form of cones, and brown them with a salamander, or in a Dutch oven. As soon as they are lightly browned, it may be inferred that the oysters are sufficiently cooked. There is scarcely any fish that requires so little cooking as the oyster.

4974. *Fried Oysters.—Grate* some bread, and season it with white pepper; dip the oysters in the crumbs, and have a light batter prepared in which to fry them. These form a pretty garnish to white fish.

4975. *Oyster Loaves.—Warm oysters* in their own liquor, and in which some cream is mixed, thickened with flour and butter, and seasoned with nutmeg and salt. Enclose the oysters in rolls made by pastry-cooks, and which are formed of a very light and short crus .

SECT. IV.—SOUPS.

SUBSECT. 1—*General Observations.*

4976. *Meat soups and gravies* have one basis, formed by boiling together meat and water; the soluble parts of the former uniting with the water, and simmered down to a certain strength, is termed "stock." When this is obtained, it is ready to be employed as the basis of any meat soup or gravy; and the soup receives its name according to the vegetables employed, or of the ingredients used in seasoning it. The proportion of meat to water for stock, from which the richest soups and gravies are to be made, is *two pounds of meat* to a *quart of water.* For more ordinary soups, *one* pound to a quart; for weak broths and meat teas, given to invalids, a quarter of a pound of meat to half a pint of water.

The strength and flavour of the stock may be increased and improved by the addition of all trimmings of meat, poultry, and game, such as the necks, feet, gizzards, &c.

4977. *Soups of meat* should, as much as possible, be made while the meat is *fresh;* in meat long killed the fibres become stiffened, and the juices of the flesh dried up; hence the greater difficulty in extracting them. In country places, in which markets occur rarely more than once in the week, fresh-killed meat cannot always be obtained. In such case, a cook should fry meat intended for soups as soon as she can conveniently do so after it is brought into the house; and this should be done especially in warm weather.

4978. *When it is possible, soups should be made the day before they are wanted.* A second boiling, if the soup is poor, increases its strength by evaporating the excess of water. The fat, too, is more readily skimmed off when soup is cold than when hot; and the fat it is desirable to clear off completely, as it renders soup, if left in it, too rich. Flour dredged on the surface, uniting with the fat, enables the cook to remove a considerable part of it, if there be not time to allow it to cool. But if the soup is to be clear and transparent, there is a danger of thickening it, though slightly, by this use of flour. Dr. Kitchener recommends, in the "Cook's Oracle," another mode of removing the warm fat from soup: that of dipping a *tamis* sieve or clean cloth in cold water, and then passing the soup through it. The cold temperature of the water in the cloth coagulates the fat, which adheres to it, but allows the soup to pass through. After this process, the soup must be warmed again over the fire before it is served.

Hard or fast boiling is, in making soups, to be carefully avoided. It hardens and contracts the fibres of the meat, so that it cannot yield its juices to the water.

Gentle boiling or stewing has a contrary effect; the water gradually warming the meat, has a tendency to relax its fibres, and while penetrating into the meat, extracts from it and carries away with it the finest of its flavours; and if the pot be closely covered, this flavour does not escape with the steam. All soup pots should be closely covered while on the fire; the vapour not being permitted to escape, becomes condensed, and returns to the soup, *whereby* less water is required to keep up the quantity of stock to be made, and, consequently, less meat to keep up its proper strength. Yet still, all stock should be allowed to boil up in the first instance, because the ebullitions send up to the surface the impurities which there may be either in the water or on the ingredients, and which should be carefully scummed off. When these cease to appear on the surface, the boiling of the soup should be moderated, by bringing the kettle off from the strongest heat of the fire, and placing it where it can only gently simmer.

Clear soups are at this period more fashionable than those that are thickened. But whenever the thickened soups are preferred, it is only requisite to incorporate the proper thickening (see " Thickening") with the clear stock.

Seasoning of soups with spices should be sparingly done; generally speaking, Cayenne pepper and salt are the chief seasoning. When other spices are to be added, the following receipts will specify the kind and quantity to be employed:

SUBSECT. 2.—*Winter Soups.*

4979. *Clear brown Stock.*—Take beef; after washing it well and cracking the bones in two or three places, add to it any trimmings of meat, poultry, and game, and cover the whole with cold water. Set the pot over a moderate fire, and keep stirring the meat from the bottom as the water begins to warm. When it boils, remove the scum and throw in a tea-cupful of cold water, to make more scum rise. The excellence and clearness of the soups and gravies made from this stock will depend upon its clearness. It must be as limpid as water. When it has been skimmed completely, add one carrot, two turnips, a head of celery, and one onion. There must be neither sweet herbs, garlic, nor spice added. Stock must not have any flavour given to it, which might interfere with its general uses: in forming soups and sauces out of it, any required flavour may be then added. Now cover the pot *closely*, and set it *by* the fire to *simmer* gently for four or five hours; strain it through a hair sieve, or tamis, into a clean earthen pan, and set it in a very cool place. The meat thus stewed will be found still sapid and nutritious, capable of being converted into a savoury dish; or it may be potted, or again put into water and boiled four or five hours more to yield a second stock.

4980. *Second Stock, or Consommé* (see " *French Cookery*").—This is a more concentrated stock than that described in the preceding receipt. Prepare it thus: Lay at the bottom of a stew-pan slices of ham or bacon, over these a layer of sliced beef; or, if to be drawn white, slices of veal instead of beef; to these add some parsley and green onions, with trimmings of poultry and game, and moisten the whole with a little of the first stock. Put the stew-pan over a slow fire, care being necessary to keep the stock from burning or from acquiring a high colour. When warm, score the meat with a knife to let out the gravy, and fill up the pan with first stock. Simmer the whole for three hours, keeping on the cover, except when it is requisite to take off the scum and fat. While hot, strain it into a clean earthen pan, and set it in a cool place.

By longer simmering this stock may be converted into *glaze*.

4981. *Thickening for brown Gravy Soups.*—Materials for thickening soups may be either *bread, bread-raspings, isinglass, potatoes, pease, carrots, flour,* or *barley*. Whichever is employed must be simmered gently with the soup until incorporated with it. The whole should be afterward passed through a sieve to remove any lumps of the thickening ingredient.

A thickening which may be kept for a fortnight, or even more in cold weather, may be made by boiling half a pound of clarified butter with as much fine flour mixed in it as will make it of the consistency of a flour and water paste. The boiling of these together must be continued until the mixture becomes of a gold colour; then it must be poured into a clean earthen pan, and put into a cool place. If this be boiled over a very quick fire it may acquire a burned taste, which would spoil its flavour, as well as that of soups thickened with it.

4982. *To clarify Stock.*—If the soups and gravies to be formed out of stock are to be clear and transparent, it should first be clarified. For this purpose, two eggs, the shells, whites, and yolks together, must be pounded, and then added to the soup to be boiled in it for about ten minutes. The whole must then be poured through a tamis, or a fine sieve. Two eggs will clear three quarts of soup. It is to be observed that Dr. Kitchener considers this mode of clearing soups as less effectual than that of carefully scumming them when boiling, as recommended above.

For portable soups, see Book X., " Preservation of Food."

RECEIPTS FOR SOUPS.

4983. *Ox-cheek Soup.*—Break the bones and wash the cheek thoroughly; put it into a large stew-pan with two ounces of butter at the bottom; let the fleshy part of the cheek be downward; add half a pound of lean ham cut in thin slices, four heads of celery, three large onions, two carrots, one parsnip (all sliced and cut small), three blades of mace. Put the stew-pan over a moderate fire for a quarter of an hour; then put in four quarts of warm water, and let it simmer till reduced to two; take out the head and strain off the soup clear from the vegetables, and use a little browning to improve the colour; add the white part of a head of celery cut small and previously boiled; scald two ounces of vermicelli, put it to the soup, and boil all together for ten minutes; pour it into the tureen over a French roll, and serve it.

4984. *Ox-tail Soup.*—Divide two ox tails into separate joints, and lay them to soak in warm water to extract the blood; then put them on to stew gently in a quart of water and a pint of beef stock; when they begin to boil, remove the scum and introduce the vegetables, which are to consist of four moderately sized onions, in one of which stick half a dozen cloves and a few corns of black pepper, two turnips, and a large carrot sliced, a head of celery, sweet herbs, a bunch of parsley, and a piece of lemon peel. Let all these stew together until the tails are sufficiently tender, when they are to be picked out and reserved. To the remaining liquor and vegetables add two quarts of beef stock, and let them continue to simmer about an hour; then strain the soup and remove all fat; now put in the tails, and boil gently for twenty minutes; a little before you remove it from the fire, add a wine-glassful of port wine and one of catsup, with salt and Cayenne pepper. *N. B.*—Always rather under-season soups, as additional salt and Cayenne may be added at table, if required.

4985. *Mullagatawny Soup.*—It is best prepared by stewing down for the stock a couple of old fowls with vegetables, estimating one fowl to each quart of soup. When these have been sufficiently boiled, strain off the liquor, and have ready prepared a young and tender fowl cut into convenient pieces in the same manner as giblets are divided; thicken the soup with butter, flour, curry powder, and the livers of the fowls previously parboiled and well beat together in a mortar; then put in the pieces of fowl, and let it simmer about an hour; season as usual.

4986. *Mock Turtle Soup.*—When you receive the calf's head, detach the scalp and separate the tongue; wash the latter in cold water, and then in warm, to draw out the blood; put these into a stew-pan with two quarts of water and a little salt; let it simmer gently, removing the scum, and peeling the tongue at the convenient opportunity; let them boil until tender; in the mean time, divide the head and take out the brains (which may be employed for a side dish); wash the head well, and lay it in warm water to soak out the blood. Crack the bones of the head and jaws, that they may lie in a smaller compass, and cleanse the bones of the nose. Have ready another stew-pan lined at the bottom with slices of fat ham or bacon; put in the head, together with the vegetables, consisting of sliced turnips and onions, one of them whole, stuck with a few corns of pepper and four cloves, the white part of two leeks, two table-spoonfuls of chopped mushrooms, a bunch of sweet herbs, the rind of half a lemon, and a little salt; moisten with some veal stock, and set it on the fire to heat gently. When the scalp and tongue in the other stew-pan are sufficiently done, take them out and divide them into convenient pieces; add the liquor in which they have been boiled to the head and vegetables, and let them simmer for two hours. Prepare the forcemeat balls in the following manner: Pound some lean veal in a mortar, and when it becomes a uniform mass, add crumb of bread, a little minced eschalot, chopped parsley, and mushroom powder, the yolks of two eggs boiled hard, Cayenne pepper, and salt; beat these with the yolks of two raw eggs and sufficient flour to form a paste of proper consistence, which roll into balls; boil them a few minutes in salt and water to harden. When the head and vegetables have stewed the prescribed time, strain off the liquor and remove all fat. Add veal stock sufficient to make in the whole three quarts of liquor; thicken with butter and flour, put in the divided scalp, tongue, and forcemeat balls, with two glasses of sherry; let it simmer for half an hour, and a little before you remove it from the fire season with salt, Cayenne pepper, and the juice of a lemon, or the latter may be added at table. Neither this nor the real turtle soup can be classed as a winter soup only. It may be regarded, however, as less acceptable in the warm seasons than in autumn and winter. (See "Real Turtle Soup.")

4987. *Giblet Soup.*—Stew in two quarts of water three sets of giblets thoroughly cleansed, with some sweet herbs, three large onions, some eschalots, allspice, pepper, and salt; let them continue on the fire until nearly done, then pick out the giblets and divide them into pieces. Let the liquor in which they have been stewed boil slowly with the vegetables about an hour longer, then strain it and remove the fat. To the strained liquor (which will be about a quart) add two quarts of beef stock, put in the giblets, and let the whole simmer until they are done; thicken with some butter and flour, and, lastly, add the seasoning, which should consist of Cayenne pepper, some juice of lemon, and, if you approve it, a gill of sherry. Some persons introduce balls of forcemeat, but this soup is sufficiently rich without them.

4988. *Soup Maigre.*—Put into a gallon stew-pan three ounces of butter; let it remain over a slow fire; while melting, slice four ounces of onion; cut in small pieces one turnip, one carrot, and a head of celery;

put them into a stew-pan, cover it close, and let them fry till they are of a light brown; this will take about twenty-five minutes. Have ready in a sauce-pan a pint of pease, with four quarts of water; when the roots in the stew-pan are quite brown, and the pease come to a boil, put the pease and water to them, set it on the fire, and when it boils, skim it and put in a crust of bread about as big as the top of a two-penny loaf, twenty-four berries of allspice, the same of black pepper, and two blades of mace; cover it close, let it simmer gently for one hour and a half, then set it from the fire for ten minutes; pour it off very gently, so as not to disturb the sediment at the bottom of the stew-pan, into a large basin; let it stand about two hours till it is clear; while this is doing, shred one large turnip, the red part of a large carrot, three ounces of onions minced, and one large head of celery cut into small bits; put the turnips and carrots on the fire in cold water; let them boil five minutes, then drain them on a sieve; next pour off the soup clear into the stew-pan, add the roots, put the soup on the fire, and let them simmer gently till the herbs are tender, about thirty or forty minutes; season it with salt and Cayenne, and it is ready. You may add a table-spoonful of mushroom catsup.

To make this, it requires nearly *five hours.* To *fry* the herbs requires *twenty-five* minutes; to *boil* all together, one hour and a half; to *settle*, at least two hours; when clear, and put on the fire again, half an hour more.

4989. *Old Pea Soup.*—Boil a pint and a half of split pease tied up in a cloth until they are quite tender; slice two carrots, three turnips, three large onions, two heads of celery, and a leek; add some pepper; let these warm, moistened with beef stock until they are thoroughly soft; rub the pease and stewed vegetables through a tamis; add to them sufficient beef stock to render the soup of the desired consistence, and let it boil gently for half an hour to incorporate. Stir it frequently, give the necessary seasoning, and serve it with fried bread cut into dice, and some powdered mint. For a family dish, the liquor in which a leg of pork has been boiled may serve instead of beef stock.

4990. *Celery Soup.*—Take six heads of celery, cut them into pieces about two inches long, wash and drain them on a hair sieve, and put them into a gallon of stock. (See "Clear Gravy Stock.") Stew the whole together for an hour, season with salt only, and serve.

4991. *Vegetable Winter Soup.*—Peel and slice six potatoes, six onions, six carrots, four turnips; fry these in half a pound of fresh butter; put them, when fried, into a soup-kettle, and pour on them four quarts of boiling water; toast a crust of bread very brown without burning it, and put it to the soup, with a head of celery cut small, white pepper, and salt; stew the whole gently for four hours; an anchovy, if added, will improve the flavour. Strain the whole through a tamis, and serve it very hot.

Subsect. 3.—*Spring Soups, White and Vegetable.*

4992. *White soups* have for their basis veal stock instead of beef; and the materials are blended into a uniform fluid, resembling cream, by means of a leason (a word corrupted by cooks from the French liaison), which means the medium of union or incorporation.

4993. *To make the Leason.*—Mix well together the yolks of four eggs with half a pint of cream and a little salt. Or the leason may be formed of almond paste, prepared in the following manner: blanch some sweet almonds, and when cold pound them in a mortar to a uniform paste. Examples for the employment of both will be now given.

4994. *Veal Stock.*—Cut up a knuckle of veal, of lean ham, or gammon, one pound; put these into a stew-pan, with a peeled carrot, turnip, onion, leek, and celery, and add one quart of water; draw these down till nearly done, removing scum and not allowing it to colour. Then add as much beef broth as will cover the whole, and add game to it if possible, as greatly improving the flavour. When these have been gently boiling for one hour, skim off the fat carefully and strain it. Be careful not to burn it, or allow any of the ingredients to become brown, or it will not answer for white soups and gravies.

4995. *Vermicelli Soup.*—Make two quarts of white stock hot; put into it half a pound of vermicelli, and *simmer* the soup for half an hour. If boiled quickly the vermicelli will burst and make the soup thick, which it ought not to be.

4996. *Macaroni Soup.*—Boil a pound of the best macaroni in a pound of good stock; when it becomes tender, take out half of it. To the remainder add some more stock, and boil it till the macaroni will pulp through a fine sieve. Add a pint of boiling cream, the macaroni that was first taken out, and half a pound of grated Parmesan cheese; make it hot again, but do not let it boil. Serve with French roll.

4997. *Chicken Soup.*—Take a couple of chickens, or a large young fowl; divide them down the back, as for broiling, and lay them in warm water and a little salt to discharge the blood; then set them to boil in three quarts of veal stock, add some green onions, a few small mushrooms, and a piece of lemon peel; when it begins to boil, carefully remove the scum. As soon as the chickens are about three parts done, take them out, remove the skin, and pick out all the white meat; score or chop the other parts, return them to the veal stock, and let them gently simmer for an hour longer, closely covered. Put the white meat into a mortar with sufficient almond paste, and crumb of bread soaked in milk and afterward squeezed in a napkin. Beat all these intimately together, moistening from time to time with a little strained broth, until it acquire the consistence of thick cream; now strain off the veal stock, and mix them together. Let them gently boil a quarter of an hour, add the appropriate seasoning, and serve up with pieces of French roll, not toasted. This is a very elegant, wholesome, and nutritious soup. *N.B.*—For the purposes described, a large marble mortar, with a wooden pestle, is an indispensable utensil in the kitchen.

4998. *Sorrel Soup.*—Take two pecks of young sorrel leaves, pick them from the stalks, wash, and drain them. Set them in a stew-pan over a slow fire, with a quarter of a pound of butter; when softened, drain them over a sieve for two minutes, and put them again into the stew-pan, with a small bit of butter, and half a pint of second stock, or consommé. (See Receipt, "Second Stock.") When reduced to half the quantity, add half a pint more, and a few table-spoonfuls of plain meat stock; boil all together and pass through a tamis. Add next a whole quart of stock, and boil it again gently for two hours before dinner. Just before it is to be served beat together six eggs, and mix them first with half a pint of cream, and then gradually with the boiling soup.

4999. *Green Pea Soup.*—Take two quarts of large green peas, not too young, three middle-sized turnips, two cabbage lettuces, and a dozen green onions. Boil these with a little pepper in a quart of first veal or beef stock (the former is preferable) until quite tender: mash or pound them to a pulp, and rub them through a *tamis*. Add two quarts of veal stock, and if you wish a richer and more nutritious soup, a pint of veal consommé. Then take a quart of young green pease, which heat gently over a slow fire until they are tender; add these to the soup, with some flour and butter to give the proper consistence, and boil them for half an hour. A few leaves of green mint may be introduced, if approved; and if it be required to have the soup very green, boil a bunch of parsley, and rub it through a hair sieve, which will give the desired colour: if any slight acidity should prevail from the vegetables, a lump of sugar will remove it. Season to the palate, and serve it as usual with fried bread.

5000. *Asparagus Soup.*—This is made with the points of asparagus in the same manner as the green pea soup is with pease; or by adding the asparagus heads to common pea soup.

Subsect. 4.—*Game Soups.*

5001. *Game Soups*, in houses well supplied with game, may be made at a very moderate expense. Take the meat from the breasts of birds, hares, or rabbits that may have been left from the preceding day's dinner, and pound it. Beat the bones to pieces, and boil them in broth for an hour. Boil and mash six turnips, strain them with the pounded meat through a tamis, passing the broth at the same time, by which means the whole will be got through. Put these ingredients into the soup-kettle, and set it near a moderate fire, never allowing it to boil. When it is to be served, beat the yolks of six eggs, and mix with them half a pint of cream; strain them through a sieve into the soup, which should be nearly boiling; stir the eggs and cream well into it to prevent them becoming curdled.

5002. *Hare Soup.*—Empty a hare; reserve the liver and parboil it. Cut the hare into junks, or thick pieces; trim the bottom of a stew-pan with slices of fat ham or fat bacon. Have ready cut some carrots, turnips, and onions, one of which should be whole and stuck with six cloves, a blade of mace, and a few corns of pepper, a bunch of parsley, and some sweet herbs, two table-spoonfuls of chopped mushrooms, two eschalots minced, and a piece of lemon peel, with a little salt. Fill the trimmed stew-pan with the pieces of hare and vegetables, and moiston with a pint of beef stock and a gill of port wine. Let these gently simmer together, closely covered, on a very slow fire for two hours. Then remove the stew-pan from the fire, and take out the best pieces of the hare, as the thighs and back; pick the meat clean from the bones, which latter return into the stew-pan. Pound the meat you have picked off with the parboiled liver in a mortar, and when it becomes a smooth and uniform mass, add a large lump of flour and butter intimately mixed, and rub them through a tamis. Replace the stew-pan on the fire, with sufficient beef stock to afford three quarts of soup, and let them gently simmer an hour more; then strain it off and remove any fat. Mix gradually the pounded meat of the hare with the strained liquor, and set it on the fire for twenty minutes to thicken and combine.

5003. *Partridge Soup.*—Skin and cut to pieces two large partridges, with three or four slices of ham, a little celery, and three large onions. Fry them in butter till brown, but mind they do not burn; then put them into a stew-pan with three quarts of boiling water, a few peppercorns, and a little salt. After stewing gently for two hours, strain it through a sieve; put it again into the stew-pan with some stewed celery and fried bread When near boiling, pour it into a tureen, and serve it quite hot.

Subsect. 5.—*Fish Soups.*

5004. *Stock for Fish Soup.*—Take a pound of skate, four or five flounders, and two pounds of eels; clean them well and cut them into pieces; cover them with water and season them with pepper, mace, salt, an onion stuck with cloves, a head of celery, two parsley roots sliced, and a bunch of sweet herbs; cover them close, stew for an hour and a half, and then strain it off for use. If for brown fish, first fry the fish brown in butter, and then do as above. It will not keep more than two or three days.

5005. *Eel Soup.*—Take a couple of middling-sized onions, cut them in half, and cross the knife over them two or three times; put two ounces of butter into a stew-pan, put in the onions, and stir them about till they are lightly browned; cut into pieces three pounds of unskinned eels, put them into your stew-pan, and shake them over the fire for five minutes; then add three quarts of boiling water, and when they come to a boil take the scum off; then put in a quarter of an ounce of the green leaves (not dried) of winter savoury, the same of lemon thyme, and twice the quantity of parsley, two drachms of allspice, the same of black pepper; cover it close, then let it boil gently for two hours, strain it off, and skim it clean. To thicken it, put three ounces of butter into a stew-pan; when it is melted, stir in as much flour as will make it of a thick paste, and add the liquor by degrees; let it simmer for ten minutes, and pass it through a sieve; put your soup on in a clean stew-pan, and have ready some little square pieces of fish fried of a nice light brown, either eels, soles, plaice, or skate will do. The fried fish should be added about ten minutes before the soup is served; forcemeat balls are sometimes added.

5006. *Lobster Soup.*—Boil three fine young hen lobsters ; when cold, split the tails, take out the meat, crack the claws, and cut the meat into small pieces ; take out the coral and soft parts of the body ; bruise part of the coral in a mortar with part of the meat from the chines, and with this make forcemeat balls, seasoned with mace or nutmeg, anchovy, grated lemon peel, and Cayenne ; pound these with the yolk of an egg. Have three quarts of veal stock, bruise the small legs and chine, and put them into the stock to boil for twenty minutes ; then strain it, and to thicken it, take the fresh coral and bruise it, and put it into a mortar with a little butter and flour ; rub it through a sieve, and put it to the soup with the meat of the lobsters and the remaining coral. Let it simmer very gently for ten minutes ; do not let it boil, or its fine red colour will immediately fade. Pour it into a tureen ; add the juice of a lemon and a little anchovy.

5007. *Cray-fish Soup.*—Put six whitings, and one eel, and a thornback into cold water, and set them on the fire ; as the scum rises in boiling it must be carefully removed. An onion, carrot, and some parsley, together with a few peppercorns, must be added. Then remove the shells of fifty cray-fish, and add them to the soup, together with the small claws and shells finely pounded. Boil the whole an hour ; then strain off the soup, and put in some pounded crusts of bread, and then sprinkle over the spawn of a lobster.

5008. *Prawn soup* is made in the same way.

5009. *Common Fish Soups.*—Excellent fish soups may be made of the scull of cod, skate, or flounders, boiled in no more water than will cover them, and the liquor thickened with oatmeal.

5010. *Turtle Soup.*—The head of the turtle should be cut off the evening previous to the day on which the soup is to be made, and the turtle hung up by the fins, with the neck downward. In the morning cut off the *fore* fins, and the callipee all round ; remove the entrails and carefully detach the gall ; then cut off the *hind* fins, and separate all the meat from the bones, both callipee and callipash, and cut it into pieces. Scald these all together, taking care the scales do not set. When cleaned, chop the fins into pieces four inches long, and put them, with the other pieces and bones, into a pot, with sufficient water to cover them ; throw in a bunch of sweet herbs and some whole onions, and when the liquor boils, take off all scum and froth. When these are nearly done, take them out and detach the bones from the fins ; strain the liquor, and reduce it by boiling to about one third of its original quantity. Divide the meat into pieces of a convenient size for the mouth ; put them into a pot, with some parsley, thyme, savoury, knotted marjoram, basil, and green onions, chopped fine together, with some pounded spices, consisting of clove, black pepper, mace, allspice, and salt. Pour over them the reduced liquor, and some good veal stock ; let it boil very gently till three parts done, and clear it free from the herbs. Let the liquor be strained through a tamis, and thickened with flour and butter (passed), and add a bottle of Madeira wine. Set it on the fire to boil, add the meat, and, lastly, put in the juice of five or six lemons, and a seasoning of Cayenne pepper and salt. When served, put in forcemeat balls previously prepared, together with some of the real green fat, divided in moderate portions. In countries where turtle is abundant and cheap, the broth in which it is prepared is made of the turtle only, whereby the flavour is much improved.

Sect. V.—GRAVIES.

5011. *Beef Gravy.*—In plain family cooking, stock, or consommé, is seldom in daily request, and, consequently, small quantities of gravy are made as occasion demands. Gravy, as well as soup, is an extract of the soluble and nutritious juices of meat, united in certain proportions to those of vegetables, which are, in fact, the flavouring ingredients.

Let the proportion of beef to water be a pound to a pint ; pepper and flour the meat, put it into a well-tinned pan, in which a small lump of butter has been previously melted. Set the stew-pan, *uncovered,* over a clear fire, until the meat becomes brown ; remove it to a soup-plate, and score it with a knife in various places, to allow the gravy to flow out. In the mean time, put into the same sauce-pan, and by the same process draw out the juices of one carrot, one onion, and some celery, all cut small. When these are heated, or, as the cook terms it, *sweated,* add to them the meat and its gravy, and a pint of boiling water ; boil all together, and scum the surface continually, and when the scum ceases to rise, cover the pot, and let it simmer gently for an hour or more. Strain it off, and if not immediately wanted, let it cool, in order to remove more entirely the fat than can otherwise be done, as well as to pour it, after it has settled, clear off from the sediment.

5012. *Veal Gravy.*—Veal gravy may be obtained by the same plan as the last, but it requires a greater proportion of meat to water than beef gravy, and instead of butter, the sauce-pan should be lined with slices of fat bacon. The cover of the stew-pan should be put on while both meat and vegetables are sweating, as one object is to keep the gravy from becoming brown. Of vegetables use only parsley, green onions, and mushroom parings.

5013. *Browning.*—This is used to give a fine brown to gravies ; it is prepared by putting a quarter of a pound of good moist sugar into a frying-pan, with three table-spoonfuls of water ; this is kept over the fire and stirred all the time, until it becomes of a deep brown colour ; another pint of water is then added ; it is to be skimmed well while boiling, and after it is done it must be bottled and well corked.

5014. *Gravy for Roast Beef.*—Melt a little salt in a quarter of a pint of boiling water, about an hour before a joint of roast beef is to be served, place an earthen-ware dish under it, and drop some of the salt and water on the brown parts of the roast, catching it in the dish beneath. When enough is thus obtained, set to cool, in order to remove the fat from it ; this being done, warm it in a sauce-pan, and pour it over the beef when it is served.

5015. *Gravy for Roast Mutton.*—Make a gravy of mutton, without vegetables, and remember to send some of this in a tureen whenever there is a saddle or haunch of mutton to be served. Venison, also, should have mutton gravy, unless there are sufficient venison trimmings to make it. Put no seasoning except a little salt to either mutton or venison gravy. Browning may be added.

5016. *Gravy for Steaks and Chops.*—Pour away the fat in which steaks or chops have been fried ; put in a small lump of butter, and, while it is melting, dredge it well and continually with flour, until it becomes a thick mass; then add a little boiling water and any flavouring ingredient, such as mushroom or walnut catsup, whichever the meat requires, with which it is to be served.

5017. *Savoury Jelly for Meat Pies.*—This is a composition of animal and vegetable substances, reduced by slow boiling to a jelly. Stick two large onions with a few cloves, peel three eschalots, slice two carrots, a bundle of parsley and sweet herbs; put these into the stew-pan with four pounds of chuck beef, two calf's feet, remnants of poultry and game, with a knuckle of veal and some ham. Let these ingredients heat together for an hour over a slow fire; moisten with some beef or veal stock, and let it stew gently for four hours; remove all the fat and strain it; then clarify it with the whites of eggs; and when cold it will be a jelly.

5018. *Gravy for Hashed Meat.*—Make a gravy of the bones of the meat to be hashed; break the bones, and, if for mutton, put in an onion sliced, some celery cut small, and a carrot and turnip; pour boiling water over them, and simmer gently for two or three hours; strain all through a sieve. If to be served thickened, stew some sliced potatoes with the vegetables, and pulp all together through the sieve, or tamis. Season with pepper and salt; flavour with mushroom catsup for veal or mutton; with walnut catsup for beef.

5019. *Gravy for Poultry.*—Add the liver, necks, and feet of poultry, either to the brown beef stock (see "Beef Gravy"), or to the white veal stock (see "White Veal Stock"), according as the poultry is to be dressed, whether fricasseed or ragouted.

5020. *Gravy for Game.*—Add to the beef gravy (see "Beef Stock") the trimmings of game rabbits, one table-spoonful of mushroom catsup, and the juice of half a lemon.

5021. *Turtle Gravy, for Hashed Calf's Head.*—Thicken with butter and flour a pint of beef gravy; and a wine-glass of Madeira, the juice and peel of half a lemon, a few leaves of basil, an eschalot sliced, a few grains of Cayenne or curry powder, two tea-spoonfuls of anchovy essence. Simmer these together for five minutes, and strain through a tamis. Add or omit, as may be convenient, a dozen of turtle forcemeat balls.

Sect. VI.—sauces.

5022. *White Roux, or Thickening for Sauces.*—Melt some butter in a stew-pan over a slow fire, and dredge in sufficient flour to form a thin paste; stir this for ten minutes to incorporate. By submitting the same materials to a brisker fire in the beginning, and then continuing the process over a more gentle heat, it will assume a brown colour, and is then termed *brown roux.* These are the usual thickenings for all gravies and sauces, and when thus prepared will keep good for a considerable time.

5023. *Liaisons, or Leasons.*—These are thickenings for white sauces, formed of egg and cream; the yolk of egg beaten well is mixed with cream, and both are gradually mixed with the hot broth or stock which is to be thickened. Care must be taken not to *boil* this mixture, which would cause the eggs to curdle. When cream is not at hand, the yolk of an egg thus combined with the gravy serves as a substitute for thickening.

5024. *Bread Sauce for roasted Poultry and Game.*—Put a tea-cupful of bread crumbs into a sauce-pan, and pour over them half a pint of milk; add an onion and a dozen black peppercorns. Let it boil, stirring it well together; then simmer it till it becomes stiff. Take out the onion and pepper, and, with butter and cream, reduce the bread to a proper consistence. Serve in a tureen.

5025. *Gooseberry Sauce.*—The accompaniment to a boiled leg of house lamb, or to mackerel. After cutting off the tops and tails with scissors, half a pint of gooseberries must be scalded, drained on a sieve, and then put into a pint of melted butter. (See "Melted Butter.") For mackerel, some add finely-chopped fennel to the gooseberries; other cooks flavour the sauce with ginger and lemon peel; and occasionally the gooseberries are merely scalded and sent up whole, without any mixture of butter or other things.

5026. *Green Mint Sauce.*—This is principally eaten with roast lamb, either hot or cold, in the early part of the season. It consists of green mint finely chopped with a little parsley, a tea-spoonful of moist sugar, and a wine-glassful of vinegar.

5027. *Young Onion Sauce.*—Peel a pint of button onions, and put them in water till you want to boil them: put them into a stew-pan with a quart of cold water; let them boil till tender; they will take, according to their age, from half an hour to an hour. You may put them into half a pint of melted butter, to which two spoonfuls of mushroom catsup has been added.

5028. *White Onion Sauce for boiled Rabbits, or roasted Shoulder of Mutton.*—For this sauce the Spanish are the mildest. Peel and cut them in half; lay them in cold water for ten or fifteen minutes; then boil them for another quarter of an hour; and, to render them very mild, pour off this water, and with fresh boiling water boil them up once more; drain them on a sieve, put them on a chopping board, and cut them very fine. In a fresh sauce-pan put them again on the fire, adding a small lump of butter, half a pint of cream or milk; stir it till it boils, and if too thick, add more milk or cream; rub it through a tamis, or sieve; put it again into the sauce-pan to make it warm again; and pour into the tureen when the dish is served which it is to accompany.

5029. *Brown Onion Sauce.*—Peel and slice some onions (some put in an equal quantity of cucumber or celery) into a quart stew-pan, with an ounce of butter; set it on a slow fire, and turn the onion about till it is lightly browned; now gradually stir in half an ounce of flour; add a little broth, pepper, and salt; boil up for a few minutes, and add a table-spoonful of claret or port wine, and some of mushroom catsup (you may sharpen it with lemon juice or vinegar), and rub it through a hair sieve.

5030. *Curry Powder will convert this into excellent Curry Sauce.—N.B.* If this sauce is for steaks, shred an ounce of onions, fry them brown, and put to the sauce you have rubbed through the tamis; or some small silver button onions, peeled and boiled tender, and put in whole when your sauce is done, will be an acceptable addition. The flavour of this sauce may be varied by adding Tarragon or Burnet vinegar.

5031 *Caper Sauce.*—Chop a table-spoonful of capers very small, and boil them up in melted butter. See receipt for "Melted Butter."

5032. *Parsley and Butter.*—Put a lump of butter into a sauce-pan, and as it begins to dissolve, shake in flour till it forms a thick paste; bring this to a proper thickness with water; chop the parsley very small after having soaked it in boiling salt and water; put it to the butter and give it a boil up, stirring it all the time. Serve it in a tureen.

5033. *Mushroom Sauce.*—This is best made by pounding a pint of the small or button mushrooms with about an ounce of butter and a table-spoonful of fine flour; work this well over a gentle heat, moistening with veal gravy and a little cream: it requires to be well seasoned. Some persons add a dessert-spoonful of cavice; others the same quantity of lemon juice.

5034. *Tomato Sauce.*—This is usually eaten with fried lamb chops: it is also well adapted for game. When the tomatoes are ripe, stew half a dozen large ones in a pint of beef gravy, with two tea-spoonfuls of minced eschalots; when they become tender mash them, and pass the pulp through a tamis; set this on a moderate fire to reduce with a glass of sherry, or other white wine. Towards the end of the process, when it has acquired a proper consistence, add sufficient Cayenne pepper, salt, and a little lemon juice. This sauce may be preserved in bottles, but it is much superior when fresh made.

5035. *Apple Sauce.*—This is made by boiling apples after they have been pared and the core extracted, with a little allspice tied up in a muslin rag; when sufficiently tender, mash them, add a very small piece of butter, and sweeten with moist sugar.

5036. *Wine Sauce for Venison.*—To a quarter of a pint of claret, or of port wine, add the same quantity of mutton gravy (unseasoned), and a table-spoonful of currant jelly: boil them, and serve them in a sauce-tureen.

5037. *Sharp Sauce for Venison.*—Put into a clean, well tinned sauce-pan, half a pint of good white wine vinegar, and a quarter of a pound of loaf-sugar pounded. Let these simmer gently by the fire; skim the surface of the liquid carefully, and serve hot in a tureen.

5038. *Sweet Sauce for Venison, Hare, or Roasted Mutton.*—Melt currant jelly in a sauce-pan, adding to it two table-spoonfuls of hot water.

5039. *Melted Butter.*—Melted butter, said by foreigners to be the only English sauce; and it would not be so difficult an art to make it well, if it were not often done in a hurried and careless manner. Sometimes the butter is oiled, and floats on the surface; sometimes there is too much, and sometimes too little flour; and generally too much boiled. Let the cook keep a pint sauce-pan for this purpose only, and remember that about two ounces of butter will make a sufficient quantity for one tureen. Put the butter into the stew-pan, with a large tea-spoonful of flour and two table-spoonfuls of milk; when melted and mixed together, add six table-spoonfuls of water; shake the sauce-pan constantly while holding it over the fire, taking care that the contents go one way. When it begins to simmer, it may stand quietly and boil up; pour it into a tureen as soon as it boils. If the butter oils, put a spoonful of cold water to it, and stir it well; if that does not succeed, try the pouring it backward and forward from the sauce-pan into the basin. Melted butter made to be mixed with essences and catsups should be of the thickness of a light batter.

5040. *Clarified Butter.*—Put butter into a nice, clean stew-pan over a clear, slow fire; watch it, and, as it melts, skim away the butter-milk it casts up; let it stand for a minute, that impurities may sink to the bottom; pour the clear butter through a sieve into a clean basin, leaving the sediment in the stew-pan.

5041. *Burned Butter.*—Put a lump of butter into a frying-pan; when melted, and it becomes brown, add to it a table-spoonful and a half of vinegar, a little pepper, and salt.

5042. *Butter, oiled (for frying Fish, instead of Olive Oil).*—Melt two ounces of butter in a sauce-pan or cup; put into hot water: it can scarcely be done too gradually. From the sediment at the bottom it must be poured away.

Fish Sauces.

5043. *Oyster Sauce.*—Preserve the liquor of the oysters, and the beards when taken off; boil up the liquor and beards together; strain it and put in the oysters; warm them in it for a few minutes; then take them out and drain them; strain off the liquor clear. Put into a stew-pan a small bit of butter with a spoonful of flour, and fry them together; dilute this with the oyster liquor and two table-spoonfuls of cream; let it boil gently, then add the oysters. When boiled sufficiently, season it with salt and with a spoonful of essence of anchovy. Serve in a tureen.

5044. *Lobster Sauce.*—Mash or pound the fresh eggs of the hen lobster, which squeeze through a piece of muslin and reserve; divide the flesh of a boiled lobster into convenient bits, and dust them with a little flour to prevent them from adhering together; put them into a sauce-pan with sufficient butter and cream, or milk, constantly stirring over a gentle fire until dissolved; let it simmer a minute or two, then add the strained eggs, or spawn; and when it assumes a brilliant red colour, instantly remove it from the fire, as the continuance of a boiling heat would destroy its fine redness. Those who prefer the flavour of anchovy, cavice, or lemon juice, may make the addition at table.

5045. *Shrimp Sauce.*—When the shrimps are picked at home, reserve the bodies and shells, and stew them in a little water; strain this liquor through muslin, and employ it with sufficient butter, flour, and the picked shrimps. Some persons pound the picked shrimps into a paste, which may be afterward mixed with the butter, flour, and the water in which the bodies have been stewed. In this way the sauce becomes strongly impregnated with the flavour of the shrimps.

5046. *Anchovy Sauce.*—Take a couple of anchovies, pick them clean from the bones, and pound them to a paste with some flour. When sufficiently smooth, add two ounces and a half of butter, and incorporate it with the anchovy paste; put this mass into a sauce-pan with nearly a pint of milk or cream, and set it over a gentle fire to dissolve, frequently stirring it; when it has simmered a minute or two, it will be of the requisite consistence. Made with the essence of anchovy, two table-spoonfuls will be necessary to flavour half a pint of good melted butter. It should be served hot, and have the juice of half a lemon squeezed into it.

5047. *Fennel and Butter for Mackerel.*—After the fennel is washed, boil it in half a pint of salt and water for six or seven minutes; drain it and mince it very small. Mix it well with melted butter, and serve it in a sauce tureen. Fennel and parsley sauce is sometimes preferred to fennel sauce alone. A sprig of mint and an onion chopped very small are also sometimes added.

5048. *Mackerel Roe Sauce.*—Boil the soft roes of mackerel, and bruise them with a spoon; then mix them with the yolk of an egg well beaten. Add to them salt and pepper, and some fennel and parsley boiled and chopped small. To these must be added half a pint of thin melted butter. Some add mushroom catsup, or walnut pickle and soy.

5049. *Egg Sauce for salt Fish.*—Boil three eggs for twelve minutes, and harden them by putting them immediately into cold water; this will also prevent the surface from becoming black. Chop all the yolks, but only half the whites, into small square dice, and, after putting them into the sauce tureen, pour upon them half a pint of melted butter, not too thick. Stir these well together.

5050. *Liver Sauce for Fish.*—Boil the liver of the fish and pound it in a mortar with a little flour; stir it into broth, or some of the liquor the fish was boiled in, or in melted butter, parsley, and a few grains of anchovy essence, soy, or catsup. Give it a boil, and run it through a sieve. You may add lemon juice or lemon cut in dice.

5051. *A very fine Sauce for Fish.*—Put into a well-tinned sauce-pan a pint of port wine, a glass of mountain, half a pint of fine walnut catsup, twelve anchovies and the liquor belonging to them, three or four table-spoonfuls of walnut pickle, and the rind of half a lemon. A few eschalots and Cayenne, to taste, may be added. Also, three ounces of scraped horseradish, two or three blades of mace, two tea-spoonfuls of made mustard. Boil all gently together till the rawness of the taste is lost. Put it into a jug to cool, and thence pour it into pint bottles and cork them close.

5052. *Cullis for Fish.*—Broil a jack or pike, then take off the skin, and separate the flesh from the bones. Boil six eggs for twelve minutes, and take out the yolks; blanch and beat to paste a few almonds. Add the eggs, and mix these all together with butter; put in the fish, and pound the whole mass together. Set a stew-pan on the fire with a piece of butter to brown, and when boiling put half a dozen onions sliced, two parsnips, and three carrots, to brown also; pour to them afterward a little broth to moisten them. When these have boiled for a few minutes, strain them into another sauce-pan, put in a whole leek, some parsley, sweet basil, half a dozen cloves, some mushrooms, truffles, and bread crumbs, and let them stew together for a quarter of an hour, when the fish, eggs, and almonds from the mortar must be added, and the whole stewed together some time longer, but not boiled. When sufficiently done, strain it through a hair sieve.

Sect. VII.—Forcemeats and Flavouring Ingredients.

Subsect. 1.—*Forcemeats.*

5053. *To compound forcemeats*, and to use discriminately flavouring ingredients or condiments, is the next branch in cooking to which attention must be given. Forcemeats should have the various ingredients of which they are composed equally incorporated, so that the whole mass may be uniform in quality and flavour. Flavouring herbs or condiments employed in forcemeats should be carefully added, all predominance in any one over the rest being avoided. As in these flavours it is impossible to state precisely how much of each should be used, the cook must accustom herself to taste and to judge for herself of the due proportion of each; experience will give her delicacy and accuracy of taste. Accuracy, in regard to flavour, is an important attainment in a cook; perhaps none can be eminent who do not strive to acquire it.

5054. *Forcemeat for Veal or Turkey, roasted.*—A forcemeat for roasted veal or turkey should be made of equal quantities of finely-minced suet and grated bread, somewhat less than a quarter of a pound of each. About two ounces of each will be enough for a turkey poult. Some add, finely chopped, some parsley, sweet marjoram, lemon thyme, some grated lemon peel, a very small slice of onion (minced extremely fine), a little pepper and salt. When these are mixed equally together, the whole must be united by adding an egg to it, or, if insufficient, two eggs, previously well beaten, must be employed to bring it into one consistent mass.

Forcemeat for boiled Turkey.—Chop half a pound of lean veal, two anchovies, the same quantity of beef suet, a few oysters (bearded), some bread crumbs, incorporated together with yolks of eggs. To these some cooks add a flavour of herbs. Stuff the crop of the turkey, and prepare it for boiling.

5055. *Stuffing for Goose or Ducks.*—Chop onions very small, with half the quantity of sage leaves. To these add a tea-cupful of grated bread, a small lump of butter, some pepper and salt, and incorporate the whole with the yolk and white of an egg beaten up.

Another Way.—Boil the onions and sage, and then chop them very small, and put into the goose or ducks without any other addition except that of pepper and salt.

5056. *Stuffing for Hare or roasted Rabbit.*—If the liver be perfectly fresh, parboil it, and mince it very fine; add to it a small tea-cupful of beef suet chopped fine, the same quantity of grated bread, a bunch of parsley, also finely chopped, some marjoram, lemon thyme, and grated lemon peel, together with a shred or two of eschalot, and a little pepper and salt. Mix these together with an egg into a tolerably stiff mass; put them into the hare, and sew up the skin.

5057. *Stuffing for roasted pigeons*, the same as for veal. For *stewed pigeons*, boil and bruise the livers, and add to them a little butter, a few bread crumbs, some pepper, salt, pounded cloves, chopped parsley, and sweet herbs; mix these ingredients together, and put a portion into each pigeon.

5058. *Forcemeat for Pies.*—A pound of lean veal trimmed of all the sinews and skins, and chopped with half a pound of fat bacon, some powdered herbs, a little salt, two eggs, and a little mushroom catsup; these, mixed together, may be used rolled up with best olives, or made into balls, and added to pies or some made dishes.

5059. *A Forcemeat of Rabbit.*—Take a pound or more of the meat of wild rabbits; add to it two pounds of fat bacon, chop both together, and afterward pound them with a flavouring of herbs, a little salt, two yolks and one white of an egg.

Subsect. 2.—*Flavouring Ingredients.*

We may remind the reader that the several spices and mustard have been described in Book VII., Chap. X.; and salt is treated of in Book X., Chap. III., Sect. III.

5060. *To prepare Mustard for use.*—In this country mustard is simply made with milk, water, vinegar, or wine. The flour of mustard should be kept dry in a bottle properly corked.

First Method.—When made with water in the usual way, it has for some little time a bitter taste. To avoid this, rub in a mortar one table-spoonful of the flour of mustard with two of milk or cream, half a tea-spoonful of salt, and the same of lump sugar powdered.

Second Method.—Made with vinegar, they should be rubbed together smooth for upward of seven or eight minutes, and when done should be of the consistency of thick cream. Put it into a stone jar; and, closely stopped, it will keep good for a fortnight. That which is put into the table mustard-pot should not be more in quantity than what will be consumed in one or two days.; the air soon causes it to turn sour if it be exposed.

Third Method, according to Dr. Kitchener.—Boil three ounces of salt in a quart of boiling water or vinegar, and pour it hot on two ounces of scraped horseradish. Closely cover the jar, and let it stand twenty-four hours. Strain and mix it by degrees with the best Durham flour of mustard; beat well together till quite smooth and of the thickness of cream. Put it into a wide-mouthed bottle and stop it close.

5061. *The French flavour their mustard* with Champagne, Madeira, or other wines; or with vinegar flavoured with capers, anchovies, tarragon, elder, basil, burnet, garlic, eschalot, celery, adding Cayenne or various spices, or sweet savoury, or fine herbs, truffles, catsup, &c.; in short, considering mustard only as a vehicle for flavours. Some of these are to be had in the London shops, as Moutarde de Maille, de Bordui, &c.

Spices, such as nutmeg, mace, allspice, should be powdered and kept dry in bottles. When powdered, these ingredients go much farther, and more rapidly give out their flavour, besides being more ready at the moment they are wanted.

Subsect. 3.—*Sweet and Savoury Herbs, dried.*

5062. *As the various herbs used as condiments cannot be had at all times of the year in a fresh state*, means have been found for preserving their flavours. Drying and reducing them to powder is one of the methods practised. The common method of drying is to put them into paper bags, and lay them on a shelf in the kitchen, exposed to all the fumes, steam, smoke, &c., by which they soon lose their flavour; but the following method is greatly preferable. The substances to be preserved should be gathered on a fine day, at the time when they are in the highest perfection. Having cleaned them well by separating the leaves from the stalks, and having separated the dirt by rubbing them with the hands over a hair sieve, which will suffer the dust to go through by shaking, they are to be put into a common oven, or a Dutch oven, before the fire, and dried quickly, but not so as to burn. This method is preferable to drying them more slowly by the heat of the sun. When quite dried, they are pounded in a mortar, passed through a sieve, and the powder put into bottles well stopped; in this way parsley, winter savoury, sweet marjoram, lemon thyme, sweet basil, bay leaves, celery seed, lemon peel, horseradish, mint, sage, tarragon, burnet, mushrooms, and others of this class, will retain their fragrance and flavour for several months.

5063. *Seasons for drying Sweet Herbs.*—*Basil* is in the best state for drying from the middle of August and three weeks after. *Knotted marjoram*, from the beginning of July and during the same. *Winter savoury*, the latter end of July and throughout August. *Summer savoury*, at the same time. *Thyme, lemon thyme, orange thyme*, during June and July. *Mint*, latter end of June. *Sage*, August and September. *Tarragon*, June, July, and August. *Burnet*, June, July, and August. *Parsley*, May, June, and July. *Chervel*, the same. *Fennel*, the same. *Elder flowers*, the same. *Orange flowers*, May, June, and July.

5064. *It is found convenient to keep ready prepared mixtures of these powders*, for flavouring certain soups and ragout, of which the following may serve as a specimen: Dried parsley, winter savoury, sweet marjoram, lemon thyme, of each two ounces; lemon peel cut very thin and dried, one ounce; sweet basil, one ounce; celery seed and bay leaves, of each one drachm; or part only of these may be employed, according to taste. Another mixture, recommended for pea soup, consists of dried mint and sage, celery seed, and pepper.

5065. *The following are kept ready prepared in the London shops:* Dried mushrooms, dried truffles and morels, artichoke bottoms, bottled and green truffles.

Infusions of these may likewise be made in vinegar or white wine, which may be employed in relishing sauces; although these are inferior to the fresh gathered herbs.

5066. *Curry powder* is much used for flavouring and increasing the relish of such dishes as chicken, rabbits, veal, sweetbreads, lobster, turbot, soles, oysters, &c. It made after the following receipt, it will be found scarcely to differ from what is brought from the East:

2 oz. of coriander seed; 1 oz. of cummin seed; ½ oz. of caraway seed; ½ oz. of ginger (in powder); 2 oz. of turmeric; ½ oz. of black pepper (pounded); ¼ oz. of Cayenne (of the very best quality, or more will be necessary).

These ingredients are to be dried in an oven, pounded and sifted separately, then mixed together in a mortar, and put into a dry bottle and corked. *N. B.*—A table-spoonful will be sufficient for a large dish of curry.

5067. *A Ragout Powder:*

1 oz. of salt; ½ oz. of mustard; ¼ oz. of allspice; ½ oz. of black pepper (ground); ½ oz. of grated lemon peel; ½ oz. of ginger; ½ oz. of nutmeg; 2 drachms of Cayenne.

Dry these ingredients in an oven, pound, sift, mingle them well together, and bottle them.

5068. *Mushroom Powder.*—Wash half a peck of large mushrooms while quite fresh, and free them from grit and dirt with flannel; scrape out the black part, and do not use any that are worm-eaten; put them into a large stew-pan over the fire without water, with two large onions, some cloves, a quarter of an ounce of mace, and two spoonfuls of white pepper, all in powder; simmer and shake them till all the liquor be dried up, but be careful they do not burn. Lay them on tins or sieves in a slow oven, till they are dry enough to beat to powder; when powdered, put it into small bottles, which must be closely corked, and kept in a dry place.

5069. *Anchovy Powder.*—Pound the fish and rub them through a sieve, make them into a paste with dried flour, and roll it into thin cakes, and dry them before a slow fire (or oven). Pound them very fine, and put them into bottles. Cork them well, and the powder will keep good for many years. *N.B.—This sprinkled on bread and butter is an agreeable relish.*

5070. *Oyster Powder.*—Open the oysters carefully, so as not to cut them except in dividing the gristle which attaches the shells. Put them into a mortar, and when you have got as many as you can conveniently pound at once, add about two drachms of salt to about a dozen oysters; pound them and rub them through the back of a hair sieve, and put them into a mortar again, with as much flour (but previously thoroughly dried) as will roll them into a paste; roll this paste out several times, and, lastly, flour it, and roll it out the thickness of a half crown, and cut it into pieces about an inch square; lay them in a Dutch oven, where they will dry so gently as not to get burned; turn them every half hour, and when they begin to dry, crumble them. They will take about four hours to dry. Pound them, sift them, and put them into dry bottles; cork and seal them over. *N.B.*—Three dozen of natives required 7½ ounces of flour to make them into a paste, which then weighed 11 ounces; when dried, 6½ ounces. To make half a pint of sauce, put one ounce of butter into a stew-pan with three drachms of oyster powder and six table-spoonfuls of milk; set it on a slow fire, stir it till it boils, and season it with salt. This extract is valuable in inland countries, and equally good, when made into sauce, with fish, fowls, or rump steak; sprinkled on bread and butter, it makes a good sandwich. It is an excellent store sauce for the army and navy.

Subsect. 3.—*Store Sauces, Essences, Vinegars, and Catsups.*

5071. Under this head is an almost endless variety of flavouring ingredients, many of which, in the present state of English cookery, are almost indispensable.

Anchovy essence is one of the most esteemed of the essences. For those who prefer to have it home-made, it will be necessary to remark that success in making it depends greatly on having anchovies which have been long enough pickled, so as to dissolve easily without giving a rusty flavour to it. In choosing the fish, take care that you do not purchase sprats instead of anchovies, which are often sold for them; also, avoid having those in which red paint has been put into the pickle in order to improve the colour of the fish. Having observed these precautions, take a pound of the best anchovies you can get, and put them into two quarts of water, with two bay leaves, some whole pepper, a little scraped horseradish, thyme, two blades of mace, six eschalots chopped small, a wine-glass of port wine, and the rind of a lemon; boil all together for twenty minutes, rub them through a tamis, and pour the liquor into pint bottles; these must be corked down, and kept in a cool, yet dry place.

5072. *Soy.*—This sauce, much used for fish, comes from Japan, and is called there soja. It is made from the seeds of a plant called *Dolichos soja.* Some is also brought from China, but the Japanese is the best. It is supposed to be extensively counterfeited in this country. When genuine, it is of an agreeable flavour, neither too salt nor too sweet, of a thick consistence, and clear brown colour. When shaken in a glass, it should leave a coat on the surface of a bright yellowish-brown colour.

A somewhat similar sauce may be prepared in the following manner: Boil a gallon of the seeds of the *Dolichos soja* till they are soft; and even pease or kidney-beans may be used as a substitute; add an equal quantity of bruised wheat; put this mixture into a warm place for twenty-four hours, and add a gallon of common salt and two gallons of water. Shake the whole together, and put it into a stone jar, where it should remain closed up for two or three months, during which time it should frequently be shaken. After this time, the liquor should be pressed out through a sieve, which will constitute the soy. An inferior kind may be procured by putting salt water upon what remains, and treating it in the same manner.

5073. *Essence of Ham.*—Cut of lean ham three or four pounds into pieces about an inch in thickness; lay them in a stew-pan with slices of carrot, parsnips, and three or four onions. Let them stew till they stick to the pan, but do not burn. By degrees, pour in some good veal gravy, a few fresh mushrooms (or mushroom powder), truffles, morels, cloves, parsley, leek, basil, and a crust of bread; cover it close, and simmer it till it gets thick, then strain it off for use. *N.B.*—This essence is sold in the shops for three shillings a pound; and as a small quantity will give a strong flavour, it is by no means an expensive essence.

5074. *Soup Herb Spirit.*—Of lemon thyme, winter savoury, sweet marjoram, sweet basil, half an ounce each; lemon peel grated, two drachms; eschalots, the same; celery seed, a drachm avoirdupois weight. Infuse these in a pint of brandy or proof spirit for ten days. Neither wine nor vinegar will extract the flavour of the ingredients so well as the spirit.

5075. *Spirit of Savoury Spice.*—Black pepper, an ounce; allspice, half an ounce (*finely powdered*); nutmeg grated, a quarter of an ounce avoirdupois weight. Infuse these in a pint of brandy or proof spirit for ten days.

5076. *Soup herb spirit and spirit of savoury spice,* mixed in the proportion of half a pint of the herb spirit to a quarter of a pint of the savoury spice spirit, form a valuable auxiliary in the kitchen in heightening the flavour and giving an immediate finish to soups, sauces, ragouts, &c. They will keep for twenty years.

5077. *Relish for Chops.*—An ounce of black pepper, half an ounce of allspice pounded fine, an ounce of salt, half an ounce of scraped horseradish, and the same of eschalots peeled and quartered; put these ingredients to a pint of mushroom or walnut catsup; let them steep for a fortnight, then strain them off. A tea-spoonful or two of this mixed with the gravy sent up with chops, or with melted butter, is an agreeable addition.

5078. *Essences, likewise, of the various flavouring substances* may be prepared by procuring their essential oils, and adding them to proof spirit: a few drops of this will answer nearly the same purpose as the fresh herb; but, as they are extremely powerful, they must be employed with a cautious hand, drop by drop, until the article to be flavoured has acquired the proper taste. These domestic essences are now very generally used, on account of the superiority of the flavour they impart, and their economy. The following essences are now kept in the shops: Essence of allspice, bitter almonds, cassia, cinnamon, cloves, lemon, nutmegs, ginger. *Tinctures* may be made by infusing the substances in proof spirit or French brandy: these are superior to the essences. Some examples of these are the following:

5079. *Essence of Lemon Peel.*—Add gradually one drachm of oil of lemons to two ounces of the strongest rectified spirit. A few drops of this will give all the flavour of the rind of the lemon, and is very convenient for punch, blanc-mange, jellies, negus, lemonade, pies, puddings, ragouts, &c.

5080. *Tincture of Lemon Peel.*—Put the rind of lemons into brandy or proof spirit. In a fortnight the tincture will be ready. Tincture of Seville oranges may be made in the same way.

The olio saccharum of lemon may be preserved by rubbing lumps of sugar upon lemon peel, so as to take up the essential oil of the lemon: and these may be kept in a pot, pressing them well down.

5081. *Essence of Pimento.*—Add one drachm of oil of pimento to two ounces of proof spirit. This is very useful in making mulled wine, or gravies: a few drops will suffice.

5082. *Tincture of allspice* is made by steeping three ounces of pimento in a quart of proof spirit, occasionally shaking it during a fortnight.

5083. *Essence and tincture of nutmeg* are made in the same way.

5084. *Essence of Cinnamon.*—Add one drachm of oil of cinnamon to two ounces of rectified spirit of wine.

5085. *Tincture of Cinnamon.*—Steep grated or bruised cinnamon in proof spirit for a fortnight.

5086. *Tincture of celery, thyme,* savoury, marjoram, basil, &c., may be made by steeping these herbs for a fortnight in proof spirit or French brandy. A few drops will be sufficient for flavouring soups, &c.

5087. *Compound essences and tinctures* may likewise be made by exposing two or more of these substances together to the action of spirits.

5088. *The above essences and tinctures are kept ready for sale* in London shops, particularly Fortnum's, Piccadilly.

5089. *Chili Vinegar.*—Infuse fifty red English chilies (cut in half or pounded) in a pint of the best vinegar for a fortnight. A quarter of an ounce of Cayenne pepper added to the vinegar will answer as well.

Chili wine is obtained by putting fifty pounded red chilies into brandy instead of vinegar.

5090. *Basil Wine or Vinegar.*—Fill a wide-mouthed bottle with fresh, green basil leaves, and cover them with vinegar or wine, and let them steep for ten days. If a very strong essence be required, the liquor must be strained off, and more leaves be added to it, to steep in it for another fortnight; when this is done, it must be corked down. When used, a table-spoonful will give to mock-turtle soup the basil flavour.

5091. *Garlic Vinegar or Wine.*—Take a stone jar and put into it a bottle of white wine, half a glass of vinegar, the juice of two lemons, six cloves of garlic, the same number of cloves, the quarter of a nutmeg, and two bay leaves. Put the jar into a kettle of hot water, and set it over the fire; when it boils, cover the kettle close and take it off the fire, and let it stand closely covered near the fire for seven or eight hours; strain it through a coarse sieve; then filter and bottle, keeping it closely corked. A few drops will give a strong flavour to a pint of soup or gravy. A slight flavour of garlic is one of the finest we have; used to excess, it is disagreeable.

5092. *Eschalot Vinegar.*—Eschalots are in high perfection during July, August, and September. Peel and chop a quarter of a pound of eschalots, and pour on them a quart of white-wine vinegar; stop the jar, and let it steep for ten days, shaking it well every day. Pour off the clear liquor into small bottles.

5093. *Eschalot wine* is a more expensive, but a finer flavoured extract of eschalots than the above, and is prepared in nearly the same way. Three ounces of eschalots, peeled and pounded, are infused in a pint of sherry for ten days; the liquor is then poured off, and three more ounces of eschalots, peeled and pounded, are put to it, and suffered to steep in it for ten days longer, when the wine is again poured off and put into bottles, and closely corked. An ounce of scraped horseradish may be added, and the thin rind of lemon.

5094. *Tarragon Vinegar.*—This is an agreeable addition to soups, salad, sauce, and to mix in mustard. A wide-mouthed bottle must be filled with fresh-gathered tarragon leaves. These should be gathered on a dry day any time between midsummer and Michaelmas, just before it flowers. The leaves must be picked from the stalks, and dried a little before the fire, covered with the best vinegar, and steeped for fourteen days; strained through a jelly-bag until fine, and bottled in half-pint bottles; these must be carefully corked, and kept in a dry place.

5095. *Mushroom Catsup.*—Look out for mushrooms from the beginning of September; take care they are of the right sort, and fresh gathered; full-grown flaps are to be preferred: put a layer of these at the bottom of a pan, and sprinkle them with salt, then another layer of mushrooms and some salt on them, and so on alternately, salt and mushrooms; let them remain two or three hours, by which time the salt will have penetrated the mushrooms, and rendered them easy to break; then pound them in a mortar, or mash them well with your hands, and let them remain for two days, not longer, stirring them up and mashing them well each day. Then pour them into a stone jar, and to each quart add an ounce and a half of whole black pepper and half an ounce of allspice; stop the jar close, and set it in a stew-pan of water, and keep it boiling for two hours at least. Pour the juice clear from the settlings through a hair sieve (without squeezing the mushrooms) into a clean stew-pan; let it boil very gently for half an hour. Those who are for superlative catsup will continue the boiling till the mushroom juice is reduced to half the quantity; it may then be called *double catsup.* There are several advantages attending this concentration; it will keep much better, and only half the quantity be required, so that you can flavour sauce, &c., without thinning it. Neither is this an extravagant way of making it, for merely the aqueous part of the water is evaporated: skim it well, and pour it out into a clean jar or jug; cover it close, and let it stand in a cool place till the next day; then pour it off as gently as possible, so as not to disturb the settlings at the bottom of the jug, through a tamis, or thick flannel bag, till it is perfectly clear; add a table-spoonful of good brandy to each pint of catsup, and let it stand as before; a fresh sediment will be deposited, from which the catsup is to be quietly poured off, and bottled in pints or half-pints, which have been washed with brandy or spirit: it is best to keep it in such quantities as are soon used. Take especial care that it is closely corked, or dipped in bottle cement. If kept in a cool, dry place, it may be preserved for a long time; but if it be badly corked, it will soon spoil. Examine it from time to time by placing a strong light behind the neck of the bottle, and if any pellicle appears about it, boil it up again with a few peppercorns

5096. *Walnut Catsup.*—Boil or simmer a gallon of the expressed juice of walnuts when they are tender, and skim it well; then put in two pounds of anchovies, bones and liquor, ditto of eschalots; one ounce of cloves, ditto of mace, ditto of pepper, and one clove of garlic. Let all simmer till the eschalots sink, then put the liquor into a pan till cold; bottle and divide the spice to each. Cork closely, and tie a bladder over each. It will keep twenty years, and is not good the first. Take care to express the juice at home; it is rarely unadulterated if bought.

5097. *Walnut Catsup made of the green Walnuts.*—Bruise one hundred and twenty young walnuts; put to them three quarters of a pound of salt and a quart of good wine vinegar; stir them every day for a fortnight; then strain and squeeze the liquor from them through a cloth, and lay it aside; put to the husks half a pint of vinegar, and let it stand all night; then strain and squeeze them as before, adding the liquor obtained from them to what was put aside the day before; add one ounce and a quarter of whole black pepper, forty cloves, half an ounce of nutmegs bruised or sliced, half an ounce of ginger, and five drachms of mace, and boil it for half an hour; then strain it off from the spices, and bottle it for use.

5098. *Tomato Catsup.*—Take one gallon of fine, red, full-ripe tomatos; mash them up with half a pound of salt; let them rest for three days; then press off the juice, and to each quart add two ounces of eschalots and one ounce of ground black pepper; boil these up together for half an hour; then strain them through a sieve, and put to the juice the following spices: quarter of an ounce of mace, allspice ditto, ginger ditto, nutmeg ditto, one drachm of coriander seed, and half a drachm of cochineal; bruise them all together, and let them simmer together gently for twenty minutes, and strain them through a sieve. When cold, bottle it, and add a wine-glass of brandy to each bottle; cork it, and it will keep good for seven years.

5099. *Oyster Catsup.*—Take some fine fresh Milton oysters, wash them in their own liquor, then pound them in a marble mortar, and to a pint of oysters add a pint of sherry; boil them up, and add an ounce of salt, two drachms of pounded mace, and one drachm of Cayenne; let them all boil up again; skim them, and rub them through a sieve. When cold, put it into bottles; cork, and seal it well. It is best to pound the spice in the mortar with the oysters.

SECT. VIII.—PASTRY.

SUBSECT. 1.—*Preparing Pie Crusts.*

5100. *Pastry generally* is composed of similar ingredients, but which, being differently proportioned and incorporated, form many varieties; such as the *rich*, the *plain*, the *flaky* or *puff pastry*, the *short crust*, &c. In hot weather, a cool place, a marble slab, and cool hands are essential in making good pastry; in the winter it is necessary to render the temperature warmer. The cook, in hot weather, should place the butter to be used in a pan of cold water for a few hours, and, whenever it is possible, the pastry should be made early in the day; the less the hand touches the pastry the better. The flour and water may be mixed together with a wooden pestle, the butter laid on with a knife, and the whole completely united by the use of the rolling-pin. In making pastry, a proportion is always observed between the quantity of butter to be incorporated with the flour, and the number of times the paste is to be folded up and rolled out. Thus, if half a pound of butter to a pound of flour is the proportion, the paste is made up into three folds, and rolled out three *times*, or *turns*, as the cook calls it; if three quarters of a pound of butter is used to one of flour, the paste must have *five turns*, that is, folded in three, and rolled out five times. A pound of butter to a pound of flour will require five and a half or six turns. By half a turn, the doubling the paste, and not folding it in three, is understood. In all pastry very little liquid should be used in mixing the ingredients together; no more than just to form them into a smooth paste.

5101. *Receipt for a rich Meat Pie Crust.*—Make a pound of well-dried flour into a stiff but smooth paste, with very weak salt and water; roll it out on the marble slab or paste-board; take a pound of butter, and lay with a knife a portion of it in patches on the surface of the paste; roll it in three folds, and roll it out again; lay on another portion of the butter, and proceed in the same manner for five times; the butter being thus incorporated with the flour, the paste requires nothing more than to be rolled out the thickness required for the pie. Roll out and put a small piece of the paste in the oven, which, if sufficiently heated, will soon show its thickness, and serve as a test for the rest. When once put into the oven, the door must be closed until the pastry has risen; cold air admitted to the oven while the pastry is rising would cause it to fall and become heavy.

5102. *Plain Meat Pie Crust.*—The proportion: half a pound of butter or beef suet, or dripping, to a pound of flour; the turns, three.

5103. *A Short Pie Crust.*—Rub half a pound of butter into a pound of dried flour, and add a tea-spoonful of finely-pounded sugar. Mix the paste smooth with water, and give it three turns. The suet, or dripping crust, answers for the servants' table, or for that of a family in which economy is an object. A dripping crust requires great care in baking; if the oven is too hot, and it is all burned, the crust is then neither agreeable nor wholesome.

5104. *Crust for Venison Pasty.*—The *crust for venison pasty* is sometimes made like other meat pie crust, the proportion being three quarters of a pound of butter to a pound of flour, half rubbed in, the rest laid on; five and a half turns allowed. Another receipt allows only half a pound of butter to a pound of flour, the paste being formed before the butter is incorporated with it, with the yolks and whites of three eggs well beaten. If these are insufficient to mix it smooth, a little weak salt and water may be added. The dish in which a venison pasty is to be baked must be lined with paste on the sides, but not at the bottom. The lid of the pasty should be thicker than that usually covering a meat pie, in order to stand a long continuance in the oven.

5105. *Standing Crust for Yorkshire Pies.*—Take a peck of flour and six pounds of butter; boil the butter in a gallon of water, and, as it dissolves, skim it off from the surface, taking with it as little of the water as possible; work it well into the flour until a smooth paste is formed, and, when cold, make it up in the usual form.

5106. *Potato Crust.*—Pound some boiled potatoes very smooth, and add, while warm, a sufficiency of butter to make the mass hold together; if not butter, the yolk of an egg will do as well. Then roll on the board this paste to a proper thickness, and put it on the dish while warm; if cold, it will crack. It makes it richer to put both egg and butter into the crust.

5107. *Puff Paste for Patties, Vol au Vents, &c.*—*Puff paste* for any composition requiring a deep border is rarely well made. It depends upon a nice attention to the rolling of the pastry; the number of times which it is *folded* and rolled out is regulated by French cooks according to the proportion of the flour and butter. Thus, to three quarters of a pound of butter to one pound of flour they allow *five turns;* that is, the paste must be folded in three, and rolled out five times. A pound of flour and a pound of butter take five and a half or six turns. When the paste is only doubled, not folded in three, it is called half a turn. Now take a pound of well-dried flour, separating from it as much of it as may be wanted for working the paste; weigh and wash a pound of butter, and put a small piece of it into the flour; take a quarter of an ounce of salt, dissolve it in cold water, and mix the flour with it to a smooth paste. If the butter is soft, put it into a dish, and set it in a pan of cold water until it is of a consistency equal to that of the paste. Dust the board with some of the reserved flour, and spread out the paste as square as possible. Mould the butter, also, into a square, with a floured cloth; lay it in the middle of the paste, and fold the paste over it, so as to cover it entirely; dust it with flour, and roll it out gently, taking care that the butter does not break through the paste, which, if too hard, it will be apt to do. When the paste is rolled out to its utmost extent, fold it up in three, dust it and the table with flour, and roll it out again; this is called two turns. Dust it with flour, and let it lie untouched for a quarter of an hour, after which give it two more turns; then let it lie another quarter of an hour or ten minutes, and roll it out again for the fifth and last time, unless, as before mentioned, the proportion of butter to flour is greater than here directed, in which case it will require half, or a turn more. The last rolling must extend the paste to the proper thickness, as it cannot be rolled out again without injuring it. Have a quick oven for it, and do not open it till the paste is nearly done, or it will fall.

SUBSECT. 2.—*Making Savoury Pies.*

5108. *Rump-steak Pie.*—Cut three pounds of rump steak, sufficiently hung to be tender, into pieces about three or four inches in length; trim off all skin and sinew, and beat the steaks well with the rolling-pin. Chop half a dozen eschalots very fine, and mix a tea-spoonful of black pepper and a tea-spoonful of salt together; spread on the bottom of the dish a layer of eschalot, and sprinkle it with the seasoning; on this spread a layer of meat, then the eschalot and seasoning, and fill the dish in this manner; pour over it a wine-glass of mushroom catsup, and the same quantity of beef gravy or of red wine. Cover it with a moderately thick crust, and bake for two hours.

5109. *Beefsteak Pie, with Oysters.*—Cut from a tender rump a thick steak of about three pounds weight. Fry it slowly in some of its own fat, of a nice brown. Beard three dozen oysters; reserve their liquor, which stir and mix with some beef gravy; distribute the beef and oysters into the pie-dish; season highly with black and Cayenne pepper, but not too much salt. Put in part of the gravy, and cover it with a pretty thick crust of puff paste. Bake it slowly, and if more gravy be required, pour in the remainder some time before it is taken from the oven. *N. B.*—All meat pies should be done in a slow oven, for if they boil fast the meat will be rendered tough.

5110. *Veal Olive Pie.*—Cut off from a fillet of veal as many slices as the number of olives required; make them flat and smooth with the chopper, or by beating them once or twice with a rolling-pin. Rub each over with beaten yolk of egg; cut thin slices of fat bacon the same size as the veal; lay it on the veal; rub that with egg also: have a veal forcemeat ready (see "Forcemeat"), and spread it scantily over the bacon; roll the whole up tight, and cover the surface with egg and bread crumb. Line the pie-dish with paste, and put in the olives, covering them with some good gravy. Let it bake two hours; have a gravy ready thickened with cream and flour, and pour it into the pie before it is served.

5111. *Ham and Veal Pie.*—Cut some thick slices from a leg of veal, divide them into convenient pieces, and make an incision into each piece to introduce a thin slice of lean ham well seasoned. Put at the bottom of the pie-dish some light forcemeat, composed of the fat of the ham, beat with the panada herbs and yolk of egg (see "Forcemeat"); make also some balls of the same, which poach and distribute between the layers. Add plenty of seasoning, pour in veal gravy, and cover the dish with a thick puff paste. Bake, and before it is done, introduce some additional gravy. In the same manner ham and chicken pie may be made; but in the latter instance some cream should be worked into the veal gravy.

5112. *Venison pasty* is best made with the neck and breast of venison. Take out the bones and stew these with the trimmings in sufficient beef stock, a bunch of parsley, green onions, and an eschalot; add two glasses of port wine. In this liquor braise the pieces of venison till they are half done, when they are to be put into the pie-dish, and seasoned with salt, pepper, and allspice; strain, and clear the gravy from fat; cover with a thick puff paste, and reserve some of the gravy to supply that which is consumed. A slice of raw ham considerably improves the flavour of this pasty.

5113. *Mutton Pie.*—Cut into chops, trimmed neatly from all fat, off the best end of a neck or loin of mutton. Lay them in a dish, and season them with pepper and salt; add a wine-glass of mushroom catsup, some chopped onion, and sliced potatoes; cover it with a crust (see " Pastry"), and bake it for two hours. When done, lift up the crust, and pour out the gravy to cool, so as to remove the fat; then boil it up, and pour it into the pie again.

5114. *Small Mutton Pasties.*—Cut the paste the size of a mutton chop; season and shred some garlic over each, and, if not very fat, add a small piece of fresh to each. Cover them with a crust, and bake them in a moderately quick oven. These small pasties serve to make out a dinner, and are very relishing when nicely dressed.

5115. *Pork Pies.*—Cut the meat left after trimming flitches that are being prepared for salting into small pieces, together with trimmings from the griskins, and the meat from the sweet bone. Keep the fat and lean separate, and season both with pepper and salt; then raise the crust (see receipt for), and, when ready, fill the pies closely with layers of lean and fat, those of the lean being of greater depth than the fat layers. Unite the lids firmly to the sides, and bake the pies in a soaking oven, the meat, being solid, requiring this; put no water or gravy into the pies.

5116. *Rabbit Pie.*—Stew in clarified butter some parsley, mushrooms, a table-spoonful of green onions chopped, and an eschalot minced; when tender, put in a couple of rabbits properly divided, and let them stew about a quarter of an hour. Take them out, and put them into a raised earthen pie-dish, sheeted with paste. Drain the butter from the vegetables, and put them into the pie with plenty of seasoning and some veal gravy, or, which is better, some gravy obtained from rabbits. Put a paste cover to the dish with a hole in the top, to suffer the steam to evaporate, and also to introduce some fresh gravy as the other consumes. Bake it till done. *N. B.*—Never put water into a meat pie, but always gravy, as the water dissolves the nutritious parts of the meat, and leaves it tasteless, so that the whole of the savour is in the extracted gravy.

5117. *Giblet Pie.*—Clean and half stew two or three sets of geese giblets; cut the leg into two, the wing and neck in three, and the gizzard into four pieces; preserve the liquor, and set by the giblets till cold, as the heat of the giblets would spoil the paste which covered them. When cold, put them into the dish, season and salt them, and cover them with a good butter and flour paste. (See " Pastry.") Cover the surface with the yolk of egg, and bake it an hour and a half in a moderately heated oven. Take away the fat from the liquor in which the giblets were stewed, and in a clean stew-pan set it over the fire with a little flour and water, seasoned with black pepper and salt, and flavoured with lemon juice; add a few drops of browning, and, when hot, pass it through the tamis, or sieve, and afterward, by means of a funnel, into the pie. Into a giblet pie some put a beefsteak, or remnants of cold game or poultry.

5118. *Pheasant Pie.*—This is to be eaten cold. When you have a superfluity of game, pick and empty a couple of pheasants, clean the insides well, and pepper them thoroughly. Stuff the insides with a bunch of parsley, an onion or two, some trimmings of mushrooms, and truffles, if you have them. Put a piece of the fat of ham on the breasts of each, and half roast them. When removed from the fire, empty their insides of the herbs, which stew with some veal broth for their gravy. Cover them with paste, and bake them, with the precautions before directed. In the same manner proceed to make pies of moor-game and partridges. Observe to press the birds flat, and bake them with the backs uppermost.

5119. *Pigeon Pie.*—When pigeons are plentiful and cheap, you may afford a couple to make the gravy for the pie. When emptied and washed, divide these two pigeons, and mash them, bones and all, in a mortar; put some parsley, trimmings of mushrooms, and truffles, if you have any, with green onions and some salt, into butter, to stew gently; when tender, put in the mashed pigeons, and, when they have well sweated, moisten with some veal broth, so as to possess, after the gravy is completed, rather more than a pint, which strain, and skim off the fat. Put into a pie-dish, sheeted with paste, a veal cutlet, and over it six pigeons, both well seasoned; distribute some egg balls (see "Forcemeats"), and fill up the dish with part of the prepared gravy; then apply a paste cover of a good thickness. Bake it, and, as the gravy exhales, fill up with the remainder. *N.B.*—This pie requires to be well seasoned, and eaten hot. If you make a pigeon pie to be eaten cold, you may cover the bottom, sides, and top with slices of bacon, as, when cold, the fat may be removed. If you prefer beefsteak to veal at the bottom, it may be substituted.

5120. *Trout Pie.*—This is to be eaten cold, and is nearly as good as potted char. Take a dozen of small trouts, from a quarter to half a pound; empty them, and detach the fins. Parboil them in salt and water, and lay them on a hair sieve to drain, and put them in a very slack oven for a few minutes to become dry. When they are taken out, brush them over, inside and out, with clarified butter, and have ready a mixture of salt, black pepper, Cayenne, and allspice, with which season them, likewise, both inside and out. Pour some clarified butter at the bottom of the earthen dish, and arrange the trout in it; then pour in more of the butter until they are covered. Set them in a moderate oven for half an hour, or till they are sufficiently done, and suffer them to cool. In this manner they will keep some time.

5121. *Eel Pie.*—When the eels are skinned and cut into pieces about two inches in length, blanch them, by pouring on them sufficient boiling cider with some salt, or, if this be not at hand, some vinegar, salt, and water of the same temperature. This hardens them, and extracts a portion of their oil; when cold, take them out, and place them in a sheeted pie-dish; add a little salt, shred lemon peel, and black pepper. Cover them with a sauce composed of equal parts of veal gravy and thin cream. Let it bake gently, and the eels will eat firm.

Subsect. 3.—*Savoury Patties.*

5122. *Of savoury patties, the first consideration is the pastry*, which should be made according to the directions already given under the head *Puff Paste.* The tin moulds being lined with the paste, and the covers neatly cut out (the surface of which must be brushed over with beaten egg), pieces of crumb of bread sufficient to support the cover are put into each, and they are baked in a moderately brisk oven until they become of a yellowish brown. If the oven be too hot, they should be covered with a sheet of paper. When baked, the cover is taken off, the bread removed, and the inside filled with some savoury composition. The cover is replaced, and the patties are ready to be served. Sometimes they are made without covers; if this method be adopted, it is necessary to make a depression, or hollow, in the middle sufficient to contain the savoury composition.

5123. *Lobster Patties.*—The meat of boiled lobsters is set over the fire with some strong veal consommé, a little flour to thicken, some eschalot chopped fine, an anchovy pounded, and a little grated lemon peel. After these and a seasoning of Cayenne pepper are put in, the whole must simmer together for five or six minutes, and when taken off the fire, some lemon juice must be added and stirred in well. The patties are then filled, and served hot. *Oyster patties* are made in the same way, the oysters being previously chopped.

5124. *Patties of ham and chicken,* finely mixed, may be made of a lean boiled ham and the breasted and white meat of roasted fowl; to these are added eschalot, a slice or two of truffles stewed till tender in wine or gravy, and afterward chopped fine, some veal consommé, a little cream, Cayenne pepper, salt, and flour to thicken the gravy. After simmering these over the fire for a few minutes, the patties may be filled. Lemon juice, if added, must be put in at last, after the composition is withdrawn from the fire.

5125. *Patties of forcemeats,* such as those compounded of sweetbreads, herbs, and panada, or any other light forcemeat, must be united with the yolk and white of egg, and baked in the patties. When baked, the covers must be removed while some strong consommé or bechamelle is added.

5126. *Patties of game* may be made of any cold pheasant, partridge, or woodcock, finely minced with eschalot, mushrooms, and truffles, and seasoned with Cayenne. To these may be added either sauce velouté or bechamelle, with flour to thicken. After simmering for a few minutes, this savoury meat may be put into the patties.

SECT. IX.—COOKING VEGETABLES.

For a description of the vegetables, see Book VII., Chap. VIII.

5127. *Potatoes.*—These should be selected of the same size, because, if boiled together, the small ones will be overdone and the larger remain hard. Let them be pared, and put on in cold water, by which they get gradually heated; they should boil very slowly; fast boiling breaks them, and lets in the water. Feel with a fork when they are done enough. When they are sufficiently boiled, pour the water from them, throw in some salt, cover them with a napkin to absorb the vapour that may arise, and put them by the side of the fire to keep hot. Some prefer cooking them by steam. *Potatoes half boiled* may be sliced and broiled, or they may be fried until they acquire a nice brown. *Potatoes three parts done* may be put into the dripping-pan to receive the drippings from the meat; in this way they are excellent, and, at the same time, economy is consulted. *Potatoes roasted* in the Dutch oven, or baked, do not require paring, but only to be well cleaned. *Potatoes mashed* after they have been boiled ought to be beaten smooth in a mortar or potato-masher, and mixed with the yolk of an egg and cream, or, if you have no cream, with hot milk and some butter; add salt, and put them in either dish or scollop shells, or they may be warmed in a sauce-pan, constantly stirred. The surface may afterward be browned with the salamander.

5128. *Cabbage and Greens.*—All the cabbage tribe, which includes cauliflower, brocoli, coleworts, sprouts, and turnip tops, in order to be delicate, should be dressed young, when they have a rapid growth; but if they have stood the summer, they require to have felt the influence of the frost to become tender. In order to appear green at table, they must be boiled in hard water. Greens of the above description, when of advanced growth, are better flavoured when boiled in two waters, which is managed in the following manner: After they have been about half boiled, take them out of the pot, place them in the colander, and allow cold water to run on them for two or three minutes; then replace them in a fresh pot of boiling water, with some salt, and let them continue to boil briskly till done. Cauliflower should boil more slowly, as it is apt to be broken by the force of a violent ebullition. Brocoli, to be freed of its offensive odour, should always be boiled in two waters.

5129. *Carrots,* when young, require to be simply boiled till they are sufficiently tender, which may be known by passing a fork into them; but during the winter they are apt to become in parts hard and stringy; when they are in this state, they may be cut into lengths convenient for boiling, and their internal and stringy part, which is very indigestible, may be scooped out by a small gouge.

5130. *Turnips* are seldom served whole, but, after they have been boiled, are sent to table mashed. When stringy, they must be passed through a coarse sieve. In order to mash them, let the water be well pressed from them; add sufficient butter, salt, and pepper, with a little powdered white sugar, which much improves their flavour. A little flour mixed with the butter renders the turnips less watery when mashed.

5131. *Spinach*, after being well picked, may be boiled in water with some salt; or it may be put into the sauce-pan and boiled in the juice which itself affords. When done enough, let the water be pressed from it, and, when put into the dish, divide it into squares. Spinach, when boiled, may be finely chopped and mixed in a stew-pan with some cream previously heated; add some pepper, salt, and a little powdered sugar. If you prefer a slightly acid flavour, add a tea-spoonful of lemon juice after it is removed from the fire. Avoid stewing spinach in butter, as the heat it communicates renders it crisp and destroys its colour. Fried toasts are usually served round the dish when spinach is stewed in this manner.

5132. *Asparagus and Sea Kale.*—The latter requires simply boiling over a brisk fire. Asparagus, when properly scraped, and cut of a uniform length, is tied up in bundles and boiled. A toast moistened in some of the liquor is sent up with both, and they are eaten with melted butter, salt, and pepper. When the asparagus is young, and so slender that it is not fit to be brought to table dressed whole, the green tops and more tender parts may be cut into pieces and boiled till more than half done, in salt and water; let them drain, and when you have melted some flour and butter in a small stew-pan, moisten with a spoonful or two of veal consommé, to which add a lump of sugar; next work the yolk of an egg and some cream into the sauce; put in the pieces of asparagus, and let them boil for two or three minutes. Serve it up in a dish garnished with fried toasts. You may occasionally vary this dish by adding green onions and chopped parsley to the asparagus.

5133. *Cucumbers.*—A fresh-gathered cucumber requires to be pared and thinly sliced; put the slices for about a quarter of an hour into cold spring water. Before you dress them, take them out and let them drain on a napkin for a minute; put them into a dish, and add oil, vinegar, and plenty of Cayenne and black pepper. Sprinkle them, of course, with a little salt. Cucumber thus dressed is now eaten with boiled fish, as turbot, salmon, and mackerel. *Another way of dressing cucumbers* is to cut them into slices about the thickness of a crown piece, and let them soak in vinegar and salt for half an hour. When taken out, dry them with a napkin, and fry them in butter of a very light brown; take them out of the pan when sufficiently done, and let them drain before the fire. To the butter in which they have been fried add some flour, and incorporate them well; moisten this with veal gravy and the yolk of an egg; work the sauce well, and, when reduced to a proper consistence, season it and pour it over the fried slices of cucumber.

5134. *Green Pease.*—According to the English fashion, they only require to be gathered young and dressed on the same day. They ought to boil fast; mint may be put with them, or omitted, as it may be most agreeable. A few taken out of the pot with a spoon, and tasted, will indicate when they are done enough. When properly drained in the colander, have ready a couple of pie-dishes made hot, into one of which put the pease, with some pieces of butter, and cover it with the other; then invert the dishes four or five times, that the butter may be equally distributed among the pease, and serve them up hot.

5135. *Windsor beans*, when young, are to be simply boiled, and served up with parsley and butter. When old, the external skin may be taken off after they have been boiled, and the green part well mashed over a gentle fire, adding butter and a little flour, chopped parsley, pepper, and salt. You may cover the top with grated Parmesan cheese, and apply the salamander, or you may include in the mashed beans some pieces of boiled bacon, cut into such shapes as may be most approved.

5136. *French Beans.*—In order to have them green at table, they should be gathered young, and trimmed, stringed, and divided. Boil them fast in water, with some salt. Do not divide each bean into more than four pieces, as they lose their flavour when shred, and become watery. All French beans should be of the same growth; for, if the young be mixed with the old, they will be unequally done.

5137. *Salad.*—The component vegetables of a salad are very numerous, and there are various modes of dressing it. Whatever may be selected should be fresh gathered, scrupulously washed, and it should lie for some time in cold spring water. Let it be trimmed for the table, so that there may be no cutting off any refuse parts when brought to it. To be in perfection, a salad should be eaten the moment it is dressed; if it soak in the materials, it becomes vapid and flaccid. It is always best to have the materials ready mixed to pour on the salad. If mustard be employed as one of the ingredients, it ought to be made the day before. The vegetables, when taken out of the water, should be properly drained; this is best effected by swinging them in a clean napkin, together with gentle pressure; when dripping wet they dilute the vinegar, which should be strong and sparingly used. As many persons cannot digest a mixture of boiled egg with mustard, oil, and vinegar, the two former may be omitted: indeed, the best and most elegant salads are composed of two parts of oil, with one of strong vinegar, and a sprinkling of salt; in winter a small quantity of Cayenne pepper may be added.

SECT. X.—PUDDINGS, TARTS, AND SWEET DISHES.

SUBSECT. 1.—*Puddings.*

5138. *Plain Family Rice Pudding, baked.*—Put into a pie-dish rice washed and picked, in the proportion of a quart of milk to four table-spoonfuls of rice, one of moist sugar, some grated lemon peel, a stick of cinnamon, and two or three small pieces of cold butter. Let this bake in a slow oven for three, or even four hours. The milk must be new, or it will curdle.

5139. *Another Receipt for baked Rice Pudding.*—Boil for a quarter of an hour a pint of milk and half a pint of cream, with a piece of lemon peel and cinnamon; sweeten it with powdered loaf-sugar; strain it, and set it on to boil for the same time, with two ounces of ground rice. When cold, stir into it three table-spoonfuls of oiled butter, four eggs beaten, a glassful of noyeau, and some grated nutmeg; sheet some puff paste round the rim of the dish, and bake it gradually.

5140. *Rice Pudding, boiled.*—Take half a pound of *Carolina* rice; steep it in milk for half an hour, that is, put it into cold milk, and set it by the fire to warm gently and slowly. If too quickly done over a hot fire, the swelling of the rice is checked. When cold and stiff, tie it up in a pudding-cloth, and boil it for an hour in water. Serve it with sweet sauce of melted butter and sugar, flavoured with lemon peel and lemon juice.

If a richer pudding be required, three or four eggs may be added to the rice after it has been steeped, and then it may be boiled either in a cloth or basin.

5141. *Rice and Apple Snow-balls.*—After steeping rice in milk, apples, peeled and cored, may be boiled in the centre of the pudding. Currants and raisins, in the same way, may also be mixed with the rice.

5142. *Ground Rice Pudding.*—Mix four table-spoonfuls of ground rice very smoothly in a few table-spoonfuls of cold milk; boil a pint of new milk, and mix it with the rice as smoothly as possible, beating it well together. When cold, add to it the yolks of four or six eggs (according as the pudding is required to be rich or otherwise), and the whites of half the number; pound three bitter and half a dozen sweet almonds with sugar; grate some lemon peel, and, if liked, some nutmeg also; butter a dish, and bake in a quick oven for half an hour, or boil in a basin for the same time. Turn it out, and serve with white wine sauce.

5143. *Puddings of millet, sago, tapioca, and arrow-root* are also very wholesome and elegant. The whole art of making them consists in incorporating these different farinaceous substances in the first instance with milk, in which they are to be boiled; then sweeten to the palate; after which, when they are cold, add beaten eggs and some powdered spice, as cinnamon, nutmeg, or cloves infused in brandy.

5144. *Batter Pudding.*—Take six eggs, a pint of new milk, half a pound of dry flour, and a little salt; beat up the eggs with the milk, and by degrees sift in the flour till the whole quantity is incorporated; add a little powdered cinnamon or grated nutmeg; boil it in a basin an hour and a quarter. To be eaten with a sauce composed of melted butter, sugar, and lemon juice; wine may be added, if agreeable.

5145. *Pancakes and Fritters.*—*For pancakes,* break three eggs in a basin and beat them up with a little salt, put to them four ounces and a half of flour, mixing them together with milk until the whole is brought to the consistency of good cream. Have a clean frying-pan, not too large; make it hot, and to each pancake put in a piece of butter the size of a walnut. When the butter boils, pour in the batter until the bottom is covered, and fry them on both sides of a light brown. Serve them one by one, or roll them up and send up three or four together.

For fritters, make the batter rather thicker, adding a spoonful more of flour to it. Peel either apples or lemons, take out the core and pips, and slice them; pour a tea-cupful of batter into a pan of hot lard, and lay a slice of apple or lemon in the centre; pour a little more batter on it, and fry of a light brown on each side. Various kinds of fruits may be fried in fritters besides apples.

Rice Fritters.—Steep a quarter of a pound of rice in a small quantity of milk, and fry it with butter in thin cakes. Serve with sweet or wine sauce.

5146. *Plain Fruit Puddings.*—These are a common family dish: they are usually boiled, and are prepared by sheeting, wholly or partially, a basin with pudding paste, and the vacancy filled with any kind of green or ripe fruit. Care must be taken that the crust does not burst or detach to let in the water. When sufficiently boiled (and the time required will depend on the state of ripeness in the fruit, the green occupying much longer) a hole may be cut in the top, by which they are to be sweetened before they are sent to table.

5147. *Apricot or Greengage Pudding, baked.*—Boil ripe apricots or greengages, in sufficient water to cover them, till they are tender; then take them out and rub the pulp through a hair sieve; sweeten it sufficiently. Beat half a pound of this pulp with a quarter of a pound of Naples biscuits, to which add six eggs, a pint of cream, and a pinch of salt; when well incorporated, sheet the rim of the dish with puff paste, and bake gently till done. In the same manner puddings may be formed of the pulps of ripe peaches, nectarines, egg-plums, or of any ripe fruits from which a pulp may be obtained.

5148. *Lemon Pudding.*—Pare thinly and boil the external rinds of three lemons; beat these in a mortar with loaf-sugar, an ounce of blanched almonds, and half a pound of Naples biscuits; beat up six eggs with a pint of cream, and mix all well together; add some powdered cinnamon or grated nutmeg; edge the rim of the dish with puff paste, and bake it gently. In the same manner you may make an orange pudding, by substituting their rinds for those of lemon.

5149. *A Plain Pudding.*—Line a pie or pudding dish with thin slices of bread and butter. Peel, core, and slice some apples; lay them in layers in the centre of the lined dish, adding here and there a small lump of fresh butter, some grated lemon peel, and sugar; fill up the dish, and lay at the top some thin slices of bread and butter soaked in cold milk. Cover the top with a plate or dish, and put a weight on it to press down the fruit. Bake it for three hours in a slow oven; an hour before it is done, remove the weight and dish, and let it brown on the top. When done, turn it out of the pie-dish to the one on which it is to be sent to table.

5150. *Tansey Pudding.*—This is with many a favourite in the spring. Bruise sufficient tansey to obtain three table-spoonfuls of its juice; pour this on as much crumb of French roll as will imbibe it. Pound three ounces of blanched sweet almonds to a fine paste with two ounces of loaf-sugar, the same quantity of butter, and a tea-spoonful of grated Seville orange peel. Beat up a pint of cream with six eggs, and mix all the ingredients thoroughly together. This pudding may be either boiled or baked; if the former, it requires a sauce of melted butter, sugar, and lemon juice.

5151. *Rich Plum Pudding.*—The excellence of this depends equally on the mixing and boiling. Pound to a fine paste two ounces of blanched almonds, and mix them with eight egg yolks and whites beaten up together; add a pint of cream; into this stir a pound of sifted flour, a pound of raisins stoned, the same quantity of currants picked, and a pound of suet very finely chopped. Add sufficient sugar, with spices, some candied orange peel or citron, and a couple of glasses of cherry brandy. Boil it five hours. This pudding may be baked, if you prefer it.

5152. *Plain Plum Pudding.*—Stone half a pound of raisins, clean very well half a pound of currants, chop finely half a pound of beef suet, grate a pound of bread crumbs, pound a few bitter and sweet almonds, and shred a little candied peel; mix these thoroughly together, and moisten them with milk; put the whole either into one mould, or into three small ones. Boil the large one for four or five hours, the small for three.

5153. *Suet Pudding.*—Take beef suet, chopped fine, and flour, of each half a pound, three eggs, whites and yolks well beaten together; mix these with as much milk as will be required to make it of a proper consistence; add some salt and a little powdered allspice; tie it firmly in a cloth, and boil it thoroughly.

5154. *Marrow Pudding.*—Pour gradually a quart of boiling milk on half a pound of Naples biscuits and the same quantity of chopped marrow; mix them well together, and let them cool; when cold, beat up six yolks of eggs and the whites of two only, which stir into the other ingredients; add a handful of currants picked and washed, thin slices of candied citron, and a little powdered cinnamon; sheet the sides and rim of the dish with puff paste, and bake it.

Subsect. 2.—*Apple Tart.*

5155. *Peel, core, and quarter* eight or ten russet apples or lemon pippins; lay them closely in a dish, adding lemon juice if the apples are not very sharp, and lemon peel and sugar. Some cooks put in two or three cloves, others quince marmalade; but as the flavouring ingredients are not always liked, they are better omitted. Cover the dish with puff paste, and bake an hour and a quarter.

5156. *Cranberry Tart.*—Take and wash a quart of cranberries in several waters; put them into a baking-dish, with the juice of half a lemon and a quarter of a pound of moist or powdered lump sugar. Cover them with puff paste, and bake three quarters of an hour. Five minutes before it is quite done, ice it (see "Icing") and return it to the oven.

5157. *Rhubarb Tart.*—If the rhubarb has a green spotted surface, it is a kind that may be cut up without peeling; if the red sort, the peel must be torn off before it is cut up in pieces of an inch in length. Fill a dish with these, adding sugar and lemon peel, and, after covering it with a puff or short paste, bake it for three quarters of an hour.

5158. *Icing for Fruit Tarts.*—Beat up to a froth the white of two eggs, and when the tart is nearly baked, with a paste brush cover the crust with some of the white, and sprinkle it over with some finely-powdered lump sugar; wash the brush, and splash the sugar very gently with water till it is dissolved. Put the tart again into the oven for five minutes longer.

Subsect. 3.—*Cheese-cakes.*

5159. *Curd Cheese-cakes.*—Incorporate a quart of curd with half a pound of butter in a soft state, half a dozen macaroons, three yolks, and the white of one egg. Sweeten it sufficiently, and put in a pinch of salt and some grated lemon peel. When all these are well beaten together in a mortar, sheet some tartlet moulds with puff paste, put some of the mixture into each, and bake them quickly. If you please, some currants and candied orange peel may be added. Some are partial to the flavour of noyeau. These puddings may be either boiled or baked; when intended for the latter, they are improved by the addition of a little oiled butter. Some add perfumes, as rose or orange flower waters.

5160. *Lemon Cheese-cakes.*—Grate the rind of three and the juice of two lemons; mix them with three sponge biscuits, six ounces of fresh butter, four of powdered sugar; add some pounded cinnamon and nutmeg, and mix the whole well together with three well-beaten eggs and a glass of cream. Sheet the patty pans with puff paste (see "Pastry"), and fill them with the mixture, laying on the surface of each cheese-cake thin shreds of candied peel.

5161. *Orange Cheese-cakes.*—Orange cheese-cakes are made in the same way, orange juice and rind being employed instead of lemon.

5162. *Almond Cheese-cakes.*—Blanch, dry, and pound with rose or orange flower water very fine, six ounces of *sweet* almonds and half an ounce of *bitter;* reduce to a cream with a spoon half a pound of butter, and mix the almonds with it, adding six ounces of powdered sugar, some grated lemon peel, a quarter of a pint of cream, and four beaten eggs. Fill the patty pans, sheeted with puff paste, and bake in a quick oven for half an hour; put candied peel on the tops of each cheese-cake.

5163. *Mince Meat.—Take two pounds* of beef suet finely chopped and picked free from strings, *two pounds* of apples peeled and chopped small, *two pounds* of raisins stoned and chopped, *two pounds* of currants washed and thoroughly cleansed, one pound of good moist sugar; boil three lemons, and, after pounding the rinds small, add them and the juice to the other ingredients; chop small half a pound of candied citron and lemon peel, and work all these ingredients together with two wine-glasses of French brandy, and a little salt. Put them into a covered jar, which place in a cool spot, and the mince meat will keep for several weeks. Keep at the top of the jar some unchopped candied peel, and add a slice to each mince pie, when any are being made. Some prefer puff paste, others a short crust, for sheeting the pans.

Subsect. 4.—*Creams and Custards.*

5164. *Cream for Tarts.*—Mix together half a pint of cream and the same quantity of milk; put into it a piece of fresh lemon or Seville orange peel, a little cinnamon, and sweeten it with loaf-sugar. Let them boil about ten minutes. Have ready prepared in another pan the yolks of six eggs, well beaten up with a heaped tea-spoonful of fine flour; to these gradually strain the boiled ingredients, and whisk them well together over a gentle fire, so that they may acquire the proper consistence without curdling. If you are deficient of cream, milk only may be employed, but in that case a little more flour will be required. When cold, it may be distributed over tartlets or pies.

5165. *Cream another Way.*—Take a pint of cream mixed together in equal proportions, as in the last receipt; boil it with some lemon peel and cinnamon, and sweeten it to the palate; beat up the yolks of eight eggs with a table-spoonful of rose or orange flower water and a little salt. Mix these with the boiled cream when strained, set the whole on the fire, and keep constantly stirring with a wooden spoon. When the cream has acquired the proper consistence, lay it on a hair sieve to drain.

5166. *Cold Custards.*—Pound to a fine paste two ounces of blanched Jordan almonds, with half a dozen of the bitter ones, and two ounces of loaf-sugar; moisten with a little milk, and add a few grains of salt. When it becomes of the consistence of a thick cream, take it out and beat it up with the yolks of eight eggs; then gradually add a pint of half milk and cream; set this on a very gentle fire, with a couple of bay leaves, and continue to stir it till it acquires the proper consistence, when it is to be removed immediately and distributed into glasses. Some persons, on the supposition that they are unwholesome, omit the bitter almonds and bay leaves, and substitute the perfumes of rose or orange flower waters, or a little vanilla.

5167. *Blanc-mange.*—Simmer together a quart of half cream and half new milk, with some cinnamon, a few coriander seeds bruised, sufficient sugar, and a bay leaf; to these add an ounce of picked isinglass, and, when it is dissolved, strain the mixture. Set it by to cool, and if any film arise on the surface, skim it off. When nearly cold, pour it into the moulds.

To dissolve Isinglass.—This substance is indispensably necessary for jellies, ices, creams, and a variety of other preparations of dessert. Let the isinglass be of the best quality, and properly beaten; of this put a quarter of a pound into a pint of water moderately warm, and let it continue covered, in a heat below boiling, stirring occasionally till it is dissolved. This will be a very firm jelly, and will readily dissolve in any warm fluid. The confectioners who employ ice in their jellies prepare a weaker solution, by adding four ounces of the isinglass to six pints of water, which they reduce by boiling to two quarts; it is then strained.

5168. *Syllabub.*—Whisk well together a quart of cream, two glasses of French brandy, a pint and a half of sherry, with a table-spoonful of strained lemon juice, and sufficient powdered loaf-sugar to render it agreeably sweet. As the froth is produced, collect it with a spoon, and lay it on a sieve to drain; continue to whisk it till no more froth is produced. To the remaining liquor grate some nutmeg, fill the glasses half full with it, and at the top add an equal portion of the froth.

5169. *Trifle.*—This is a compound of syllabub and sweetmeats. Line the bottom of a glass trifle-dish with sponge biscuits stuck with blanched almonds; moisten them with sweet wine, or with sherry and sugar. Over these lay a dozen of ratafia cakes dipped in noyeau. Intersperse with these some thin slices of citron and orange peel, and distribute over these pieces of apricot and raspberry jam with currant jelly. Pour over these a few spoonfuls of the liquor of the syllabub. The next layer should consist of tartlet cream (see "Tartlet Cream") of about the thickness of an inch, over which grate some nutmeg, and strew a little powdered cinnamon, together with a small quantity of grated lemon peel and some powdered loaf-sugar. Lastly, take the whipped froth from the sieve, and put it on the top as abundantly as the dish will contain. To give it a pleasing appearance, strew variously-coloured comfits over the froth.

5170. *Gooseberry Fool.*—Stew a quart of green gooseberries with a little water till tender, and pass the pulp through a tamis. When nearly cold, add the juice of a lemon, sweeten it with powdered loaf-sugar, and dust in equally about two tea-spoonfuls of flour. In the mean time, boil a pint of new milk with some beaten cinnamon, lemon peel, and bruised coriander seeds, till it becomes impregnated with the flavour of the spices; sweeten it to the palate; then strain the milk, and mix it well with the yolks of four eggs beaten up. Whisk them over the fire to prevent curdling, and continue this till it begins to boil, when it is to be removed. When cold, mix it with the pulp of the gooseberries, and grate some nutmeg on the top. The same method may be pursued with the pulps of ripe apricots, strawberries, and raspberries, always remembering to add the lemon juice, which considerably improves the flavour.

SUBSECT. 5.—*Jellies.*

5171. *Calves' Feet Jelly.*—Take out the bones from the calves' feet, divide them into pieces, and throw them into warm water to soak out all the blood. After this wash them well in cold water, and put them into a stew-pan with sufficient water, that is, to four feet put five quarts of water; let them simmer gradually, and remove all froth and scum as it rises. When they are nearly dissolved, and the water reduced by boiling to half its quantity, which takes five or six hours, strain them hot through a fine silk sieve, and if any fat remain, remove it entirely. Put the strained liquor again on the fire in a clean stew-pan, sweeten it with loaf-sugar, add the peels and juice of lemons and some cinnamon. Mash four eggs, shells and all, which put in, and whisk it well with a clean rod, till it begins to become white and form bubbles; let it then continue to simmer about half an hour longer, when it may be removed from the fire, and strained through a flannel bag. This operation of straining must be repeated till it is perfectly transparent. If you wish to introduce any wine into the jelly, let it be put in with the eggs and spices. Madeira is the best, and if you require it of a deep tint, some liquid of colour may be added.

5172. *Fruit jellies* in the summer time are very salubrious, and are made at little expense. Such fruits as abound in juice are best adapted for these preparations.

5173. *Strawberry Jelly.*—Mash with the hand a quantity of fresh-gathered strawberries; squeeze the juice through a cloth, and put this liquor, with sufficient sugar and lemon juice, into a pan over a gentle fire, and skim it well from froth; when clear, add some melted isinglass, and strain it through a flannel bag. Repeat this till it is transparent, and, when nearly cold, put it into moulds. Some whole strawberries may be put in before the jelly concretes. This is the most difficult to make of all these jellies, as the fine aroma and flavour of the strawberry become dissipated by heat.

5174. *Cherry Jelly.*—Take two pounds of Kentish cherries and half a pound of blackhearts; stone them; mash the cherries and pound the stones; mix them together, and let them simmer about half an hour with some cinnamon and a few bruised coriander seeds. Strain them through a sieve. Set them again on the fire, with sufficient sugar, and the juice of two lemons; remove any scum that may arise, and add sufficient melted isinglass; strain it, till clear, through a flannel bag, and, lastly, pour it into the moulds. In proportion as the juice of these fruits is diminished by evaporation, the less isinglass will be necessary. If required particularly transparent, whites of eggs must be put in; and whenever the person preparing these can have access to ice, the process is much facilitated.

5175. *Raspberry Jelly.*—Express the juice of the raspberries, and let it simmer, removing all scum till about a third is consumed; add lemon juice and sugar, or, which is better, clarified sirup, as it produces no additional scum; with this mix sufficient isinglass previously dissolved, and, when nearly cold, pour it into the moulds. In the same manner, jellies may be made from any of the fruits that abound in juice, as barberries, currants, white and red, grapes, oranges, and lemons. In proportion as the juices are evaporated, they will require less isinglass to form them into a jelly. The addition of lemon juice, the quantity of which must be adjusted by the palate, and also the sugar, very considerably improves the flavour.

5176. *Currant Jelly for Sauces.*—This may be made of the white, red, or black currants. The red is mostly used in cookery. Pick red currants, and express their juice, which boil in the preserving-pan until a third part is consumed, removing all scum that may arise. While hot, strain this juice through a flannel bag. To a pint of this juice add a pound of fine loaf-sugar powdered, and, when it boils, carefully remove any scum; let it continue to boil about half an hour, when it may be poured into pots. Prepared in this manner, by previously concentrating the juice, it will keep for a long time, if preserved in a dry place.

5177. *Another Way (without boiling).*—Put red currants, stripped of their stalks, into a stone jar; cover it close, and put the jar either into an oven or into a kettle of hot water, by which means the juice may be completely expressed, the fruit being only just swelled by the heat. While hot, strain the juice through coarse muslin, and pour it into a china bowl, after ascertaining the number of pints of juice thus obtained; to every pint add a pound of loaf-sugar broken into very small lumps. Put the bowl in a cool place, and occasionally, in the course of every day, stir the sugar and juice together, for two or three weeks, when they will begin to jelly sufficiently, though not so firmly as when boiled in the usual way. The advantage of this mode is its economy, no waste of juice occurring as it does when boiled for a sufficient time. It is, however, firm enough to be used for sweet sauce.

BOOK XIV.

FRENCH COOKERY.

CHAPTER I.

FRENCH AND ENGLISH COOKING COMPARED.

5178. *Among the distinctive characteristics of French cooking*, the first that obtains notice is that which arises from the long-continued, although gradual action of heat to which all solid meats under the hands of French cooks are submitted, and by which all the fibrous parts are brought into a state of perfect incineration. In English cooking, the time allowed for roasting or broiling, and even for boiling, is, in all general cases, limited, in the apprehension of a French cook, to such a degree as to render English dishes scarcely eatable; as food for semi-barbarians, not for a civilized people. The English imagine that more genuine flavours and greater nourishment are to be found in their dishes than in those of the French; the latter, on the other hand, assert that in English cooking too much is left for the digestive organs to perform. The state of incineration into which solid food is reduced by French cooking is that into which the digestion must bring it before it can complete its operations; and as in English cooking this is not, according to French notions, sufficiently brought about, it is regarded as the cause of the frequent derangement of the digestive organs, and consequent hypochondriacal affections common to the English.

5179. *Another characteristic in French cooking* is the variety of flavours which it can impart to any single meat. From the long-continued action of heat allowed by French cooks, the juices of meats are almost entirely extracted to form the basis of *soups*, together with the *gravies* of various dishes, to each of which a variety in flavour may be given, the original one of the meat being so intermingled as to be scarcely distinguishable. In this way French cooking yields an almost endless number of dishes, prepared from a few original substances, which, by the art either of *braising*, *marinading*, or *poëling*, may be impregnated with any peculiar flavour the cook may desire to produce. The addition of an appropriate sauce, or purée, completes the effect, and determines also the name of the dish, whether it be "fowls *aux Truffes*," "fowls *à la Mirepoix*," or "fowls *à la Perigord*."

5180. *In English cooking* no flavour is considered to be equal to the one peculiar to each meat. Beef, mutton, or venison would, at the English table, be considered as having lost their distinctive excellence if, in the cooking, their genuine flavour were interfered with. Whatever condiment or sauce is employed as an accompaniment to each meat, it is always of such a modified nature as not to overpower that flavour which is peculiar to the meat, the juice of which, when, in a well-roasted joint, it issues from the opening made in carving, is considered as far excelling any which the cook can compound.

5181. *Again, French dishes* have always had a decided advantage over the English in appearance; they are made to please the eye as well as the taste. No heavy masses of viands are served at a French table; but light, elegant, and tempting forms are presented to those around it. In this respect the English cooks are beginning to reform their style, and to study, in serving, neatness and elegance in the arrangement of the contents of each dish.

5182. *In the last place, the economy of French cooking* must be noticed, and with approbation. In its various processes nothing is wasted; every particle has a use and consequent value. The flavour and richness of the meats are not obtained by any expensive means or prodigal use of them, but are the results of the modes of cooking skilfully followed. In English cooking the maxim that "good dishes can only be formed out of good and abundant materials" is often carried to the utmost length in practice. Many ingredients in the English kitchen are cast aside, or reserved as the cook's perquisites, which in the French kitchen would be brought into use, and would render needless the employment of more expensive ingredients. In this slight comparison of these two principal systems of cooking, it may, perhaps, be perceived that from each might be transferred to the other useful and valuable modes, favourable to the enjoyment of the table and to the economical use of food.

CHAPTER II.

FRENCH COOKING TERMS AND PROCESSES EXPLAINED.

Atelets.—Small silver skewers.

Assiettes.—Dishes with four compartments for chopped herbs, parsley, eschalots, &c., to which, being in the kitchen always at hand, the cook can resort at once. The chopped ingredients are prepared by the under assistants.

Bain Marie.—A large flat vessel containing boiling water, in which dishes already prepared can be kept hot. See a wood-cut of this vessel, *fig.* 684, p. 829.

Braising consists of stewing without much moisture any article in a seasoning of carrots, onions, parsley, thyme, bay leaves, and cloves.

Buisson is a high-standing remove on a dish of pastry dressed high.

Compôte.—A fine mixed ragout to garnish white poultry, or to serve as entrées. Fruit also stewed with sirup for dessert is termed *compôte.*

Compotice.—The deepest dish appropriated to the *compôtes.*

En couronne.—To place or dress the articles of a dish in the form of a crown.

Crustades.—Bread baked in moulds, and hollowed out to receive farces of different kinds.

Croutons.—Bread cut out in shapes and fixed in oil or butter; these are ornaments of some of the mirotons and other made dishes.

Dorey.—To cover pastry with yolks of eggs. *Dorures* are yolks of eggs well beaten.

Desseites.—Things left at table untouched, and afterward used up in forming farces and salpiçons, &c.

Dormant.—A centre dish, allowed to remain during a whole dinner.

Entrées.—Dishes served at the first course.

Entremêts.—Dishes served at the second and third courses.

Emincé.—A mince of some kind of meat.

Feuilletage.—Puff paste.

Friture.—A frying-pan.
Farce à quenelles.—Forced, or farced meats.
Glaze.—Reduced consommé, used to cover the meats of made dishes.
Glace.—White of egg beaten with powdered loaf-sugar.
Godiveau.—A veal forcemeat.
Au gras.—When a dish is to be dressed with meat gravy.
Gratiner.—To make the surface crisp of any dish, and to give it a grilled taste.
Hors d'œuvre.—A small dish served during the first course.
Lardons.—Meat cut for larding.
Larding.—Meat, poultry, &c., having lardons of bacon or other articles drawn through the flesh by means of the larding pin.
Larding pin is an instrument as sharp as a needle at one end, and like a port crayon at the other. The lardon is entered at the square and open end; the sharp end is then passed through the meat, and in drawing the instrument out, it is so contrived as to release the lardon from its hold, and which is left drawn into the flesh of the article to be larded.
Liaison.—A thickening for soups and gravies, formed of yolks of eggs.
Au maigre.—Soups prepared without meat.
Marinade.—A pickle into which meat, fish, or poultry is put for several hours, sometimes for days, previous to its being cooked. A marinade is composed of different flavouring ingredients combined with vinegar, sometimes with oil, according to the dish to be prepared.
Au naturel.—Anything simply boiled.
Nouilles.—An Italian paste resembling macaroni, but flat instead of being piped.
Noix de veau.—The large and fleshy part of the leg of veal attached to the udder.
Passer.—To fry lightly.
Pigné.—Larded on the surface only.
Panieres.—Everything dressed with a coating of crumbs of bread and egg.
Poëling.—Take a pound of beef suet, one of fresh butter, one of very fat bacon; cut the suet and bacon into large dice, and put them in a stew-pan with two pounds of veal, cut in the same manner; fry them till the veal becomes white; moisten with three pints of clear boiling water, a handful of salt, a bay leaf, a few sprigs of thyme, an onion stuck with cloves, and a bundle of parsley and green onions. Let the whole boil quietly till the onion is done; strain it through a sieve, and set it by for use. Poële is employed to make everything boiled in it look white, and to acquire a relishing taste; it will keep for a week. Do not boil any lean of bacon with it, or the meat boiled in it will turn red from the saltpetre used in curing the bacon. Poëling and braising are almost the same operation; but in poëling meat must be underdone, in braising overdone.
Potage.—Soup, or broth.
En Poule.—A particular way of trussing a fowl for the spit.
Purée.—Meat, fish, or vegetables boiled to a pulp and passed through a sieve.
Ravigôte.—A sauce.
Au rosette.—To dress a dish in the form of a rose.
Salmi.—A highly-flavoured dish.
Salpiçon.—A dish made of equal quantities of any and all sorts of meat and vegetables; these are minced and cooked separately, and warmed together when ready to serve.
Sauté.—To fry lightly.
Singer.—To put flour into the stew-pan.
Sabotier.—Tin utensils containing sand, in which are placed the moulds that are to be put into the ice-house to be frozen.
Tamis.—A silken sieve.
Toppot.—The fat from the water in which meat has been boiled: it is much used in French cooking.
Vanner.—To take up a sauce and turn it over quickly with a spoon.

CHAPTER III.

RECEIPTS FOR FRENCH COOKERY.

SECT. I.—SOUPS AND SAUCES.

5183. *Grand Consommé.*—Put two knuckles of veal, part of a leg of beef, a fowl, a rabbit, or two old partridges; add a cupful of soup, stir it well, and when it jellies, add two quarts of clear stock; boil and skim it carefully, season it with three turnips, three carrots, three onions, one stuck with two or three cloves, a bunch of leeks, and two heads of celery. Let it then simmer for four hours; strain it through a sieve, or tamis, into a clean earthen pan, and set it in a cool place for use.

5184. *Consommé of Poultry.*—Veal and ham, with the trimmings of poultry, are the basis of this consommé. The flavouring ingredients are mushrooms, parsley, and green onions. Veal broth or stock, sufficient to keep the vessel full, must be added, and the whole, after boiling, must be gently stewed for two or three hours. The broth will be more savoury and mellow if the meat be not overdone. The fat must be skimmed off, and the consommé strained through a silken sieve.

5185. *Consommés of Game.*—Entrées of partridges must be prepared with consommé of partridge, made from veal and from the backs and other trimmings of partridges and rabbits. If the entrées are served with truffles, the consommés must be *flavoured* with truffles and mushrooms, together with a bundle of parsley and green onions. The whole must be moistened with consommé (containing ham), and must then be boiled, but not over much, strained, and set by for use.

5186. *White Roux for thickening white Sauces.*—Put into a sauce-pan a lump of butter; melt it over a slow fire, and separate, by draining, the residue of butter-milk contained in the butter; dredge it with flour till it is of the consistency of paste; keep it on the fire for a quarter of an hour, but take care not to let it colour; pour it into an earthen pan ready for use.

5187. *Brown Roux.*—Put butter into a stew-pan, and proceed as above directed for white roux; fry the paste of butter and flour over a slow fire, till, by very gradual steps, it becomes finely coloured; when of a light-brown, pour it into an earthen pan ready for use: it will keep for some time.

Sect. II.—Potages.

5188. *Potage à la Reine.*—Take three chickens or pullets; skin them, take out the lungs and clean them; lay them in a stew-pan with a bunch of parsley only; moisten the whole with boiling broth; stew for an hour, and take out the chickens. Soak the crumb of two penny rolls in the broth; pound the meat of the chickens with the soaked bread, and three or four yolks of hard-boiled eggs. Rub the whole through the tamis, or sieve. Boil a quart of cream, stirring it all the time, and pour it on the soup; it is not so likely to curdle, if done in this way, as by the usual mode of mixing it, while cold, with hot liquids. To this soup rice or vermicelli may be added, but either must be previously stewed in some broth, the rice for some time, the vermicelli for five or six minutes only.

5189. *La Brunoise—Winter Soup.*—Blanch carrots and turnips cut into dice; add to them as much rich broth as the number of the party may require. Season it with salt; add a little sugar to it; boil the whole for an hour. Skim off the fat, and serve with mitonnage of crusts.

5190. *Potage à la Condé.*—Take a quart of French beans, put them into a stew-pan with two quarts of consommé, a pound of bacon, three carrots, three onions (one of them stuck with cloves), a bunch of leeks, two heads of celery. Let all simmer together for three hours. Take out the vegetables, pulp them into the soup, and again boil all together. Fry bread in dice, and serve in the soup.

Sect. III.—Removes (after fish and soup).

5191. *Beef (à la Flamande).*—Take the brisket or part of the rump of beef. Season it with carrots, onions, parsley, bay leaf, and cloves. Boil it gently four hours. Drain away and reduce the liquor to a glaze. Cover the beef with it when served. Garnish the dish with carrots and turnips braised, also with cabbage done separately. Serve it with Espagnole sauce. (This dish may be sometimes garnished with cucumbers, farcé, or with Spanish onions glazed, or with artichoke bottoms.)

5192. *Braised Leg of Mutton.*—Put a leg of mutton into a braising-pan, with trimmings of veal, and with carrots, onions, and a bunch of parsley; also a few green onions properly seasoned. Cover the whole with thin slices of bacon, to keep them from burning. Stew all for four hours. Strain through a sieve, and afterward reduce to a glaze the liquor. Glaze the mutton, and serve with glazed onions.

5193. *Calf's Head (de fruits certain).*—Bone a calf's head. Make a farce of veal, bacon, and sweet herbs finely chopped. Mix them together with two yolks of eggs. Stuff the head with the farce, and secure it by sewing up the head. Wrap it in a cloth, and put it into a braising-pan, with several slices of veal and bacon. Season it with carrots and a bunch of parsley, thyme, bay leaf, and a blade of mace. Moisten it with one glass of white wine and a ladleful of broth. Let it stew for four hours, and serve it with a financiere. Boil a glass of Madeira, and put it into the sauce, which should be highly seasoned.

5194. *Fowls à la Montmorencie.*—Take a couple of fine fowls; prepare them as if for boiling, taking away also the breast bone. Put lemon juice, salt, and a little butter into the body; lard the breast. Line the stew-pan with bacon, and lay the fowls in, covered with a poële made in the following manner: Cut into dice a pound of veal, another of bacon, and a small piece of the fat of ham. Fry them white in half a pound of butter. Moisten with water; season it with parsley, salt, pepper, thyme, half a bay leaf, and one clove. Stew it for some time over a slow fire; strain it over the fowls, which stew for three quarters of an hour. When done, drain and glaze them of a fine colour. Garnish with larded sweetbreads, and serve with ragout à l'Allemande for sauce.

5195. *Fowl à la Monglus.*—Take a cold, roasted fowl, and remove the breast and fleshy parts away from the back bone and side bones. Put into the fowl either an emincé or a salpiçon (see terms explained). Beat the yolks of two eggs, and cover the fowl with them, strewing over it afterward crumbs of bread. Brown it lightly in a Dutch oven, or by a salamander. Serve it with a brown sauce if the inside be stuffed with a salpiçon; but if with an emincé, a veloutè sauce must be used.

The salpiçon may be made of dressed fowl, tongue, truffles, and mushrooms, cut into dice, and warmed up in sauce Espagnole. When cold, use it as above directed. Salpiçon is always used with brown sauces.

Emincé may also be made with meat of dressed fowl or game, minced extremely small, and warmed up in béchamelle sauce well seasoned. With an emincé a white sauce is always used.

5196. *Removes of Ham.*—Soak a Westphalia ham for twelve hours; a Westmoreland, unless very highly dried, for half that time. Boil it for two hours; then drain, skin, and trim it; put it into a braising-pan, lined at the bottom with thin slices of veal, and seasoned with carrots, onions, parsley, bay leaf, and spices. Pour over it two glasses of rich consommé and a bottle of Madeira. Let it boil for two hours more. When done, pour out some of the liquor and reduce it, after skimming off the fat, to an Espagnole, the sauce to be served with this dish. Of the rest of the liquor make glaze, and serve the ham immediately on taking it out of the braise.

5197. *Westphalia Ham à l'Essence.*—Saw off the knuckle of a small Westphalia ham, taking care not to splinter the bone. Soak it one day in water, to draw out the brine. Boil it in plain water four hours. Drain it, remove the rind, trim it, giving it a nice round form. Dry the fat from it for a few minutes in the oven, that the glaze may be properly given to it. Serve under it sauce à l'essence.

5198. *Remove of Beef Tongue.*—Take a pickled tongue; boil it for three hours. Peel off the skin while hot, trim, and glaze it. Serve it with mashed turnips on one side, and with mashed carrots and spinach on the other.

Sect. IV.—entrées.

Subsect. 1.—*Entrées of Beef.*

5199. *Miroton of Beef.*—Cut into neat slices some rump of beef, either cooked previously, or fresh. Put the slices into a frying-pan, with sauce *Espagnole* or *brown Italienne.* Give them a few boils, and serve hot; keep the meat always well covered with the sauce, or it will become black and dry.

5200. *Mirotons of Palates of Beef* (*à la Ude*).—Cut the palates and some truffles into equal sizes. Dress them *en miroton* (that is, boil them with sauce in a frying-pan). Take mushrooms, all of nearly one size, to make a border round the dish; put in the middle a salpiçon of truffles, mushrooms, and beef palates. Add sauce Espagnole to the miroton. Let every article to be used be prepared before the dish is made up—palates and truffles, alternately, to the very top. Remember to keep the whole hot, or it will become dry.

Subsect. 2.—*Entrées of Mutton.*

5201. *Cutlets of Mutton*—(*purée of Mushrooms*).—Divide the best part of a neck of mutton into cutlets, trimming each neatly. Season each side of the cutlets with pepper and salt, and with a paste-brush cover them with yolk of egg; dip them into melted butter, and then into bread crumbs. Press the crumbs firmly on the meat, and again dip them into the bread crumbs. Make each cutlet equal and neat with the knife, and put them into the frying-pan with butter. When dinner-time is at hand, fry them over a brisk fire of a very good colour. If the fire be not quick, the cutlets will take too much time in browning, and will be dried up. As soon as they acquire the right colour take them out of the pan. Press each cutlet between clean pieces of whity-brown paper, to drain the fat from them. Glaze them, and put round them a purée of mushrooms.

5202. *The inside of Fillet of Mutton marinaded—au Chevreuil.*—Have the fillets of four saddles of mutton, producing eight *filets mignons.* Lard them, and put them into a marinade pickle; namely, of thyme, parsley, bay leaves, onions, salt, pepper, and vinegar. After being in this pickle for two or three hours, put them into a frying-pan over layers of bacon, and bake them of a nice colour. Glaze, and serve them with a poivrade under them.

Subsect. 3.—*Entrées of Veal.*

5203. *Grenadier de Veau*—(*purée of White Celery*).—These are small fillets of veal, larded as fricandeau of veal, cut thinner than for fricandeau, and consequently requiring less time in cooking. After larding them, put them into a stew-pan with a carrot, a large onion, a root or two of parsley, a bay leaf, and some thyme, a small quantity of mace, allspice, and whole pepper; let the vegetables be at the bottom of the stew-pan, and cover them with layers of *fat* bacon (*lean* bacon will turn veal red); the veal must be laid on them and sprinkled with a little salt. Pour some broth upon the vegetables, but not enough to reach the meat. Close the stew-pan, and put it on a slow fire; cover the lid with hot coals or charcoal, and when it begins to boil, put it over a slow and equal fire for two hours and a half, basting it frequently with the liquor. After this, put a great deal of fire over it to harden the bacon. Reduce to a glaze the liquor, and serve it with a purée of white celery.

5204. *Scollops of Sweetbreads, with Green Pease.*—Wash and blanch four sweetbreads. Cut them into large scollops. Put them into a frying-pan with melted butter and a little salt. A quarter of an hour before dinner is served, fry them of a very light brown over a clear fire; turn them, that they may be equally done; drain away the butter, and put a little glaze into the pan, in which keep stirring the scollops. Put the pease in the middle of the dish, and place the scollops en miroton around them. Scollops of sweetbreads are easier to arrange when a slice of fried bread cut round is put between them, without which they seldom keep the form in which they are first dished.

N.B.—All entrées of veal, such as currés, fricandeaux, cotelettes, sweetbreads, &c., with all sorts of purées; and in the summer with la Macedoine. They are all dressed nearly in the same manner; but by changing the sauce, the flavour and appearance are changed also.

SUBSECT. 4.—*Entrées of Tongues.*

5205. *Miroton of Pickled Tongue.*—Cut some thin slices of cold pickled tongue; dress it en miroton in a dish, and put it into an oven for ten minutes. Put mashed turnips in the centre of the dish, and glaze the tongue.

5206. *Stewed Beef Tongue (unsalted).*—Take a fresh tongue, wash it, and blanch it in hot water. Stew it in a good braise for two hours and a half, skin it, and cut it in two; spread it open, and mash with sauce machée.

5207. *Miroton of Tongue, with Sorrel Purée.*—Take slices of tongue stewed as above, and dress it en miroton; highly glaze it, and serve with sorrel purée.

SUBSECT. 5.—*Entrées of Fowl.*

5208. *Fowl à la Villeroi.*—Take a fine fowl, empty, singe, &c., and truss it with its legs turned outward; put in the inside a small quantity of butter kneaded with salt and lemon juice. Put the fowl into an oval stew-pan, with a layer of fat bacon; pour some poële over it. While entrées are not to be kept longer on the fire than needful, three quarters of an hour will dress a fowl in this manner; a capon perhaps an hour. Serve it with sauce à la financière.

5209. *Scollops of Fowls.*—Take the fillets of three fowls. Cut each scollop of the size of half a crown; dip each in clarified butter, and fry them on both sides over a brisk fire. Put them into the sauce prepared for them; if truffles, cut the truffles about the same size as the meat, and fry them with the scollops of fowl. A few minutes before dinner put them all into a béchamelle sauce, into which a reduction of truffles has been added. The reduction is prepared with trimmings of truffles, put into and stewed in consommé till it becomes a glaze. This glaze is stirred in with the scollops, and, to make it white, a few spoonfuls of thick cream must be added. In preparing this or any other meat with truffles, care must be taken to do both meat and truffles thoroughly. Both the meat and truffles may be fried together; but the meat must be taken out first, and the truffles must be allowed to remain in a little longer, and be very equally fried on both sides. The scollops are then put in a second time; the butter is drained away from them, the truffle sauce added, and the meat allowed to lie in it for an hour, that it may fully imbibe the truffle flavour. The sauce must be kept thick: it may be thinned at any time. Though the meat and truffles must be well done, they must not be over-fried. It is the most difficult point in French cookery to know the precise time required by the various articles which are frequently combined. Experience only can give this excellence to cooks.

5210. *Scollops and fillets of fowl* may be dressed with any of the under-named sauces and purées; with maréchal sauce, Espagnole, béchamelle, essence of cucumbers, sauce Allemande; with oysters, truffles, mushrooms, purées of green pease, of celery, and cucumbers.

Each sauce gives its name to the dish of which it is the accompaniment, or prepared with it, as, scollops of fowl—à l'Espagnole, à l'Allemande.

5211. *Chickens à l'Ivoire.*—Pick and singe two chickens well, thrust the hand inside, and remove the breast bone. Mix together some butter, the juice of half a lemon, some pepper and salt, and put some of the mixture into the body of each chicken; bind them up neatly, lay them in a stew-pan surrounded with layers of bacon, and cover the breasts of the chicken with thin slices of lemon and bacon. Pour some poële over them, and stew them for half an hour. They should be perfectly white, and served with velouté or béchamelle.

5212. *Chickens à la Villeroi* are dressed in the same way, but served with aspielié or maréchal sauce.

5213. *Curry.*—This may be made of chicken, lobster, veal, or mutton. When of chicken, let a couple be divided into pieces convenient to distribute at table; blanch them in hot water, and stew them gently till half done in some veal stock with a table-spoonful of curry powder. Next prepare the sauce, which consists of a couple of moderately-sized onions, sliced, a table-spoonful of curry powder, some butter, and flour; work this well over the fire; moisten with the liquor in which the chicken has been stewed, with additional veal stock; put in the chickens, and let them simmer till done, when they are to be taken out and kept warm. Pound two ounces of sweet almonds to a paste, and incorporate it with the sauce; remove any fat, season it with Cayenne pepper and lemon juice, and pour or strain it hot to the chickens. When veal, lamb, and mutton are employed, they should previously be fried of a light brown. For preparing the rice, see "Vegetable Entremêts," Sect. VII., Subsect. 2.

SUBSECT. 6.—*Entrées of Partridges and Pheasants.*

5214. *Partridges à l'Espagnole.*—Let it be remembered that old partridges are unfit for French dishes: they may be dressed with purées of lentilles, or employed in the game consommés or cold patties. The young ones only can be introduced as entrées, and may be known by the white tinge at the sharp extremity of each wing; when that mark is observable, the birds will be found tender enough for use. Truss three partridges (see "Directions for Trussing," &c.), put them between layers of bacon, and pour a poële over them. Over a slow fire stew them for twenty minutes; dish, and pour over them an Espagnole, to which some glaze of game has been added to give it a game flavour.

5215. *Young Partridges à la Montmorenci.*—Empty and truss young partridges; dip the breasts into boiling water, and immediately after into cold, to make them firm. Lard them with slits of bacon, and put them into a stew-pan surrounded with slices of bacon. Immerse only one half of the birds in poële or other liquids. Over a brisk fire stew them for twenty minutes; glaze them, and probe them in the back; if no blood issues they are done sufficiently. Drain them, and glaze a second time. Serve with ragout *à la financière.*

5216. *Partridges à la Crassandine.*—After emptying and picking the birds, cut off the claws, make a hole below the joint of the leg, truss the leg inside the body, singe the birds over a flame till the flesh becomes firm, pinch the breast with your left hand, scollop the breasts without reaching the skin, turn the flesh over on the table, beat the bird flat, dust it with salt and pepper, dip it twice in clarified butter and crumbs of bread, broil it, and serve it with an Italienne, or essence of game.

5217. *Soufflé of young Partridges.*—Pound the meat of roasted partridges in a mortar, seasoning it well, and adding to it a few spoonfuls of velouté and a lump of butter. Mix with this the yolks of four or five eggs, and strain the whole through a sieve; beat the whites of the eggs, and mix them also, but lightly, with the *purée.* Bake the whole in a soufflé-dish for twenty minutes. Prevent it from burning at the top by covering it with paper.

5218. *Salmi of Pheasants.*—For this dish roast the pheasant only half an hour. When cold, cut it up as if for eating. Put the parings into *sauce à salmi.* If two pheasants are thus prepared, do not use the legs, except for flavouring. Cut each side of the breast into three slices, and fry the same number of slices of bread of equal size; the meat put into a covered stew-pan to prevent it drying. Now prepare the sauce by frying together a small bit of lean ham, four eschalots cut small, some parsley roots, a carrot cut in dice, some thyme, a bay leaf, six cloves, mace, ten grains of allspice. Add either brown sauce or a spoonful of flour, two glasses of Madeira, and a ladleful of veal gravy. Season with salt and pepper, put in the trimmings, and boil all together; skim off all the fat, and, if it taste bitter, add some sugar. Keep the sauce thick enough to cover the meat, over which pour it through a tamis, and warm both together without boiling them. This dish may be made with truffle sauce by adding to the sauce the trimmings of truffles, and by boiling some truffles cut neatly in sauce by themselves. Put the truffles in the middle of the dish when it is served.

Subsect. 7.—*Entrées of Rabbits.*

5219. *Rabbits à l'Orlie.*—If large, the rabbits must be filleted; if small, marinaded in joints; the small bones to be taken out and put into the preparations of game consommé. Detach the fillets of four rabbits, and marinade them for two hours in lemon juice, parsley, thyme, eschalot cut in pieces, bay leaf, salt, and pepper. Drain, and dip them in white of egg well beaten, and into flour mixed with a few crumbs of bread. Fry of a fine brown, and serve under them a poivrade or Espagnole of game.

5220. *Scollops of Rabbits and Truffles.*—Detach the fillets of five rabbits, and tear off the sinews; scollop the fillets, keeping the knife on the slope; with the handle flatten the scollops, and put them into the sauté-pan with melted butter; peel and slice some truffles of the size of the scollops, and mix them with the rabbits; butter, salt, and pepper. Fry lightly twenty minutes before serving, and leave the scollops in the sauce to imbibe the flavour of the truffles. Garnish the dish with a conté.

5221. *Blanquette of Rabbits, with Green Pease.*—Detach the fillets of four rabbits, soaking them whole in melted butter, with seasoning of salt and pepper; cut them on a sheet of paper the size of a shilling, and put them into the sauce à blanquette aux pois. This entrée may be sent up in a vol au vent, or casserole of rice.

5222. *Rissoles of Rabbits.*—Make *fine farce* of the remnants of roasted rabbits; make a light, but not rich, puff paste, and roll it out; cover at equal distances the paste with lumps of the farce, moisten the paste round the farce, fold it over in two, press the paste with the fingers to make it adhere, cut it with a rowel, and fry it till it is of a fine brown colour. If dipped in egg and covered with bread crumbs, they will fry of a better colour. Serve with fried parsley in the middle of the dish.

Subsect. 8.—*Entrées of Hare.*

Hare is in England most commonly served as a remove, but may also be introduced as entrées, either in boudins, quenelles, or minces.

5223. *Fillets of Hare (with blood).*—After skinning two hares, thrust the knife along the spine, taking care to bear towards the bone. Tear with your fingers the fillet from the neck down to the legs; leave the thick fleshy part to the leg: introduce the sharp side of the knife to the tender part of the fillet, and the thumb towards the skin; press your thumb on the sharp side of the blade, that it may not cut the part containing the sinews; then pull the fillet towards you, and the sinews will remain attached to the leg. Lay the fillets on the table, and flatten them with the knife. Lay them in a sauté-pan with melted butter, and dust over them salt and pepper. When it is dinner-time, fry the fillets, and scollop them. Put them into sauce de civet made of the remnants of the hares; add to it the blood of bot hares, that the sauce may be of a dark brown.

5224. *Fillets of Hare en Chevreuil.*—Take fillets of hare, and lard them with bacon ; put them into a deep vessel, with salt, pepper, parsley, two onions cut into slices, a bay leaf, some thyme, a glass of vinegar, and half a glass of water. Let the fillets marinade in this two days ; then put them into a sauté-pan, bake them underdone, and glaze with a light glaze. They are always dark enough without the colour being deepened by the glaze. Serve with poivrade sauce under.

Subsect. 9.—*Entrées of Quails.*

5225. *Compôte of Quails.*—Quails are fashionable, rather from their rarity and expense than from their real excellence. A white compôte of quails is made in the same manner as compôte of partridges, the only difference being in the use of broth of veal instead of gravy. Thicken the same with yolk of eggs, and serve the onions white, the same as mushrooms.

5226. *Quails, with Pease.*—Put into a stew-pan six quails moistened with a poêle, or with two spoonfuls of broth, a bunch of parsley, a bay leaf, some thyme, one clove ; stew for twenty minutes over a slow fire. Drain them, and let them boil for a moment with pease and bacon. Next dish the quails, reduce the pease, and mash with them.

5227. *Quails à la Crassandine.*—These are dressed as pigeons or partridges, à la crassandine. Serve them with an Italienne, or a consommé à glace over them.

Subsect. 10.—*Entrées of Woodcocks.*

Woodcocks and snipes are cooked in very few ways. The most delicate parts are the legs and intestines. They may be cooked in as many ways as young partridges. A purée of woodcocks is also occasionally served.

5228. *Salmi of Woodcocks.*—This operation is the same as a salmi of partridges. Covered with paper, the birds are roasted, but not browned. They are then cut up, and the whole of the skin removed. Put them into a stew-pan to get cold, and prepare the sauce for them with the trimmings of the birds and four eschalots, some slips of ham, a carrot cut in dice, three or four mushrooms, a little parsley root, a bay leaf, some thyme, a clove, eight grains of pepper, and the same of allspice. Fry these in a stew-pan with butter, and, when slightly browned, add three glasses of Madeira, six spoonfuls of Espagnole, and two of consommé. Put in the parings of the birds, but not the claws, and stew them slowly for an hour and a half; skim the sauce, and add a small bit of sugar, and strain it through a tamis : lade the salmi hot with slices of fried bread cut in shapes, and glazed.

Subsect. 11.—*Entrées of Pigeons.*

5229. *Compôte of Pigeons (brown).*—Pigeons are less used as entrées than as garnitures; but are occasionally useful as entrées in intermediate seasons, when game and young poultry are not to be had. For a compôte of pigeons, take four or six, according to the size of the dish ; pick them clean, and cut off the sinew below the joint of the leg ; draw them, without taking out the liver, but carefully removing all grain from the craw. Truss the legs inward, and make an incision in the back that they may disgorge ; put them into warm water to draw out the blood : then cover them with bacon, and stew them as chickens. Drain them, and serve with a ragout à la financière.

Subsect. 12.—*Entrées of Wild Ducks.*

5230. *Wild Ducks, with Orange Sauce.*—Cut out the fillets of three wild ducks; give them a few slight cuts on the skin side, marinade them for an hour in oil, with young onions broken in two, branches of parsley, salt, large pepper, and the juice of mushrooms. Immediately before they are to be served, put them into a frying-pan with two spoonfuls of oil; set them over a good fire, turning them two or three times ; drain, and arrange them in the dish in the form of a crown, and serve under them orange sauce.

5231. *Wild Ducks, with Green Pease.*—Prepare and cook the ducks as above; and make the sauce in the following way : Put two quarts of fine green pease into a pan of clean water, with half a pound of fresh butter, mixing it with the pease ; drain the pease by taking them in the hand out of the water. Let them dry, and put into a stew-pan a small bit of fresh butter and half a pound of the best part of a breast of bacon, cut into squares of an inch in size. Fry them of a nice colour, and, draining away the fat, put in the pease to sweat ; when green, add to them half a spoonful of flour, and moisten with boiling water. Put in the members of the duck, and, when it has stewed sufficiently, serve it covered with pease. Remember to skim off the fat very carefully.

Subsect. 13.—*Entrées of Larks.*

5232. *Larks au Gratin.*—Take eighteen fine larks ; pick and bone them ; season with salt and pepper, and stuff them with *farce fine.* Put them into a dish with some of the farce between them, and ornament the birds with fried bread cut into fanciful shapes, and put between the birds. In arranging the birds round the dish, if any remain, raise them in the middle above the rest ; cover them with slices of bacon, and bake them for twenty minutes ; remove the bacon when done, drain away the fat, and serve with an Espagnole of a good colour and well seasoned.

Sect. V.—Stuffings and Farced Meats.

Subsect. 1.—*Panadas.*

5233. In this department of cooking the French particularly excel, and their superiority in a few niceties which will be fully explained. The usual fault of stuffing is its want of tenacity; so that, when served up, it falls to pieces; and this arises from the materials being insufficiently mixed. In order that these preparations may be served in perfection, the cook must have the use of a large marble mortar, with a smooth lignum vitæ pestle. The materials of stuffing consist of panada, or prepared bread, meat, and herbs, with adequate seasoning. These are to be mixed up and incorporated with sufficient yolk and white of egg to bind them together, so that the mass may admit of being boiled, roasted, or fried. This farced meat is employed for the stuffing of poultry, hares, and various joints; it is also rolled into balls, which are to be regarded as essential to many dishes, and especially required in meat pies. In order to prepare the *panada*, soak a French roll in milk till it is thoroughly moistened, then press the milk out of it through a clean cloth. Put this squeezed bread into a clean stew-pan with some vegetables, as parsley, green onions, and button mushrooms, chopped fine; moisten these with a couple of spoonfuls of veal stock, and over a slow fire work them well together with a wooden spoon. When the bread is nearly dry, put in a small piece of butter, and continue to work it for a few minutes longer, then remove it from the fire, and mix it well with the yolks of two eggs. This panada is the basis of the farced meat, and, when quite cold, is to be mixed with the pounded animal substances, as scraped veal, ham, chicken, or sausage meat. These are to be beaten well together in a mortar, and made to combine and adhere together with yolk and white of eggs beat up, to which sufficient seasoning is to be added. To ascertain if it be of the desired consistence, roll a small piece in a little flour, and put it into boiling salt and water for a couple of minutes; if it remains firm, it is sufficient; if not, add the yolk of another egg. The French employ calves' udder beat to a paste, in order to render the stuffing more compact; but this may be omitted, as the udder is not always to be procured, and the animal substances above mentioned answer the same purpose when sufficiently beaten in the mortar. The general principle for the preparation of stuffing having been thus explained, the farced meat may be compounded of any materials you may think fit, and varied as occasion may require; for the flavour of farced meat should be adapted to the viands, the zest of which it is intended to increase. Some dishes require delicately, others full and high-flavoured forcemeat. What would be piquante in a turkey would be insipid with turtle.

Forcemeat balls must not be larger than a small nutmeg. If intended for brown sauce or meats, flour and fry them; if for white, put them into boiling water for three minutes.

Subsect. 2.—*Flavouring or Seasoning Ingredients.*

Common thyme.	Black and white pepper.	Yolks of hard-boiled eggs.
Orange thyme.	Allspice, mace, or cinnamon.	Mutton, beef, veal, suet, or marrow.
Lemon thyme.	Ginger, nutmeg, cloves.	Calf's udder or brains.
Sweet marjoram.	Capers and pickles, minced or pounded.	Parboiled sweetbread.
Summer and winter savoury.	Savoury powder, soup-herb powder.	Veal, minced and pounded.
Sage, tarragon, chervil.	Curry powder, Cayenne.	Potted meats.
Burnet, basil, bay leaf.	Zest.	Meat gravy.
Truffles and morels.	Flour.	Lemon juice.
Mushroom powder.	Crumbs of bread.	Sirup of lemons.
Leeks, onions, eschalots, garlic.	Parsley.	Essence of anchovies.
Lemon peel, and essence of.	Spinach.	Mushroom and walnut catsup.
Shrimps, prawns, crabs.	Boiled onions.	Whites and yolks of eggs.
Lobsters, oysters, anchovies.	Minced potatoes.	Wines.
Dressed tongue, ham, bacon.		

Subsect. 3.—*Quenelles.*

5234. *Quenelles of Veal.*—Take half a pound of any fleshy part of veal; cut it in slices, and scrape it from the sinews with a knife. Boil a calf's udder in the stock-pot, or in plain water. When cold, trim away all the upper part; cut it in small pieces, and pound it till it will pass through the sieve. Make the pounded veal into one ball, the udder into another, and of an equal size make a third ball of the panada. The object in making these balls is to ascertain the quantity better. Pound the three balls together; the more they are pounded, the more delicate are the quenelles. Break two eggs' whites and yolks together, and pound them in also, with a seasoning of pepper, salt, and pounded spices. Roll in flour a small ball, and poach it in boiling water to try its texture; if not firm, add another egg, without beating the white, which makes the quenelles puff and hollow within. This is a farce of general use.

5235. *Quenelles of Fowls.*—Take the fillets of young fowls, and, after removing all the sinews, cut the meat into dice, and pound it till it can be rubbed through a sieve; then with eggs unite it to some of the panada and flavouring ingredients, pound all together, and try a small ball in hot water; if it is not hard and firm enough, add more egg. When intended for ragouts, *quenelles* must be made very firm and hard. When the quenelles are used small, the farce may be more delicately and lightly made. Do not omit, among the seasoning ingredients, salt and pepper.

5236. *Quenelles of Fish.*—Take either the flesh of whitings, salmon, pike, &c., without skin or bones, pound it, and force it through a sieve or colander, beat an equal quantity of panada, and pass that also through the sieve; of butter, the same quantity must be beaten with the two other portions of the quenelles, the fish and panada; to these add salt, spicery, and pepper, a table-spoonful of fine herbs pounded and cooked in butter; incorporate these ingredients with eggs; try some in boiling water, and finish with white of egg, if the quenelles require firmness

Subsect. 4.—*Farced-meat Balls for Pies.*

5237. There are a variety of meat pies into which these farced-meat balls are introduced, as pigeon, chicken, ham and veal, game, &c. Beat in a mortar equal parts of fat bacon and lean veal to a smooth paste; season them, and add any herbs you may choose, as parsley, eschalot, button mushrooms, green onions, a little lemon peel chopped fine; mix this with double the quantity of the prepared panada; incorporate these well together with yolk and white of egg beaten up together, and, with a little flour, roll them into balls. It is always proper to poach them for a minute or two in salt and water, to make them preserve their shape, and to prevent them from sticking together.

5238. *Egg Balls.*—Beat in a mortar the yolks of four boiled eggs, with some pepper and salt, and a tea-spoonful of flour; mix them with a raw egg, yolk and white beat together. Roll them into balls, smaller than you desire when produced at table, as they swell in boiling. Poach them for two or three minutes. These are plain; but if you prefer it, chopped vegetables may be added.

5239. *Curry Balls.*—These are composed of the plain egg balls, mixed with some of the prepared panada, with the addition of curry powder, well incorporated together.

5240. *Sausage Balls.*—Ordinary sausage meat is to be beaten smooth in the mortar, and incorporated with yolk and white of egg.

5241. *Balls for Mock Turtle Soup.*—Pound some veal in a marble mortar; rub it through a sieve with as much of the udder as you have of veal, or about a third quantity of butter. Moisten some bread crumbs in milk, and add some chopped parsley and eschalot, rubbing the whole together till it form a stiff paste. When cold, pound and mix all together with the yolks of three eggs boiled hard; season it with salt, pepper, and curry powder or Cayenne; add to it the yolk of two raw eggs, rub it well together, and make small balls. Ten minutes before your soup is ready to serve, put them in.

Sect. V.—Gravies, Sauces, and Purées.

Subsect. 1.—*Gravies.*

5242. *Jus de Bœuf.*—See "Beef Gravy," "English Cooking."

5243. *Blond de Veau.*—See "Veal Gravy."

5244. *White and Brown Roux.*—See "English Cooking."

5245. *Coulis.*—Make the coulis in the same manner as veal gravy, with slices of ham and veal, &c. When the glaze made of the gravy is of a fine colour, moisten it and let it stew. Season it with parsley, green onions, and mushrooms. Mix some brown roux with it; but do not make it too thick, or the fat will not be readily removed, and a fat gravy or sauce is never agreeable. After adding the roux, let it simmer gently for an hour. Skim off the fat, and strain it.

Coulis of fish, game, or poultry is made in the same manner.

Subsect. 2.—*Sauces.*

5246. *Sauce Robert, for Roast Pork or Goose.*—Cut into dice a few onions, and fry them lightly in butter. When they begin to brown, add a dessert-spoonful of flour, a ladleful of stock, the same of vinegar, some salt and pepper. Pulp the whole through a sieve, and reduce it to a proper thickness. When ready for table, have two spoonfuls of *made* mustard. In addition to these ingredients, Dr. Kitchener recommends two dessert-spoonfuls of mushroom catsup, or the same quantity of port wine.

5247. *Sauce Espagnole.*—Put into a stew-pan slices of ham and veal; moisten and warm them. Let the glaze produced go to the bottom. When turning of a good red colour, add a little consommé to detach the glaze from the stew-pan. Pour in some coulis; boil the whole half an hour; skim off the fat, and strain it. In all sauces, remember to add mushrooms, a bunch of parsley, and green onions.

5248. *Espagnole of Game.*—This is prepared in the same way, trimmings of game being added to the veal and ham.

5249. *Sauce Tournée.*—Moisten some white roux with veal gravy, into which put some mushrooms, parsley, and green onions; let them gently stew by the side of the fire until the vegetables have given out their goodness; then skim off the fat, and strain it. If this sauce be farther reduced by evaporation, it forms, by the addition of some cream well mixed with it, the *sauce velouté.*

5250. *Poivrade Sauce.*—Put into a stew-pan a piece of butter the size of an egg, and some slices of carrot, turnip, and onion, two eschalots, two cloves, a bay leaf, thyme, and basil; set the pan on the fire, and stir the contents till they become finely browned; shake in some flour; add a glass of red wine, a glass of water, a spoonful of vinegar, and pepper and salt; boil half an hour. Skim and strain it.

5251. *Sauce à l'Allemande.*—Sauce à l'Allemande is sauce tournée into which a liaison of two yolks of eggs is introduced. This sauce is for all the following sauces or ragouts, blanquettes of all descriptions, of veal, fowl, game, or palates.

5252. *White Italian Sauce.*—After boiling some mushrooms, throw them into water and lemon juice to keep them white. Put into a stew-pan two thirds of sauce tournée and one of consommé, two spoonfuls of mushrooms chopped finely, and of which the colour has been preserved; add half a spoonful of finely-minced eschalots. Reduce the same; season it, and serve it.

5253. *Brown Italian Sauce.*—From the assiette (a dish with four compartments, in which chopped seasonings are put ready for use) take two spoonfuls of eschalots, one of parsley, and two spoonfuls of chopped mushrooms; put them into a stew-pan with two thirds of Espagnole sauce and one of consommé: some add white wine; but this sauce may be made very well without it. Put in very little salt or pepper, nor allow the sauce to thicken. Brown sauces should not be as thick as white. When done enough, change the stew-pan, and put it in a bain marie. Skim it with care, so as not to remove the parsley with the fat.

5254. *Béchamelle Sauce.*—Reduce, over a good fire, some sauce tournée; moisten it with *chicken broth* or consommé, constantly stirring it to prevent its being burned. When of a proper consistence, add two glasses of boiling cream, stirring it well in. Strain it, and serve.

5255. *Sauce aux Truffes.*—Truffles, if good, ought to resist the pressure of the hand; if soft and gluey, and having the smell of cheese, they are not good. Take two pounds; pick, and throw them into water: such as swim are not as good as those that sink to the bottom. Break them, and throw them again into fresh water—not into hot, or they will lose flavour; with a knife remove all specks or bits of wood upon which they had been stuck by the venders; wash them again until the water is no longer turbid; peel, and cut them in slices or dice; put them in a stew-pan, with a piece of butter, over a slow fire; let them sweat, and moisten them with half a glass of wine and two spoonfuls of reduced Espagnole; simmer them gently over a slow fire, adding more butter; skim it, and stir it well; put no lemon juice, as that would take off the softness of the sauce.

5256. *Sauce Piquante.*—Put two or three spoonfuls of Espagnole or coulis into a stew-pan, with a spoonful of white vinegar, a bay leaf, a clove of garlic, a little thyme, a clove, some broth, and a little salt; boil it half an hour; skim it, and pass it through the tamis.

5257. *Sauce à la Reine for Boiled Chickens.*—Beat in a mortar the white part of a dressed fowl with an ounce and a half of blanched almonds till they form a smooth paste; mix with it a small French roll, moistened with half a pint of boiling veal stock or broth, and the yolks of two boiled eggs; stir in sufficient flour to render it of a proper consistence; and, when seasoned, pour it boiling hot over the chickens.

5258. *Maître d'Hotel Sauce.*—Work over a stove a lump of fresh butter in four spoonfuls of Allemande; chop parsley, and, with the juice of a lemon, some pepper and salt, put into the sauce. Let this sauce be made thick, in general. It is easier to thin than to thicken a sauce after it is once made. The flavour is often injured by the necessary addition of flour, butter, &c.

5259. *Tomato Sauce.*—Take a dozen of very ripe tomatoes; cut off the stalks and take out the seeds; squeeze out the juice from the fruit and put it into a stew-pan with half an ounce of butter, a bay leaf, and a sprig of thyme; stir all together over a moderate fire until a purée is formed; add to it a spoonful of *top pot* (see Terms), and rub it through the tamis; return it to the stew-pan, and add two spoonfuls of Espagnole sauce. Make it of the consistence of a thin gravy; season with salt and Cayenne.

5260. *Glaze.*—Glaze is an ornament for the surface of some made dishes: it may be formed of the remains of any liquor in which meat, poultry, or game has been cooked. Let this liquor be strained till perfectly clear, and put over a brisk fire till reduced to the consistency of jelly; when it begins to stick to the spoon, remove it to a smaller stew-pan, and set it in a bain marie. It will keep some little time, and becomes black and bitter when no longer fit for use. Remember to warm it always in the bain marie, that it may not get too brown or deeply coloured.

Subsect. 3.—*Purées.*

5261. *Soubise, or Purée of Onions.*—Take a dozen white onions, peel, wash, and cut them in halves. Mince and blanch them. Put them into a closely-covered stew-pan, with a small bit of ham, a little mace, half a bay leaf, and simmer them for one hour. Rub them through the tamis, and add four spoonfuls of béchamelle; keep it hot, but without boiling.

5262. *Purée of Celery.*—Wash and string several heads of celery; blanch them, and strain away the water when it becomes cold. Put the celery into a stew-pan with a little consommé and sugar. Stew it for an hour and a half, and reduce till there be no kind of moisture. Mix four spoonfuls of béchamelle or velouté, strain the whole through a tamis, and put it into the bain marie. When ready to serve, add boiling cream to thicken it and improve the colour.

A variety of purées may be made of vegetables; also of fish and game.

Purée of potatoes is merely well-mashed potatoes moistened with good broth until the whole is not much thicker than a cream. Instead of broth, cream is sometimes used as the moistening ingredient.

Sect. VI.—Entremets.

Subsect. 1.—*Omelettes.*

5263. Break six eggs into a basin, at the bottom of which some salt dissolved in a tea-spoonful of water and a little pepper had been previously put. Keep back three of the whites. Omelettes are sometimes tough, from having too much white of egg in them, as well as from being too thin. Beat the eggs thoroughly, and pour them into a frying-pan with a small quantity of butter. Keep turning the pan continually, but never let it be too near the fire. When the sides begin to harden, roll the omelette up before the middle part, which should be kept soft, gets too much fire. Roll it equally with the knife before it is dished; and, in turning it out of the frying-pan, take care not to soil the dish.

The general principle of making an omelette being thoroughly comprehended, various additions may be made; thus, you may form an omelette of ham, by mincing some that has been boiled, either with or without herbs. It may likewise be composed of cold fowl minced or beaten in the mortar, properly seasoned, and, to render it more relishing, an anchovy may be pounded with it. A very elegant omelette may be compounded by adding a quantity of scraped Parmesan cheese to the batter. The kidney fat of veal may likewise be employed when finely chopped, and heated in some strong consommé; this may be put into the middle part of the omelette before it is rolled.

5264. *Omelette of Herbs.*—To the mixture of eggs already described add some chopped parsley, and a little eschalot minced very fine, and proceed as above directed. In some instances, sorrel scalded and chopped may be used as a variety.

5265. *Omelette Soufflé.*—This is a raised omelette, and is made by beating the yolks of six eggs with a little grated lemon peel, salt, and sugar. The whites are to be separately beaten till they become an entire froth. These are then to be slightly mixed together; and when the margin has become solid, so as to contain the central part, it is to be put into the oven, that it may rise, which it will do to a considerable height, if sufficient heat be applied to the upper part. If you choose, it may be glazed.

5266. *Omelette Soufflé au Gateau au Riz.*—Boil a little rice in milk and water till quite soft. When cool, put in as much orange-flower water and sugar as may please the taste. Whip the yolks of eight eggs, and mix them with the rice. Then whip to a complete froth the whites, and, just before it is to be baked, add them, and whip all together. Put it into a tin soufflé-dish, just large enough, and then into a very brisk oven, allowing twenty minutes for baking it. The top surface alone should be browned; the rest should be as white and as light as possible.

5267. *Salamandered Eggs.*—When you desire to have eggs served together, first butter the inside of the dish, and place the eggs regularly in it, sprinkling over them some salt and pepper. Cover the eggs with pieces of butter. Place the dish over a moderate heat, and use a salamander at the top till the whites become solid.

5268. *Eggs in the Italian Method.*—Warm some flour and butter in the stew-pan till they are sufficiently incorporated. Moisten with some boiling milk, and season with pepper and salt; next put in about three ounces of fresh butter and a couple of teaspoonfuls of chopped parsley; work these well together. Have ready eight eggs boiled hard; slice them, and put them into the sauce. Serve them up hot, sprinkled with some additional salt and lemon juice.

5269. *Œufs à la Neige.*—Boil a quart of new milk with a large spoonful of orange-flower water and a quarter of a pound of sugar, without stirring. Beat the white of eight eggs to a complete froth. When the milk boils, with a very large silver spoon take as much of the froth as it will hold, and put it at the top of the boiling milk, and let it remain till a little hardened, pouring gently over it with the spoon some of the milk which it imbibes. When cooked sufficiently *it should boil.* Take it gently off the milk in large spoonfuls, and put it in your dishes; it will be enough for two; and after having cooked the white of the froth in this way, which takes nearly half an hour, make a custard of the milk which remains and the yolks, taking care to drain all the milk from the glass dishes. Pour the custard all over the froths while it is hot.

Subsect. 2.—*Vegetable Entremêts.*

5270. *Potato à la Maître d'Hotel.*—Boil in salt and water some unpeeled potatoes. When done, let them cool, and cut them into the shape and size of large corks. Warm them up in sauce *à la maître d'hotel.* (See "Sauces.") When there is no sauce at hand, supply its place with melted butter, with some finely-chopped parsley, pepper, salt, juice of lemon, and a little glaze. Mix it well before putting the potatoes into it; boil it up carefully, lest the potatoes should break. Serve them.

5271. *Casserole of Potatoes.*—Boil potatoes well. Mix butter, cream, and salt together, with which make the potatoes of a thick mash. Serve it, leaving in its centre a space for a ragout, macaroni, or fricassée. Before the ragout is added, the casserole must be baked of a fine brown.

5272. *Turnips, with Sauce Blanche.*—Turnips are admitted as entremêts in the winter only, during the scarcity of other vegetables. Cut them into shapes of pears or balls; boil them in salt and water and butter; drain them, and serve with sauce blanche.

5273. *Turnips, glazed.*—Cut some turnips into shapes, and stew them in broth with a little sugar. When done, reduce the broth to a glaze, andglaze each turnip. With a spoonful of Espagnole dissolve the glaze remaining in the stew-pan, and work into the same a small bit of butter the size of a walnut. Season the same, and pour it over the turnips.

5274. *Carrots à d'Orleans.*—Take a few young carrots and cut them in slices about the eighth of an inch thick. Blanch and drain them. Put them into a stew-pan with a lump of sugar and some broth. Let them boil over a large fire. Reduce the broth to glaze, and add butter and salt. When served, the butter must adhere to the carrots.

5275. *Spinach au Consommé.*—Take care that in the spinach neither stalks nor weeds are left; it must be washed several times in plenty of cold water. Some people put it into a sauce-pan without more water than that which the leaves retain after washing; others prefer its being boiled in salt and water; a few boils will be sufficient; then put it, without loss of time, into a colander to drain, and afterward into cold water, to preserve the colour; when quite cold, press the water well out of it; spread it on a wooden trencher with the knife, to see if any weed or stalk remains in it; chop it very fine, put some butter into a stew-pan, and lay the spinach over it. Dry it over a gentle fire, adding, by degrees, a spoonful of flour; moisten it with consommé, and then stew it briskly, that it may not turn yellow; make it rich with a small piece of glaze. Some people add nutmeg; a little may be grated in, and it may be dished with either fricandeaux of veal or mutton. If to be served as an entrée under ham or tongue, mix with it some sauce Espagnole.

5276. *Spinach, with Cream.*—Blanch and prepare as above, using cream instead of consommé. Boil the cream before pouring it over the spinach, lest it should curdle; add butter, salt, and a little sugar and nutmeg. Serve it with fried toasts of bread, or flourets of puff paste freshly made.

5277. *Cauliflower à la Sauce Blanche.*—Tear off the green leaves and open the cauliflower; remove all snails and insects which may be lodged near the centre; leave the cauliflower in cold water for an hour; next put it into boiling water with salt and butter. It is soon done, and will break to pieces if too long boiled; drain it and dish it, pouring sauce blanche over it.

5278. *Asparagus au Jus.*—Clean, cut, scrape, and throw into water some asparagus sprouts; tie them up in bundles; cut them into equal lengths, and put them into boiling salt and water; boil for a quarter of an hour; drain them and dress them across one another, or in bundles. Serve them in a dish containing sauce half Espagnole and half butter, warmed together.

5279. *Les Petites Pointes d'Asperge.*—Have small asparagus sprouts cleaned and cut into pieces the size of small pease; blanch them in boiling water with salt; when tender, drain and put them into cold water; dry them in a clean towel, and put them into a stew-pan with a small bit of butter, some parsley, and green onions; let these simmer quickly, adding a lump of sugar, a little salt, and two or three spoonfuls of sauce fournée; let this boil, to keep the asparagus green; thicken with two or more eggs, according to the quantity, two eggs to a pint of asparagus pease, and so in proportion. This dish, when well prepared, has precisely the flavour of pease.

5280. *Windsor Beans.*—Take a quartern of small Windsor beans; boil them in weak salt and water; into a little veloute throw half a quarter of a pound of fresh butter, some chopped parsley, and winter savoury; after draining the beans, toss them in this sauce, and serve under ham or bacon.

5281. *Windsor Beans à la Poulette.*—The beans must be young and fresh gathered; boil them in salt water;

drain them, and stew them in *sauce tournée* (see "Sauce"), with some parsley, green onions, a little chopped savoury, and a lump of sugar. When the beans are reduced, throw in a thickening of the yolks of two eggs and cream. Send them up in a short sauce, and properly seasoned.

5282. *Pease.*—Take two quarts of green pease, put them into a pan with cold water and three ounces of butter; handle them in the water, so that the butter may be equally distributed over their surface, in order that they may adhere together; drain off the water, take out the pease by handfuls, and put them into a colander. In this state, equally smeared with butter, stew them over a moderate fire, with a bunch of parsley and some green onions; dust a little flour over them, and stir them carefully; next pour over the pease sufficient boiling water to cover them, but not more; let this boil fast, to evaporate the water quickly; when it is dissipated, put in a lump of sugar, moistened, that it may be more speedily dissolved, and a little salt; have ready mixed two ounces of butter with some flour, which stir into the pease, and let it be so equally distributed among them that none remain at the bottom of the pan.

5283. *Green Pease à la Paysanne.*—Prepare the pease as in the preceding recipe; take a few cabbage and cos lettuces, a handful of parsley, and a few green onions; wash them, and, instead of cutting, break them; drain them from the water, and put them with the pease over a very slow fire. No other moisture will be required than the butter; stir the contents of the stew-pan repeatedly, that they may not burn. When done, add pepper and salt, but no thickening.

5284. *French Beans à la Poulette.*—Boil them in salt and water to preserve their colour; take some sauce tournée, reduce and thicken with the yolks of two eggs, to which add finely-chopped parsley; work into the thickening a lump of fresh butter, pepper, salt, and the juice of half a lemon; drain the beans well, and dish them lightly, that the sauce, which must cover them, may also penetrate to the bottom of the dish.

5285. *Artichokes in White Sauce.*—Pare the bottoms, and take off the points of the leaves of three or four artichokes; put them into a large pot of boiling salt and water; after boiling them well, throw them into fresh water; take away the small leaves with care, that the choke may be entirely removed; replace the leaves, and put them again into hot water. Drain, and serve them with sauce as before.

5286. *Celery, with Sauce Blanche.*—Cut into lengths twelve heads of celery; stew them in a little water, butter, and salt. When done, drain them, and serve with sauce blanche. If the celery is somewhat green, blanch it with boiling water, putting it into a blanc as for celery sauce.

SUBSECT. 3.—*Entremêts of Sweet Dishes.*

5287. *To prepare the Rice for Curry.*—The object to be attained in this preparation is to bring the rice to table sufficiently done and swollen, without sticking together. Take half a pound of rice picked clean and washed; throw it, a little at a time, into a large quantity of boiling water, and let it simmer till three parts done; take it out cautiously, and place it on a hair sieve to drain, and pour plenty of cold water on it, that all the vegetable glutinous matter may be washed off. Put it into a stew-pan, with a cloth at bottom and another at top, and set the stew-pan in a gentle heat (that of an oven is best), that the moisture may be exhaled from it, and imbibed by the upper cloth.

5288. *Casserole of Rice.*—Take a pound and a half of Carolina rice, wash it in warm water, and put it into an open stew-pan; cover it with stock in this proportion: if the rice lie one inch deep in the pans, let the stock rise two inches above it, and so on; boil and skim the surface as the impurities arise, then withdraw it from the fire and set to simmer only; in twenty minutes stir it, and let it simmer on twenty minutes longer; stir it again, and, if the rice be perfectly soft, take it off; if not, add more stock, and continue the simmering until it is done sufficiently. Drain away the fat, by setting the sauce-pan aslant, and before the rice is cold, work it well with a spoon or spatula into a fine, smooth paste; it can hardly be worked too much; every grain of rice should undergo the pressure, and more stock should be worked in if it appear too dry. Form your casserole of this paste, by laying it in a heap four or five inches high and about seven in diameter: work it with the hand as if for a raised pie, or pat it on a mould, and ornament it on the outside with cut carrots, not pressed into the rice, but standing out from it like the bas-relief of ornamented vases. Then mask the whole surface with clarified butter, and place it in a hot oven for an hour and a half; when of a fine yellow colour take it out, remove the top of the casserole, and clear away the rice that does not adhere to the crust, which should be as clear as possible. Mix some béchamelle or Espagnole with the rice, and put it again into the casserole with such ragouts as may have been prepared for it. Glaze the outer ornaments, and serve it. Water, butter, and salt are often used in preparing the rice instead of stock, as preserving better its colour. A casserole may contain either white or brown ragouts, blanquettes, minces, or fricassées of poultry, scollops of fish, macaroni, &c.

5289. *Turban de Riz.*—Wash a quarter of a pound of rice in two or three waters. Take a quart of good cream, boiling it to see that it will not curdle; infuse some lemon peel in the cream for a quarter of an hour; take it out, and put in the rice; lay it on a very slow fire till the rice bursts, and, when swollen, add a very little salt and some sugar; when done enough, add the yolks, well beaten, of eight eggs. Next beat the whites, and add them to the other ingredients, mixing them slowly. Then have some apples ready peeled and quartered; put a gallipot in the centre of the dish, to form a vacancy for some vanilla cream afterward to be added. Lay the rice round the gallipot with a spoon, levelling it with the back of the spoon. Next place the apples round the rice till they reach the summit. Next put it in the oven, but leave it there only until the sirup of the apples is dried up; decorate the dish with sweetmeats of greengage, apricots, or cherries, and, when ready to serve, remove the gallipot, and fill the space with vanilla cream. (See "Confectionery," for vanilla cream.)

5290. *Macaroni.*—This is prepared in various ways: first, by simply simmering the macaroni in water in which some pepper and allspice tied up in muslin have been previously boiled together, with a piece of butter and some salt. When nearly done, pour off the liquor, and let it steam by the fire-side. It is usually, when prepared in this manner, kept hot in a silver sauce-pan, and served at table when wanted.

5291. *Macaroni another Way.*—Boil four ounces of macaroni till tender in veal broth; then drain the broth from it, and add two table-spoonfuls of cream, an ounce of fresh butter, and two table-spoonfuls of grated Parmesan cheese, with some salt and pepper. Mix these well together over the fire for a few minutes; put it into a dish made hot to receive it; strew equally over it some grated Parmesan cheese, and apply the salamander.

SUBSECT. 4.—*Entremêts of French Pastry.*

5292. *French Puff Paste.*—For this a pound of sifted flour will require a pound of butter. If the weather be warm, the butter must be hardened by standing for some time on an ice-tub, or by putting it into cold salt and water. When hardened, half of it is at first rubbed in the flour, which is worked into a paste moistened by the *yolk* of an egg, and a tea-spoonful of the white (yolk and white must be previously and separately beaten). If more moisture be required to make a smooth paste, water must be employed, but in the least possible degree. Roll out the paste, and at three separate times roll out and lay on the butter in patches.

5293. *Paste for stringing Tartlets.*—This consists in simply adding flour and more water to a puff paste, and when well kneaded together it will become sufficiently ductile to be drawn out and twisted at pleasure.

5294. *Crisp Paste.*—This kind is usually preferred for tarts: it is stiffer than puff paste. It consists of half a pound of butter to a pound of flour, a quarter of a pound of loaf-sugar sifted, and four eggs well beaten; this is formed into pastry with cold water, and rolled out.

5295. *French Tourte.*—Cover a flat dish, called a tourte-pan, with thin pastry, and edge the rim with a layer of puff paste. Fill the centre with any kind of preserve or sweetmeat, and ornament it with leaves of puff paste; bake it, and serve it cold.

5296. *Croquante of Paste.*—Make the pastry for croquantes of half a pound of fine flour and a quarter of a pound of sifted loaf-sugar; mix these well together with yolks of beaten eggs until of sufficient stiffness. Roll out the paste about the eight of an inch thick, rub over a plain mould with fresh butter, and lay the paste on the outside, of equal thickness over each part. Pare it neatly round the rim, and ornament it with stars, leaves, or sprigs of paste, as fancy may suggest. Let these lie till dry; then in a slack oven bake the pastry for a few minutes of a light colour. Remove the mould, and put the croquante over a tourte or small dish of pastry.

5297. *Vol au Vent.*—These are made of puff paste, which is to have additional folding and rolling; by this process it will become very light. Brush them over with yolk of egg after they are in the moulds, and let each contain a piece of crumb of bread, which take out when baked, and fill the vacancy with savoury composition or preserved fruit. (See "Puff Paste," "English Cookery.") When vol aux vents are used for entrées, they must be filled with ragouts either of meat or fish; if for entremêts, with vegetables, sweetmeats, or soufflés.

5298. *Pâte d'Amandes.*—Blanch and beat to a smooth paste a pound of sweet almonds with a quarter of a pound of butter. While pounding them, add from time to time a drop of water and a drop of white of egg alternately, which last may be dropped through a small puncture made at the end of an egg. Add also a little lemon juice to whiten the almonds. When reduced to a paste, put in three quarters of a pound of sifted sugar; take the paste out of the mortar, and put it into a tin sauce-pan, or a sweetmeat-pan of bell-metal, over a slow fire; stir it and stir it till it no longer sticks to the spoon. Strew the table with sifted sugar, and roll out the paste on it; wrap it in white paper, and keep it for use.

5299. *Tartelettes à la Chantilly.*—Take almond paste, strew the table with fine sifted sugar, and roll it out, using sugar instead of flour. The paste for the bottom of tartlets must be no thicker than a sheet of paper. Cut them the proper size for *petit pâtés.* Make the bands of the same paste, three quarters of an inch broad and high. Wet the edges of the tartlets with white of egg a little beaten, and fix on the bands in the form of goblets, and so neatly as not to show the joining. Put them on white paper, and dry them in an airy place. Afterward put them only at the mouth of the oven, to dry more and yet to receive no colour; fill them with whipped cream, or, in summer, with strawberries.

5300. *Mirletons de Rouen.*—Roll out half a pound of puff paste as thin as a shilling; cut it in forms, and put it into little pans. Work together in a basin a quarter of a pound of fine sugar with an egg. Add to this a little melted butter, some orange-flower water, and another egg worked in; fill the moulds, sift sugar on the surface, and bake them slowly. Place them in a pyramidal form on a dish, and serve as a small entremêt.

5301. *Ramequins*.—Ramequins are considered as entremêts of pastry. There are two ways of making them: the first consists in rolling out a quantity of puff paste, and sprinkling over it some grated Parmesan cheese, then in folding it up and rolling it out again, and again sprinkling it over with the cheese. These processe must be repeated three or four times; the paste is then cut into square or oblong pieces, brushed over with beaten yolk of egg, and baked.

5302. *Ramequins* (second way).—For ramequins there is also another receipt. Three ounces of fresh butter is put into a stew-pan with a table-spoonful of water; when melted, three eggs must be added, and worked well into the butter. An anchovy beaten to a paste, with a little pepper, is next added, and all the ingredients are moistened with two table-spoonfuls of cream, to which is added an equal quantity of Parmesan cheese finely grated; these must be stirred well together; and some paper moulds being in readiness, the mixture is poured in, and baked for a few minutes only.

SUBSECT. 5.—*Entremêts of Fruit.*

5303. *Stewed Pears.* — Scald some pears, and when soft take them out of the hot water and put them into cold: pare, core, and quarter them; boil them in sirup made of loaf-sugar, and to every pound of fruit put a pint of sirup; cover them close while boiling; and, by way of giving them a fine colour, cochineal, tied in a muslin bag, may be put in, to be removed as soon as the colour is obtained. The juice of three lemons and a little of the rind are then put into the sirup and boiled up. A quart of water and three pounds of sugar are the proportions for the sirup.

5304. *Stewed Apples (with custard).*—Pare, core, and cut into slices some apples, steep them with lemon juice, peel, and some loaf-sugar. Put them, when done and cold, into a pie-dish; cover them over with an unboiled custard, and bake till the custard is set. They may be served either hot or cold.

5305. *Pommes à la Polonaise.*—Core with a scoop, so as not to break them, a dozen small rennet apples, afterward pare and cut them in slices. Cover a dish (not a very deep one) with apricot marmalade and the slices of apple, alternately, forming the layers as much as possible into a dome. Glaze the last layer with sifted loaf sugar, put it into an oven for half an hour, and carefully wipe the edges of the dish when it is done.

SUBSECT. 6.—*Entremêts of Cream.*

5306. *Italian Cheese, à l'Orange ou au Citron.*—Take a quart of cream, a pint of white wine, a glass of brandy, and six ounces of lump sugar. To these add the juice of two lemons, and the rind of one obtained by rubbing it with lump sugar. Line a small hair sieve with muslin, sufficient of which should fall over the sides to allow of the cream being afterward gently lifted out of the sieve. With a whisk whip the cream until it becomes thick and almost solid, fill the sieve with it, and then set it on a basin or jar, that the whey may drain out of it. When firm, turn it on the dish on which it is to be sent to table. Fill up the sieve, in the first instance, as high as possible, to allow for the loss of the whey; also, remove carefully lemon or orange peel before the cheese sets.

5307. *Fromage Bavarois.*—Boil half a pint of cream, and when cool add to it the beaten yolks of nine eggs, a little salt, half a pound of sifted sugar, and some crisped orange flowers. Let these simmer gently over a slow fire, stirring them constantly until they thicken, but not allowing the liquid to boil. Strain the whole through a silken sieve, and have in readiness an ounce of clarified isinglass to add to the cream, with a Chantilly cheese; incorporate the whole together, and pour it into a mould. Ice it for three hours; when to be served, dip the mould into hot water as hastily as possible, and turn out the contents on the dish it is to be sent in to table.

5308. *Fromage d'Abricots.*—In summer take twelve apricots, peel, stone, and pound them with a little sugar; rub them through the tamis, and to this juice add an ounce of clarified isinglass; whip a pint of thick cream, and add it to the apricots: taste if the whole be sweet enough; and, when sufficiently sugared, whip the whole over ice until the isinglass is dissolved and blended with the fruit and cream; put it into a mould, keeping ice and salt all round it. If the mixture be not stirred while it is becoming consistent by freezing, the apricots will sink to the bottom of the mould, and the fromage will be spoiled, one part yellow and tough.

In winter this fromage may be made of apricot marmalade, rubbed through a hair sieve to dissolve the isinglass; a pint of thick cream is then whipped and mixed over the ice with the marmalade; the whole is then put into a mould, and when it is becoming consistent may be left on the ice-tub till it is to be served.

Fromages of *strawberries, raspberries, pineapple,* may be made in the same way.

Fromage de Pêche.—Infuse in a sirup the peaches, and, when tender, drain them and blanch the kernels; pound these extremely fine, and rub them with the fruit through a sieve, mix it with some whipped cream, and then put it into moulds, and proceed with it, over the ice-tub, as with apricot fromage.

SUBSECT. 7.—*Entremêts of Jelly.*

5309. *Italian Jelly.*—Make a calf's foot jelly (see "Calf's Foot Jelly," E. Cookery), and when clear half fill a mould; take some Italian cheese out of a plain mould, and cut it into small rounds with the round cutter; lay these pieces of cheese in circles round the jelly in the mould, and, when neatly arranged, pour on them some more calf's foot jelly. Let it set, and then gently add more and more of the jelly until the mould is filled. In summer set it in the ice-pail, to fix it more firmly; in the winter a cool place will be sufficient. Hold the mould for an instant in hot water before the jelly is turned out.

5310. *Jeleé de Fraises Framboises.*—Take a pint of fresh-gathered raspberries, and, picking them carefully, set them over the fire with a small quantity of water; when hot, strain them through a tamis, and clear them by passing them through a jelly-bag; add to them an ounce of dissolved isinglass and half a pound of sifted sugar; warm all together, but stirring them constantly; strain and put the jelly into a mould, set the mould in a pail of ice for three hours; when wanted, dip the bottom of the mould quickly into boiling water, and turn out.

Strawberry, orange, and lemon jelly is prepared by the same process.

For fruit jellies isinglass is to be preferred to calf's foot stock, as it is always clear and free from flavour.

5311. *Maderia Wine Jelly.*—Make a calf's foot jelly, and when nearly clarified pour in a bottle of Madeira wine and some brandy (a quarter of a pint). The jelly, in clarifying, deprives both the wine and the brandy of much of their strength. It is a jelly that may be kept for several days; hence, when any is sent from table, it should be melted again and put into a fresh mould, to serve another day. This jelly is often ornamented by a thickened jelly, prepared by breaking four eggs into a stew-pan, and beating them up with a few table-spoonfuls of the Madeira jelly and a little sifted sugar; the stew-pan is then put over the fire; the contents are stirred together until they thicken; they are then passed through a sieve into a dish, which is placed in an ice-pail and kept there for three hours; when it is mingled with transparent jelly, as described in the receipts for Italian jelly, it should also be decorated with Chantilly cheese.

BOOK XV.

CONFECTIONERY FOR DESSERTS, ROUTS, AND BALLS.

5312. *Confectionery being in the present day a business of itself,* is not now uniformly practised as a domestic art; in truth, no domestic skill can compete with confectioners by trade, whether the success of their productions, or the expense attending them, be considered. Confectionery processes cannot be carried on without the aid of apparatus and considerable experience, nor without the employment of many efficient hands besides those of the master confectioner. On some occasions ornamental confectionery may be required, and in such cases the purchase of them from the confectioner secures the best of the kind, and at the least expenditure of trouble and money. Acting upon such reasoning, all elaborate receipts for ornamental confectionery are here omitted. The receipts here given will be confined to those by which may be made *cakes* and *biscuits, ices* and *compôtes*, together with the dry and liquid confects which may be wanted at desserts, or at routs and balls. For the application of *sugar* in preserves of fruits, marmalades, and jellies, the reader is referred to Book X., Chap. IV., Sect. VII., "Preservation of Food." Receipts for *creams*, and for *jellies* used as entremêts, will be found under "French Cooking."

CHAPTER I.

CAKES AND BISCUITS.

SUBSECT. 1.—*Cakes.*

5313. *The oven, when cakes are to be baked*, must be "quick," as the cook terms it, when slow, cakes will not rise properly, hence they turn out what is termed "heavy." To find out when baked enough, half open the oven-door and plunge a bright blade of a knife into the centre of the cake; if done enough, the knife will come out as clear as it went in; if not done enough, some of the cake will adhere to it. The door of the oven must in that case be immediately closed again, to prevent the cakes from falling.

Currants required for a cake must be previously cleaned and dried before the fire; if they are put into a cake *wet*, it will not rise properly.

Eggs to be added to cakes must be well beaten previously, the yolks and whites separately.

Lemon peel, thinly pared, should be pounded to a paste, with a little sifted sugar, and mixed with either wine or milk, that it may be more easily mingled with the other ingredients.

A little yeast, beaten with sugar and the yolk of an egg, makes a cake much lighter than any quantity of eggs or butter can do.

All the ingredients of a cake, when put together, must be beaten for a considerable time. Some confectioners cause this to be done for the chief part of an hour, as the lightness of a cake depends principally upon the ingredients being very thoroughly intermingled.

5314. *Rich Plum Cake.*—The ingredients are, 1½ lb. of flour, 1 lb. of butter, 1 lb. of sugar, ½ lb. of candied citron and orange peel, 2 oz. of sweet almonds, ½ oz. of allspice, ½ oz. of cinnamon, 10 eggs, and one glass of brandy.

To mix the ingredients, beat the butter to a cream; add the sugar to it; stir them together for a long time; add the allspice and pounded cinnamon; work in the yolks of the eggs two at a time; beat the whites till they are highly frothed; work in the whites gradually, keeping the paste warm, or it may become heavy. Cut into stripes the citron and orange peel; mix them with the currants (previously well washed and dried before the fire), and also with the almonds; stir in by degrees the sifted flour, then the brandy; with a whisk beat the whole together for a considerable time; put the cake into a tin hoop, and bake it for three hours. Let there be several sheets of paper both under the cake and on the top of it.

Sugar Ice for Plum Cake.—When the cake is almost cold, beat and sift eight ounces of fine loaf-sugar, and put it into the mortar with four spoonfuls of rose-water, the juice of a lemon, and the whites of two eggs beaten to a froth and strained. Whisk these ingredients well together, and with a paste-brush cover the cake with it. Set the cake in a cool oven to dry the iceing, but not to discolour it; an hour will harden it. When cold, let the cake be covered over with thin white paper, to preserve the delicacy of the iceing.

5315. *Common Plum Cake.*—The ingredients are, 2 lbs. of flour, 1 lb. of butter, ½ lb. of currants, ¼ lb. of sugar, 1 oz. of citron and lemon peel, ¼ oz. of nutmeg or ginger, 1 table-spoonful of good yeast, and 3 eggs. Set the flour as if for bread, with the yeast, eggs (well beaten), and some sugar, mixed well together, and poured in the middle. Let these ingredients stand before the fire until the yeast has worked its way into the flour; add the butter, beaten to a cream, the currants, sweetmeats, &c., and mix all thoroughly together. Put the whole into a tin band, and set it on paper before the fire to rise; put it, when risen, into the oven, and bake it for an hour and a half, trying it with the knife before it is taken completely out of the oven.

5316. *A rich Seed Cake.*—The ingredients are, 1 lb. of flour, 1 lb. of butter, 1 lb. of sifted sugar, 8 eggs, ¼ oz. of powdered cinnamon and nutmeg, 1 oz. of caraway seeds, and 1 glass of sherry. Warm the flour before the fire; beat the butter to a cream, mixing the sugar, pounded and sifted, with it, before any of the other ingredients, but not until the butter is brought to a fine cream. Beat separately the yolks and whites of the eggs, and pour them into the cream; mix together the flour and spices, and add the moist ingredients, stirring all together for an hour. The lightness of cakes is improved by thoroughly incorporating together all the ingredients of which they are composed.

5317. *Plain Seed Cake.*—The ingredients are, 2 lbs. of flour, ½ lb. of butter, a tablespoonful of fresh yeast, 2 eggs, 4 oz. of loaf-sugar, ½ oz. of caraway seeds. Dry the flour; beat the butter to a cream, adding to it a little milk and water, the sugar and the eggs, also well beaten; put the yeast to these ingredients, and pour them into the centre of the flour; work up the dough, and set it in the tin before the fire to rise. Bake it for an hour and a half.

5318. *Sponge Cake.*—The ingredients are, 10 eggs, their weight in fine sugar, the weight of six eggs of flour. Beat the yolks with the flour, the whites beat separately until they froth; by degrees mix in the sugar and the whites with the flour, and whisk all quickly together for half an hour. Put the mixture into tin moulds lined with buttered paper; cover the top of the cake with paper, and bake for an hour and a half.

5319. *Rice Cake (with butter).*—The ingredients are, 1 lb. of butter, 1 lb. of sugar, 12 eggs, ½ lb. of flour, and ½ lb. of rice flour. Beat the butter to a cream; add to it the sugar pounded; stir them till they appear light; break in the eggs three at a time, stirring the whole all the time. The eggs being worked in, add the rice and flour, previously mixed together. Bake this in a hoop, covering the top and bottom with several folds of paper.

5320. *Paper Cases for Sponge or Rice Cakes.*—These cases are generally made in the form of fluted baskets; the paper is cut somewhat larger than the moulds on which they are to be formed. A circular piece of paper, of proper size, is folded like the plaits of a shirt; then put on the mould, which fits tight into a wooden box, into which the mould is forced. The paper rising above the mould is neatly cut off, and when removed from the box the paper will be found of a firm shape; it is then iced with cream sugar inside and out, and put into the oven for a short time. It is then ready to receive the cake which is to be baked in it.

Subsect. 2.—*Biscuits.*

5321. *Champagne Biscuits.*—The ingredients are, 1 lb. of butter, 2 lbs. of flour, 1 lb. of loaf-sugar, 12 eggs, and 1 oz. of caraway seeds. The eggs and sifted sugar must be mixed together until they form a thick paste; the butter must be previously beaten to a cream, that, when the sugar and eggs thicken in stirring, the butter may be ready to stir in with them. The flour is then added by degrees, and the caraway seeds at the same time. Put the biscuits on crinkled paper, and the papers into the tin moulds; bake them in a hot oven.

5322. *Savoy Biscuits.*—The ingredients are, 15 eggs, 1 lb. of sifted sugar, ½ lb. of flour, and the raspings of the peel of two lemons. The eggs must have the whites and yolks beaten separately; the sugar and the lemon peel are next added to the yolks, and the whole beaten with two little wooden spaddles, one in each hand, rolling them like drum-sticks, to make the mixture froth. This must be continued for a quarter of an hour, during which time an assistant must be preparing the whites by beating them with a brisk whisk. They are, while in a state of froth, gently added to the yolks and sugar, during which time the whole must be constantly stirred, and the flour sifted in by an assistant, the stirring being still continued. When well mixed, the paste which is thus formed is spread on sheets of paper, in lengths of three and a half inches. When the papers are filled, finely-powdered sugar is sifted over them through a lawn or silken sieve; after remaining for a few minutes while the sugar settles in the biscuits, put them on plates and bake them of a fine clear colour; when cold, detach the pieces from the paper with the back of a knife, and lay them back to back.

5323. *Gimblettes.*—The ingredients are, 3 eggs, 6 oz. of flour, 4 oz. of sugar, and a little raspings of lemon peel. Break the eggs, and add to them the sifted sugar and rasped lemon peel; work them together, and then add flour until the paste is neither too stiff nor too soft for rolling. Roll it and cut it in form of rings about the size of a five-shilling piece; dip these rings into boiling water, taking them out as soon as they rise to the surface; drain them on a napkin, and put them on paper or plates to bake, in an oven moderately heated. When nearly done, with a brush lightly wash them with white of eggs, put them into the oven for a minute to dry.

5324. *Scotch Short-bread.*—The ingredients are, 1 lb. of butter, 2 lbs. of flour, ½ lb. of good brown sugar, ¼ lb. of blanched almonds cut small, and ¼ lb. of candied peel. Beat the butter to a cream, and add it to the flour and sugar with the other ingredients. When well kneaded and incorporated, roll it out into cakes about an inch thick. Bake it in a moderate oven.

5325. *Macaroons.*—The ingredients are, ¼ lb. of sweet almonds, 4 spoonfuls of orange-flower water, 6 whites of eggs, and 1 lb. of sifted sugar. Blanch and pound the almonds with the orange-flower water, or with some of the whites of eggs, if the flavour of orange-flowers is not approved of. Whisk the whites, and add them gently to the pounded almonds, lest they should not be properly incorporated with it, and should "oil," as the confectioner would say. Sift the sugar into the almonds till the whole forms a paste, not too stiff to be dropped on wafer paper, which must be spread ready to receive them on an oven plate. When dropped, wet a spoon, that the paste may not adhere to it, and flatten and round each macaroon till of a good shape. Bake them in a very slow oven. (Bitter macaroons are made in the same way, but with *bitter* instead of *sweet* almonds.)

5326. *Light Macaroons.*—The ingredients are, ¼ lb. of bitter, and ¼ lb. of sweet almonds, 1 lb. of sifted sugar, and 4 whites of eggs. Blanch the almonds, but, instead of pounding, cut them into small pieces, and moisten them with the white of one egg, and sift the sugar over them; then put them into the oven till they brown. Beat to a froth the rest of the eggs, and add them to the paste, whisking the whole together; drop them on wafer paper spread on the tin oven plate, and shape them with a spoon dipped in cold water. Bake them in a very slow oven. Cut the wafer paper round each macaroon, but leave it on the under surface.

5327. *Ratafia Biscuits.*—The ingredients are, ½ lb. of bitter and ½ lb. of sweet almonds, 2 lbs. of sugar, and 7 whites of eggs. Blanch and pound in a mortar with the whites of the 7 eggs the bitter and sweet almonds. They must be finely pounded before the sugar is added, which must be sifted into the mortar, and then worked in very thoroughly with the pestle for a quarter of an hour. These biscuits will not be good unless the sugar be very well incorporated with the other ingredients. Wash a bladder very clean, cut a small hole at one end of it, and fasten a glass tube to it, of the size of the biscuit required; then put into the bladder the ratafia paste, and press it gently through the tube in distinct drops on a thick white paper; drop the biscuits so that they do not touch each other. Bake them on tin plates in a warm oven. If the paper sticks to the biscuit when baked, it must be slightly wetted, when it can be easily removed, but the ratafias must in that case be put into the oven again to dry.

5328. *Almond Wafers.*—Ingredients, ½ lb. of sweet almonds, ¼ lb. of sifted sugar, 1 oz. of flour, and 2 eggs. Blanch and cut the almonds small; moisten them with the yolks and whites of eggs previously beaten. Sift into them the sugar and the flour, and mix the whole together with two drops of essence of lemon peel. Lightly butter a clean tin, and spread the mixture over it as thin as possible. Bake it of a light brown, and cut it with a knife, before it is cold, into long squares; roll them immediately on pieces of wood, to make them round and hollow. They are usually served to garnish creams.

5329. *Dry Meringues.*—Ingredients, 12 whites of eggs and 1 lb. of sugar. Beat up the 12 whites of eggs; when they are of a stiff froth, add to them the pound of sifted sugar, with some essence to flavour, either that of cloves, cinnamon, or lemon peel. Lay out the paste on paper in the form of large eggs halved; cover them with sugar, sifted through a silk sieve, and remove with a feather the surplus sugar. On a board two inches thick put the meringues to bake, for they must have no heat but from the top; when of a fine colour, remove the papers from them, and beat in, with the back of a spoon, the liquid part to form a hollow. Put them back again into the oven, to dry the inside, which is to be filled at the moment they are to be served, either with a cream or a jelly. Meringues are varied in colour and form, and may be ornamented with currants or almonds.

CHAPTER II.

ICES AND COMPOTES.

5330. In this chapter, under different sections, will be found some suggestions concerning *ices* and *compôtes*, and some receipts for the guidance of novices in either branch of confectionery. Those of *compôtes* are introduced in this chapter as being generally accompaniments of *ices.*

SECT. I.—ICES.

5331. *Ices are composed,* it is scarcely necessary to say, of congealed cream or water, combined sometimes with liqueurs or other flavouring ingredients, or more generally with the juices of fruits. At desserts, or at some evening parties, ices are scarcely to be dispensed with. Yet, in London, or in other great towns, these delicacies need not, neither can they often be of domestic manufacture. There the confectioner by trade can supply them more easily, and at a less cost than can be effected in all general cases at home; but, in country places, circumstances being different, the confectioner not being close at hand, the forming of ices, together with the preparing of other accompanying luxuries, must necessarily be a domestic concern; thus, an ice-house is convenient, for the construction of which see Book VIII., Chap. VII. Also, some suggestions and instructions in this work will be useful to the more youthful, if not to the experienced domestic manufacturer of these luxuries.

5332. *Preliminary Notices.*—The principal utensils required for making ice creams are, ice-tubs, freezing pots, spaddles, and a cellaret.

The tub must be large enough to contain about a bushel of ice, pounded small, when brought out of the ice-house, and mixed very carefully with either *salt, nitre,* or *soda.*

The freezing pot is best made of pewter. If it be of tin, as is sometimes the case, the congelation goes on too rapidly in it for the thorough intermingling of its contents, and on which the excellence of the ice greatly depends.

The spaddle is generally made of copper, kept bright and clean.

The cellaret is a tin vessel, in which ices are kept for a short time from dissolving.

The method to be pursued in the freezing process must be attended to. When the ice-tub is prepared with fresh-pounded ice and salt, the freezing pot is put into it up to its cover. The articles to be congealed are then poured into it, and covered over. But to prevent the ingredients from separating, and the heaviest of them from falling to the bottom of the mould, it is requisite to turn the freezing pot round and round by the handle, so as to keep its contents moving until the congelation commences. As soon as this is perceived (the cover of the pot being occasionally taken off for the purpose of noticing when freezing takes place), the cover is immediately closed over it, ice is put upon it, and it is left in this state till it is to be served.

The use of the spaddle is to stir up and remove from the sides of the freezing pot the cream which in the shaking may have washed against it, and, by stirring it in with the rest, to prevent any waste of it occurring. Any negligence in stirring the contents of the freezing pot before congelation takes place will spoil the whole. Either the sugar sinks to the bottom and leaves the ice insufficiently sweetened, or lumps are formed, which disfigure and discolour it.

SECT. II.—CREAMS FOR ICES.

5333. No. 1. *Ingredients:* One pint of cream, eight yolks of eggs, and lemon peel thinly pared. Beat the yolks of the eggs, and mix them gently with the cream; add the lemon peel, pared extremely fine; put the whole into a well-tinned, or bell-metal sauce-pan· being set over a slow fire, the contents of the sauce-pan must be stirred constantly with a whisk, until the cream begins to thicken. As soon as this is perceived, by the cream moving round the sauce-pan less easily, it must be taken off the fire, but the stirring must be continued for a short time, and at intervals, until the cream is cool. Great care must be taken in preventing it while on the fire from boiling, which would curdle it. When cool, a little sifted sugar may be stirred in, and the whole strained into a basin until wanted. In this state it is ready to have any flavour given to it which may be required.

5334. No. 2. *Whipt Cream.*—The ingredients are, one quart of cream, sugar to the taste. (To these flavours, either of orange flower water, or of lemon juice and wine, may be given, according to the use for which the cream is intended; but when to be used for ices, the orange flower water is the most general flavouring ingredient employed.) Put the cream, the orange flower water, and sugar into a bowl. Have at hand another basin with a silk sieve over it. Whisk the cream briskly, and as the froth rises to the surface, skim it off, and pour it into the sieve. Continue whisking and skimming, and pouring back into the bowl that part of the cream which passes through the sieve. When the whole of the cream is thus whisked, it may stand in the sieve until wanted, or it may be iced, by putting the sieve into a cellaret filled with pounded ice and salt. With either this kind of cream, or with such as may be prepared according to the preceding receipt, most of the ice creams in general use may be formed.

5335. *Orgeat Ice Cream.*—The ingredients are, 1 oz. of sweet almonds, ¼ oz. of bitter almonds, 1 pint of cream, 8 yolks of eggs, 4 oz. of sifted sugar. Blanch and pound the almonds with a little orange flower water. Beat the yolks, add the sugar, and stir all together gently into the cream. Put the whole on the fire, and whisk it round and round till it begins to thicken. Take it off, stir till cold, then put it into the freezing pot, and work as before directed.

5336. *Strawberry Ice Cream.*—The ingredients are, one pint of strawberries, one pint of thick cream, the juice of half a lemon, sugar to the taste. Mash and strain the juice of the strawberries, add to them some sugar finely pounded, and the cream fresh and thick. Squeeze and strain the juice of half a lemon into the strawberries and cream. Pass the whole through a sieve into the freezing pot, and work as before directed. In this cream, as well as in others, there should be no preponderance either of the flavour of the strawberries or lemon.

5337. *Raspberry, currant and raspberry, and pineapple ice creams* are all made in the same way as strawberry ice cream.

SECT. III.—WATER ICES.

5338. *These ices are made of the juice of ripe fruits* strained, and sweetened with clarified sugar, and put into the freezing pot, and worked as before directed. Sometimes the mixture is flavoured with a little lemon juice, or, if the freezing is not complete, water is added to the juice, but in a small quantity, or the mixture will become too solid. When congealed, it should be perfectly smooth, and soft enough to break easily with the spoon.

5339. *To currant water ice* the juice of raspberries, or of Kentish cherries, is sometimes added to soften the acid of the currant juice.

5340. *To cherry ice* a flavour of noyeau is sometimes added.

5341. *To apricot ice* the kernels blanched and pounded with a little sugar, some lemon juice, and a little water are added, care being taken to strain the whole free from every lump before it is put into the freezing pot.

5342. *Lemon water ice* is composed of the juice of lemons, into which the peel of one lemon out of four is finely rasped into the juice. A sirup of clarified sugar is added in a quantity sufficient to sweeten the whole, which must be carefully strained through a lawn sieve, before it is put into the freezing pot and worked.

To this ice ginger may be added, or liqueurs, such as Maraschino, or wines, such as Champagne, Madeira, &c.

SECT. IV.—COMPOTES.

5343. *Compôtes are fruits prepared in sirup* for immediate use, and chiefly as accompaniments of ices. In winter, or when fresh fruits are not to be had, the compotier must be supplied with preserved fruits, prepared in a manner similar to that in which the fresh fruits are formed into compôtes.

5344. *Green Apricot Compôte.*—Of this fruit is made a very favourite compôte. The thinning of an apricot-tree will often supply the fruit, which should be gathered for this purpose before the stones become hard. The down upon them must be removed by scalding them in water in which wood ashes or charcoal had been previously boiled, but strained off. The apricots are thrown in when the water is hot, and as they rise to the surface are skimmed off, and immediately thrown into cold water. They are taken out of the cold water, drained, and rubbed with a cloth. When the down is cleaned off, the fruit must be put into a hot sirup, and then, after once boiling up, and being well scummed, they must be poured into a basin till the succeeding day. The sirup is then drained from them, boiled up, and poured over them again, with some fresh sirup added to it. The apricots and sirup are then boiled up for four or five days successively, more sirup being added as it is washed in each day's boiling. When boiled up for the last time, the apricots must be taken out, the sirup boiled to the great thread, and poured over the fruit, which is then ready for the compotier. This compôte will be scarcely good if kept more than two days.

5345. *Ripe Apricot Compôte.*—Peel, divide into halves, and stone some fine ripe apricots. Prick them all over with a needle. Blanch them carefully, and drain the water from each by gentle pressure. Put them in sirup, and boil them up; scum the sirup; let the whole stand to cool, then boil the sirup, and pour it over them several times successively.

5346. *Ripe Plum Compôte.*—Prick the plums with a needle, and put them into cold water while boiling a pan of water, into which they must be put as soon as the water boils. When the fruit rises to the surface, take them out of the hot water, and put them again into cold water. Prepare the sirup for them, and boil them up in it. Pour them into a basin, and leave them for some hours, and then boil them up once or twice more; scum them well, and let them cool for use.

5347. *Strawberry Compôte.*—Strawberries for a compôte require very little boiling. It is sufficient to pour over them some currant jelly boiling.

5348. *Raspberry Compôte.—Raspberries, as well as strawberries, are too delicate* a fruit to require much boiling. When they have been carefully selected for their size and ripeness, they must be washed in cold water and drained. The sirup must be, while boiling, poured over them. In this sirup they must remain four or five hours, then be put into a bell-metal sauce-pan, and be warmed in the sirup, not boiled, or they will be broken and disfigured. When cool, they are ready for the compotier.

5349. *Apple Compôte.*—Peel, cut into halves, and core some apples; and after letting them lie for a short time in cold water, drain them, and put them into sirup, in which boil them till they are soft; then place them in the compotier, and strain the sirup over them. Remember that with apples the flavour of lemon peel is generally liked. This compôte may be improved by boiling in the sirup some of the apple to a jelly, straining it, and pouring it over the halves prepared as above directed.

5350. *Orange Compôtes.*—Peel either some China or St. Michael's oranges, cut them into slices, and remove the pips, if there be any in them. Boil some sirup, but do not pour it over the sliced oranges till it is cold. This compôte requires no boiling.

CHAPTER III.

CONFECTS FOR DESSERTS AND ROUTS.

SECT. I.—DRY CONFECTS.

5351. Under this head we shall only include *fruit in candy*, *fruit in pastes*, *fruit in biscuits*.

SUBSECT. 1.—*Candied Fruits.*

5352. *Apricots*, *cherries*, *greengages*, *barberries*, *oranges*, and any other fruits that have been previously preserved in *sirup*, may be candied by following the directions now given. For candying there must be provided two square boxes; one made of tin, about twelve inches long, eight inches wide, and about three or four inches deep. At one corner of this box there must be a hole and pipe, through which overflowings of sirup may pass off, but which must be corked up while the fruit is in the oven. The other box must be made entirely of wire, and somewhat smaller than the other; to this last there must also be a cover. The fruit which is to be candied is placed in layers one above another, on wire frames, and when the wire box is completely filled, the cover is put on to keep the contents in place, and the box is placed within the tin box, and put into an oven moderately heated. The second case must also be covered closely before it is put into the oven.

The mode of candying is by boiling sirup to what is termed the "*little blow.*" (See Book X., Chap. IV., Sect. VIII., "Preserving by Sirup.") Let a pint of sirup be boiled to this degree. While cooling, the surface of the sirup will be covered with candy, which, as it forms, must be skimmed off, and poured in among the layers of fruit after they are placed in the wire box. When the whole of the sirup has been thus used, then the box containing the fruit must be covered closely, put into the oven, and suffered to remain in it for twelve hours. When taken out, the wire case must be placed so as to allow all the sirup which has not candied to pass away. As soon as the moisture dis appears, the fruit must be taken out with great care, and put into tin boxes, to be kept dry until wanted.

5353. *Orange chips* are prepared from the parings of Seville oranges, and in the same way as directed in the preceding receipt for candying orange and lemon peel.

5354. *Candied Ginger.*—Put into a preserving-pan one ounce of finely-grated ginger, one pound of sifted loaf-sugar, and no more water than enough to dissolve the sugar. Put the pan over a slow fire till the sugar begins to boil. Add another pound of finely-sifted sugar, stirring it in till it thickens, then drop it in cakes or plates, and dry them in a slow oven; when done they will be hard, brittle, and white.

SUBSECT. 2.—*Fruits in Paste.*

When the pulp of any fruit is boiled to such a consistence as to keep in the form given to it, it is called "paste;" and, made up in different forms, it adds variety to desserts at seasons when many fresh fruits are not to be had.

5355. *Apple Paste.*—Apples, boiled till soft, peeled, and passed through a hair sieve, to be formed into "paste," must be slowly boiled in sirup until it is perceived to thicken; it is then ready to be put into moulds, or dropped on plates as cakes. The plates and moulds must then be put into a slow oven, and left in it for twenty-four hours, or longer, if the pulp is not sufficiently dried to turn out of the moulds, or to cut into rings and circles, or into stringlets by which knots may be formed.

5356. *Apricot Paste.*—Boil a dozen ripe apricots for two or three minutes, pass them through a hair sieve, and reduce the pulp they render by boiling it for some time before adding the sirup to it. Remember, it must be stirred the whole time. For every pound of pulp weigh half a pound of sugar, which must be clarified and boiled to "a feather" (see "Preserving by Sirup," Book X., Chap. IV., Sect. VIII.), before the pulp is added to it. The pulp and sugar must not be boiled together for more than a minute, when the moulds must be filled and the paste dried, as before directed, in a slow oven for twenty-four hours. Wooden moulds lined with loose paper answer the best for these pastes. When the paper is to be taken off, it must be wetted in a little warm water.

5357. *Greengage Paste.*—Boil greengages to a jam without sugar, pass them through the sieve, and again reduce them in the preserving-pan over the fire. To every pound of pulp weigh a pound of sugar; clarify it, and boil it to the "great ball." (See "Preserving by Sirup.") Mix the pulp with it, and boil both together for a few minutes, when it may be poured into moulds or on plates, and dried as directed for other pastes.

5358. *Raspberry and Strawberry Pastes.*—These fruits may both be made into pastes by the same means as above directed in regard to other fruits. More sugar is, however, requisite to make them harden properly: about a pound and a quarter to a pint of pulp will be sufficient; and after clarifying it, both are boiled for a short time, and dried as before directed.

Every fruit paste may be candied by adding sifted sugar to them, and continuing to keep them in a stove of moderate heat.

SUBSECT. 3.—*Fruits in Biscuit.*

5359. *Biscuits of fruit are composed* of the pulp of scalded fruit, with sifted sugar of weight, in most cases, equal to that of the pulp, sometimes greater. When mixed, these ingredients are dried in the oven, the heat of which should never be such as to bake, instead of drying them.

5360. *Apricot Biscuits.*—Peel and reduce as many ripe apricots as will yield one pound of pulp; stir in a pound of fine loaf-sugar sifted, and boil both pulp and sugar together for about a quarter of an hour; then pour the jam thus made into paper cases, or drop it on paper in the form of small cakes, and dry them in a slow oven, or before a fire, for several days, turning them each day. Put them in boxes or tins, and keep them dry for winter use.

5361. *Apple Biscuits.*—Slightly flavour the pulp of apples with essence of lemon peel; mix with it, while warm, its weight of sifted sugar, and drop it on plates or into paper cases, and dry it in a slow oven for several days.

5362. *Raspberry Biscuits.*—Carefully select fine raspberries, and clear them of any that appear too ripe or mouldy; weigh them before reducing them to a pulp, that an equal quantity of sugar may be added to them when reduced. When they are sufficiently reduced, take them off the fire, and mix in the sugar, finely pounded and sifted; stir it in till it is dissolved; then pour the paste out on plates, to dry it. As soon as the surface at the top is dry, cut the paste into cakes of different forms; turn them, and continue to dry them in a slow oven until they are crisp. Put them into boxes or tin cases, and keep them in a dry place.

Strawberry biscuits are made in the same way.

SECT. II.—LIQUID CONFECTS.

5363. *Iced fruit waters* are, in their season, very agreeable and elegant beverages for evening parties. Either *currants*, *cherries*, *strawberries*, *raspberries*, or *apples* may be employed for this purpose.

5364. *Strawberry Water.*—Take a pottle, if possible, of scarlet strawberries, on account of the beautiful colour they impart to the sirup, pick them carefully, and put them into three pints of very weak sirup; bruise the strawberries in it, and boil them up; strain the water through a jelly-bag without any pressure, which would render the water thick. Ice the water, and keep it in a cool place till wanted.

In making currant and cherry waters, a stronger sirup will be required than for strawberries: the taste must determine the requisite strength for it.

Orgeat Water.—Blanch and pound rather more than half a pound of sweet almonds, and about a dozen of bitter; add to them a quart of weak sirup, with as much orange flower water as may pleasantly flavour the water. Boil these together, and strain off the water through the jelly-bag, or tamis; bottle it, and ice it. To this some add the flavour of cinnamon; others that of brandy.

Orange Water.—Take the rinds of six China oranges, cut them into small shreds, and put them into two quarts of boiling water; squeeze the juice of the oranges into it; add sugar to the taste, finely sifted; boil all together, and strain the water through the jelly-bag; bottle, and ice it.

5365. *Lemonade.*—Pare off very thin the rinds of twelve lemons; put about half of these parings into three pints of hot water, and cover it over for two hours; squeeze the juice of the lemons into a China bowl, and add to it a pound and a half of fine sugar (pounded); add to this the water, and three pints of milk, boiling hot; pour this through a jelly-bag, and continue to do so until the lemonade is perfectly clear. If not sufficiently flavoured with the essence of the peel, a few drops of the prepared essence of lemon peel should be added; bottle, and ice it. *Lemonade* made with boiling water and slices of lemon, together with sugar enough to sweeten it, and a quarter of an ounce of isinglass dissolved in it, forms an agreeable beverage, and is made with less trouble than that made after the above receipt. It requires also to be passed through the jelly-bag, and to be bottled and iced.

Raspberry Vinegar.—Put a pound of fine raspberries into a *China* bowl, or glass dish, and pour over them a quart of white wine vinegar. The next day strain the liquor from the raspberries, and pour it over another pound of fresh fruit, and thus increase the quantity daily, until enough juice has been obtained. Let it be remembered that the juice must only be *drained*, not squeezed from the fruit, or the vinegar will be turbid. To every pint of the juice thus obtained weigh a pound of loaf-sugar; break it into moderate-sized lumps; add it to the vinegar, and keep stirring it at intervals until it is dissolved. Put all together into a stone jar, which set in hot water, or on a hot hearth, where it must simmer for some time, must be skimmed, when cold, bottled, and the cork closed over with sealing-wax or with bladder.

5366. *Capillaire.*—Take seven pounds of loaf-sugar, one pound of moist sugar, and four eggs, well beaten, put these into three pints of water; boil it up two separate times; skim it carefully while boiling; add to it a quarter of a pint of orange flower water; strain it through a jelly-bag, and bottle it when cold. A spoonful in a tumbler of cold water makes a pleasant beverage.

BOOK XVI.

COOKING FOR THE ECONOMIST AND INVALID.

CHAPTER I.

COOKING FOR THE ECONOMIST.

Among the foregoing receipts will be found many which, by the economist, would be considered as leading to a prodigal use of the ingredients composing our daily food; and, in the case of householders of small income, the application of those receipts could not, indeed, be otherwise regarded. Health in the body and comfort in the spirits, to be sustained, demand a daily sufficiency of food, properly cooked. A single joint, well cooked and neatly served, ought, to persons in health, to afford a dinner sufficiently nourishing and enjoyable; but when this can be varied by the art of cooking, without increasing imprudently the expenditure, there can be no objection to its being done; on the contrary, it is only co-operating with the benevolent intentions of nature to render the meals of those who earn their food fully relishing.

Sometimes the situation in life requires not only economy, but something of style to be supported. When this is the case, a really good cook is a valuable person in a family: she will know how to turn everything to account; how to produce from an old basis a new dish; and how to serve up, in some form or other, to-day the superabundance of the dinner of the previous day. Ideas and suggestions on these points will be found in the present chapter: they are offered as assistance to the novice in domestic economy, but who, in following them up, will find some that may not be in her case capable of application; some that must be modified before they are adopted; others that must be improved upon.

Sect. I.—BUTCHER'S MEAT, FISH, AND POULTRY.

Subsect. 1.—*Economy in the Use of Butcher's Meat.*

5367. *Of beef, the round* is, in large families, one of the most profitable parts: it is usually boiled, and, like most of the boiling parts of beef, is generally sold, in London, at a penny per pound less than the roasting joints.

5368. *The brisket* is also a penny a pound less in price than the roasting parts: it is not so economical a part as the round, having more bone to be weighed with it, and more fat. Where there are children, very fat joints are not desirable, being often disagreeeble to them, and sometimes prejudicial, especially if they have a dislike to it. This joint also requires more cooking than many others; that is to say, it requires a double allowance of time to be given for boiling it: it will, when served, be hard, and scarcely digestible, if no more time be allowed to boil it than that which is sufficient for other joints and meats. When stewed it is excellent; and when cooked fresh (*i. e.*, unsalted), an excellent stock for soup may be extracted from it, and yet the meat will serve as well for dinner.

5369. *The edgebone*, or *aitchbone*, is not considered to be a very economical joint, the bone being large in proportion to the meat; but the greater part of it, at least, is as good as that of any prime part. It sells at a penny a pound less than roasting joints.

5370. *The rump* is the part of which the London butcher makes great profit, by selling it in the form of steaks. In the country, as there is not an equal demand for steaks, the whole of it may be purchased as a joint, and at the price of other prime parts. It may be turned to good account in producing many excellent dishes. If salted, it is simply boiled; if used unsalted, it is usually stewed.

5371. *The veiny piece* is sold at a low price per pound; but, if hung for a day or two, it is very good and very profitable. Where there are a number of servants and children to have an early dinner, this part of beef will be found desirable.

5372. *From the leg and shin* excellent stock for soup may be drawn; and, if not reduced too much, the meat taken from the bones may be served as a stew with vegetables; or it may be seasoned, pounded with butter, and potted; or chopped very fine, and seasoned with herbs, and bound together by egg and bread crumbs: it may be fried in balls or in the form of large eggs, and served with a gravy made with a few spoonfuls of the soup.

5373. *Of half an ox cheek* excellent soup may be made: the meat, when taken from the bones, may be served as a stew.

5374. *Roasting parts of beef* are *the sirloin* and *ribs*, and these bear in all places the highest price. The most profitable of these two joints at a family table are the ribs. The bones, if removed from the beef before it is roasted, will assist in forming the basis of a soup. When boned, the meat of the ribs is often rolled up, tied with strings, and roasted; and this is the best way of using it, as it enables the carver to distribute equally the upper part of the meat with the more skinny and fatter parts at the lower end of the bones.

5375. *Of mutton, the leg and haunch* are the most profitable joints, although in price higher than the *shoulder* or *neck*. But these last joints are sold at a less price per pound than others.

The loin and saddle (the two loins not separated) are expensive joints, not in price only, but in the great proportion of fat and bone belonging to them. They are considered to be prime parts.

5376. *Lamb.*—The *hind* quarter is more advantageous in use than the *fore*, but can scarcely be regarded as an economical part. In hot weather, and in a small family, the joints which the quarters form, when divided, are of so convenient a size as to render them much in request.

5377. *Of veal, the leg*, from which the fillet is taken, *the shoulder, the neck, and the loin* are all, in turn, serviceable in a family. When the leg is purchased all together, without dividing the knuckle from it, the butcher usually considerably remits the price. In summer he is often willing to sell the leg all together at twopence per pound less than he would sell the fillet alone.

Subsect. 2.—*Economy in the Use of Poultry, Game, and Fish.*

5378. *Poultry and game* can only be considered as economical provisions in certain country districts. In town they are generally too dear to be often purchased by those who are obliged to study economy; and it may be well to remember that, although useful as food for invalids, being light, and not as stimulating as butcher's meat, these delicacies of the table are of less value in a family than the more substantial joints from the shambles. They are delicacies, but not essentials. Most of them require expensive gravies and sauces to render them agreeable as food.

5379. *Fish* may be occasionally useful in giving variety to the family table; but in London, except it be the most common kinds of fish, it cannot be regarded as among economical articles of food. It is not sufficiently nourishing to be employed as a substitute for animal food; and if it cannot be brought to table as a substitute, it is then a supernumerary dish, one that may be dispensed with, but which, when served, possesses little in its flavour to recommend it, unless accompanied with good and expensive sauces. In many maritime districts there is, it is true, such an abundance of fish, fresh, salted, and dried, as to render it the chief food of the immediate neighbourhood.

Subsect. 3.—*Hot Dishes prepared from cold Provisions.*

5380. *Cold meat goes farther in use than hot meat*, and by many persons it is preferred to the dishes prepared from it. But others, especially the aged, are better satisfied when the cold provisions are formed into warm and savoury hashes, minces, or ragoûts. When the appetite begins to decline from the debility of increasing years, it is very desirable to tempt it by any of the wholesome arts of cookery. By such means as are here about to be suggested, with very little additional expense, one day's dinner may supply two or more dishes for that of the succeeding day.

Roasted beef may be warmed again, as, 1. Lobscous; 2. Podovies; 3. Olives; 4. Fried (as Staffordshire beef-steaks); 5. Collops (with eschalot or walnut-pickle); 6. Hashed, and prepared like haricot mutton (with carrots, turnips, and onions); 7. Slices put into a pie-dish with a gravy, and seasoning of eschalots and pepper, then covered over with a coating of mashed potatoes, and baked before the fire. The fat of the inside of cold sirloin will make an excellent pie or pudding crust: the bones, well stewed with pease and onions, and seasoned with pepper and salt, form sufficient stock for old pea soup.

5381. *Cold boiled beef*, 1. Minced and warmed up in fresh beef gravy (flavoured with eschalot or onion); 2 Potted; 3. Fried with cabbage (bubble and squeak); 4. Fried with a casserole of mashed potatoes. The water in which beef has been boiled, if not extremely salt, may serve as the stock of pea or carrot soup.

5382. *Veal* may be recooked, 1. In thin slices, with white sauce; 2. Fried as cutlets (with egg and bread crumbs); 3. As a ragout (with green pease); 4. As curry (with rice); 5. Made into rissoles with grated ham; 6. Patties, with ham or oysters.

5383. *Calf's head, boiled*, makes an excellent hash: the gravy may be procured by reducing the liquor in which it was boiled. It is sometimes eaten cold with vinegar and mustard, like brawn.

5384. *Cold mutton* may be hashed in several ways: 1. It may be cooked like venison (with red wine and sweet sauce); 2. It may be simply *hashed*, and flavoured with mushroom catsup; 3. It may be made into haricot with vegetables; 4. Fried with egg and bread crumbs, and served with a made mutton gravy; 5. Broiled, and served on a rock of mashed potatoes.

5385. *Cold lamb* may be, 1. Fried, and put into a hot stew of cucumbers for a short time previous to serving; 2. Fried with egg and bread crumbs and chopped parsley, garnished also with sprigs of crisp parsley

Chops from cold loin may be fried, and served on a dish of spinach.

5386. *Pork, of cold leg or loin,* in slices or chops, will be excellent nicely fried in butter, and surrounded with a thick pucée of apples. *Pea soup* may be made of the liquor in which a leg has been boiled, if not too salt.

5387. *Cold Poultry.—Turkey,* which has been either boiled or roasted, may be again served, by pulling the fleshy parts from the bones, which must be warmed in a gravy made with the bones and carcass of the turkey, and thickened with cream; the legs, pinion, and gizzard should be highly deviled, broiled, and laid on the top of the hot mince. Cold fowls may be made into a good curry, and served with a turban of rice. *Cold goose or duck,* cut up and hashed in a good beef gravy, makes a very good entrée or remove. *From game* may be made *hashes,* salpiçons, emincés, and it may be potted.

5388. *Fish.—Cold salmon or mackerel* may be broiled or put into a pickle prepared with vinegar, diluted with some of the liquor in which the fish had been boiled, and seasoned with black peppercorns. *Cold codfish* may be spiced and potted, or made into curry.

Cold Vegetables.—1. Potatoes may be fried in slices, and used as garnish to beef or mutton; 2. Mashed and fried with beef or mutton; 3. Mashed and made into a crust with the yolk of eggs and some butter; 4. Made into casseroles for ragout or minces; 5. Made warm with gravy, and passed through a coarse sieve, or colander. Carrots, turnips, and cabbages may be warmed separately, or mingled in moulds, to be turned out when the dinner is served.

5389. *The dripping of roast meats* may be used instead of butter in the pastry of meat pies, for frying fish, fritters, and pancakes.

Top pot may be used as butter to thicken gravies, when mixed with flour.

Cold melted butter may be warmed by putting the jar or tureen containing it into boiling water, and covering it over, except when it requires to be stirred or shook up.

Eggs which have been boiled may be again made hot by putting them into a basin of hot water, and covering them over for five minutes.

Subsect. 4.—BILLS OF FARE FOR FAMILY DINNERS.

Number in Party from 10 to 12.

I.

First Course.

	Soup. (Remove, Boiled calf's head.)	
Potatoes.	Parsley and butter.	Tongue and brains.
	Horseradish sauce.	
Bacon.		Greens.
	Roast beef.	

Second Course.

	Batter pudding.	
Devonshire cream.	Sweet sauce.	Cheese-cakes.
Spanish fritters.	Tureen of sugar.	Rice blanc-mange.
	Apple tart.	

Estimate of the above.

	s.	d.
Soup made from beef bones, with vegetables, 6*d.* per quart	1	0
Calf's head (with the skin on)	4	0
2 lbs. of bacon, at 8*d.* per pound	1	4
10 lbs. of beef, at 9*d.* per lb.	7	6
Potatoes, 3*d.*; greens, 2*d.*; parsley and horse-radish, 3*d.*	0	8

	s.	d.
Pudding (milk, 2*d.*; eggs, 3*d.*; flour, 1*d.*; salt, butter, &c., 2*d.*)	0	8
Devonshire cream, 1*s.* 6*d.*; rice blanc-mange, 6*d.*	2	0
Spanish fritters, 4*d.*; cheese-cakes, 6*d.*	0	10
Apple tart	1	0
Total . . 19*s.*		

II.

First Course.

Soup. (Remove, Calf's head, brained.)	
Mashed potatoes.	Lobscous.
Fried bacon and poached eggs.	Stewed onions.
Roast neck of mutton.	

Second Course.

	Rice pudding.	
Puffs.		Slices of fried batter pudding.
Jelly, in shapes.		Baked currants, with leaves of pastry.
	Apple tart and custard.	

Estimate.

	s.	d.
Soup made of the liquor in which the calf's head had been boiled the day before, vegetables, &c.	0	6
Hashed head, gravies, &c.	0	6
Mutton, 5½ lbs., at 7½*d.* per lb.	3	5
Lobscous, made of cold roast beef, potatoes, onions, &c.	0	6
3 stewed onions, 2*d.* each	0	6
Eggs, 6*d.* (bacon taken from that in use the previous day)	0	4

	s.	d.
Mashed potatoes	0	4
Rice pudding	0	6
Apple tart and custard (the remains of yesterday's dinner put together)	—	
Puffs	—	
Slices of fried batter pudding (the remains of yesterday's dinner)	—	
Jelly, in mould	—	
Baked fruit, with pastry leaflets	0	10
Total . . 7*s.* 5*d.*		

III.

First Course.	*Second Course.*
Pea soup. (Remove, Boiled knuckle of veal.)	Fried rice pudding.
Spinach, with gravy.	Tartlets.
Calf's head hash.	Custard and stewed apples.
Piece of ham.	Lemon cream
Scolloped potatoes.	Cheese-cakes.
Mutton haricot.	French tart.

Estimate.

	s.	d.
Pea soup, made from roast beef bones and fresh vegetables	0	6
Knuckle of veal, 7 lbs., at 6*d.* per lb.	3	6
Remains of yesterday's mutton (haricot)	0	4
Calf's head hash (remains from preceding day's hash, with fresh gravy)	0	4
Spinach and gravy	0	6
Ham, 3 lbs., at 10*d.* per lb.	2	6
Potatoes	0	2
Fried pudding (left the preceding day)	—	
French tart	1	0
Tartlets and cheese-cakes	1	0
Stewed apples (with custard)	1	0
Total . . 10*s.* 10*d.*		

IV.

First Course.	*Second Course.*
White soup. (Remove, Rabbits.)	Macaroni pudding.
Mashed potatoes.	Fritters.
Fried veal in dice.	Preserves.
Curled bacon.	Jelly.
Carrots.	Puffs.
Boiled brisket of beef.	Plum tart.

Estimate.

	s.	d.
White soup, made of the liquor in which the knuckle of veal was boiled the previous day	0	3
Rabbits	2	6
Fried veal, cut in dice (remains of the knuckle)	—	
Curled bacon, 1 lb.	0	8
Brisket of beef, 10 lbs., at 6½*d.* per lb.	5	5
Potatoes and carrots	0	5
Macaroni pudding	1	0
Fruit tart	1	0
Fritters, 6*d.*, and puffs, 6*d.*	1	0
Preserves and jelly	2	0
Total . . 14*s.* 3*d.*		

V.

First Course.	*Second Course.*
Soup. (Remove, Boiled fowl.)	College pudding.
Bacon.	Jelly in glasses.
Beef baked with potatoes.	Puffs.
Fish. (Remove, Roast mutton.)	Stewed apples.

Estimate.

	s.	d.
Soup made of the liquor, reduced, in which the last day's beef was boiled, and with vegetables	0	6
Fowl, with parsley and butter	3	4
Fish (salmon), 3 lbs., at 1*s.* 6*d.* per lb.	4	6
Leg of mutton, 8 lbs., at 8*d.* per lb.	5	4
Bacon, 2 lbs., at 8*d.* per lb. (beef, with mashed potatoes)	1	8
College pudding	0	10
Stewed apples	0	6
Jelly, left the day before, put in glasses	—	
Puffs, left preceding day	—	
Vegetables on side table	0	8
Total . . 16*s.* 6*d.*		

VI.

First Course.	*Second Course.*
Soup. (Remove, Hashed mutton.)	Fruit pudding
Potatoes.	Stewed apples.
Spinach.	Custards.
Roast beef.	Macaroni.

Estimate.

	s.	d.
Soup (left preceding day), fresh vegetables boiled in it	0	4
Hashed mutton (prepared from cold mutton of the preceding day's dinner), catsup, and vegetables	0	4
Roast beef, 10 lbs., at 8*d.* per lb.	6	8
Vegetables	0	6
Fruit pudding	0	9
Macaroni (cheese grated from pieces which would not do for the table)	1	0
Stewed apples (left the day before)	—	
Custards	1	6
Total . . 11*s.* 1*d.*		

SIX DINNERS FOR A FAMILY PARTY CONSISTING OF TWELVE INDIVIDUALS.

	s.	d.		s.	d.
1st day	19	0	5th day	16	6
2d day	7	5	6th day	11	1
3d day	10	10	Total . £3 19s. 1d.		
4th day	14	3			

SECT. II.—RECEIPTS FOR COOKING COLD PROVISIONS.

SUBSECT. 1.—*Modes of cooking cold Butcher's Meat.*

5390. *Minced Beef.*—Cut into small dice remains of cold beef; any gravy reserved from it on the first day of its being served should be put in the stew-pan, with the addition of warm water, some mace, sliced eschalot, salt, and black pepper. Let the whole simmer gently for an hour. A few minutes before it is served, take out the meat and dish it; add to the gravy some walnut catsup, and a little lemon juice or walnut pickle. Boil up the gravy once more, and when hot pour it over the meat. Serve it with bread sippets.

5391. *Cold roast Beef (with mashed Potatoes).*—Mash some potatoes with hot milk, the yolk of an egg, some butter, and salt. Slice the cold beef and lay it at the bottom of a pie-dish, adding to it some sliced eschalot, pepper, salt, and a little beef gravy; cover the whole with a thick paste of potatoes, making the crust to rise in the centre above the edges of the dish. Score the potato crust with the point of a knife in squares of equal sizes. Put the dish before the fire in a Dutch oven, and brown it on all sides; by the time it is coloured, the meat and potatoes will be sufficiently done.

5392. *Bubble and Squeak.*—Cut into pieces, convenient for frying, cold roast or boiled beef; pepper, salt, and fry them; when done, lay them on a hot drainer, and while the meat is draining from the fat used in frying them, have in readiness a cabbage already boiled in two waters; chop it small, and put it in the frying-pan with some butter, add a little pepper and salt, and keep stirring it, that all of it may be equally done. When taken from the fire, sprinkle over the cabbage a very little vinegar, only enough to give it a slight acid taste. Place the cabbage in the centre of the dish, and arrange the slices of meat neatly round it.

5393. *Lobscouse.*—Mince, not too finely, some cold roast beef or mutton. Chop the bones and put them into a sauce-pan with six potatoes peeled and sliced, one onion, also sliced, some pepper, and salt; of these make a gravy. When the potatoes are completely incorporated with the gravy, take out the bones, and put in the meat; stew the whole together for an hour before it is to be served.

5394. *Beef Rissoles.*—Mince and season cold beef, and flavour it with mushroom or walnut catsup. Make of beef dripping a very thin paste, roll it out in thin pieces about four inches square; enclose in each piece some of the mince, in the same way as for puffs, cutting each neatly all round: fry them in dripping of a very light brown. The paste can scarcely be rolled out too thin.

5395. *Minced Veal.*—Cut veal from the fillet or shoulder into very small dice; put it into veal or mutton broth, with a little mace, white pepper, salt, some lemon peel grated, and a table-spoonful of mushroom catsup or mushroom powder, rubbed smooth into the gravy. Take out some of the gravy when nearly done, and when cool enough thicken it with flour, cream, and a little butter; boil it up with the rest of the gravy, and pour it over the meat when done. Garnish with bread sippets. A little lemon juice added to the gravy improves its flavour.

5396. *Cold Veal dressed with White Sauce.*—Boil milk or cream with a thickening of flour and butter; put into it thin slices of cold veal, and simmer it in the gravy till it is made hot without boiling. When nearly done beat up the yolk of an egg, with a little anchovy and white sauce; pour it gently to the rest, stirring it all the time; simmer again the whole together, and serve it with sippets of bread and curled bacon alternately.

5397. *Veal Rissoles.*—Mince and pound veal extremely fine; grate into it some remains of cooked ham. Mix these well together with a white sauce flavoured with mushrooms; form this mixture into balls, and enclose each in pastry. Fry them in butter of a nice brown.

The same mince may be fried in balls without pastry, being first cemented together with egg and bread crumbs.

5398. *Mutton, hashed.*—Cut cold mutton into thin slices, fat and lean together; make gravy with the bones whence the meat has been taken, boiling them long enough in water, with onion, pepper, and salt; strain the gravy, and warm, but not boil the mutton in it. Then take out some of the gravy to thicken it with flour and butter, and flavour it with mushroom catsup. Pour in the thickening and boil it up, having before taken out the meat and placed it neatly on the dish in which it is to go to the table. Pour over it the boiling gravy, and add sippets of bread.

5399. *Cold Lamb.*—Fry slices or chops of lamb in butter till they are slightly browned. Serve them on a purée of cucumbers, or on a dish of spinach; or dip the slices in bread crumbs, chopped parsley, and yolk of egg; some grated lemon peel and a little nutmeg may be added. Fry them, and pour a little nice gravy over them when served.

5400. *Cold Pork.*—Slices of cold pork, fried and laid on apple sauce, form an excellent side or corner dish. Boiled pork may also be made into rissoles, minced very fine like sausage meat, and seasoned sufficiently, but not over much.

SUBSECT. 2.—*Cooking cold Poultry and Game.*

5401. *Cold Fowl (made into Fricassée).*—Cut up a cold boiled or roasted fowl; put it into a stew-pan with a pounded bitter almond, a little mace, grated lemon peel, and white pepper and salt; cover it with warm water or with broth of boiled fowl, and put on the sauce-pan cover; set the sauce-pan near the fire to simmer for half an hour. When near the time of serving, thicken some of the gravy with flour and butter, and with cream or with the yolk of an egg; make it hot, pour it over the meat, and serve with sippets and curled bacon. If the gravy be suffered to boil after the cream or egg has been added, it will probably curdle the gravy. Whenever it begins to boil, it should be taken off the fire.

Cold fowl may be served with a salpiçon or emincé put within it. (See "French Cooking Receipts.")

5402. *Cold Rabbit.*—Dress cold rabbit the same as cold fowl, either as a fricassée, a curry, or a salpiçon

5403. *Cold hare* may be hashed with good beef gravy, and served with currant jelly sauce.

SUBSECT. 3.—*Warming up cold Fish.*

5404. *Salmon and Mackerel.*—When brought from table, any remains of salmon or mackerel should be soused in a pickle made with some of the water in which the fish had been boiled, and with vinegar and black peppercorns. By this means the fish may be kept, if requisite, for several days, and is then relished by those who eat suppers.

5405. *Cod.*—The remains of this fish may be employed as the basis of a curry; or it may be put into a dish, and, with bread crumbs, butter, and eggs, it may be made brown, and serve as a corner or flank dish the second day.

SUBSECT. 4.—*Warming up Vegetables left at Table.*

5406. *Cold potatoes*, cut into thin slices, floured, salted, and fried in butter, make an excellent and relishing dish, to be eaten either alone or with any insipid meats.

5407 *Cold Potatoes, scolloped.*—Bruise cold potatoes in a mortar or potato bowl. Beat well the yolk of an egg, and mix it with warm milk, with some salt, and a small lump of butter; rub the potatoes perfectly smooth, and incorporate this mixture with them; put it into a scollop shell, score it over the surface, and put on it some small bits of butter; brown it in a Dutch oven or with a salamander.

5408. *Mashed Potatoes and Spinach or Cabbage.*—Moisten *cold mashed* potatoes with a little white sauce; take cold cabbage or spinach, and chop either one very finely. Moisten them with a brown gravy. Fill a tin mould with layers of potatoes and cabbage, cover the top, and put it into a stew-pan of boiling water. Let it remain long enough to warm the vegetables; then turn the vegetables out and serve them. This might be prepared by boiling the vegetables separately, and merely putting them into the mould in layers, to be turned out when wanted. It forms a very pretty dish for an entrée.

5409. *Carrots and turnips may be added to soups*, if they have not been mixed with other gravies, or warmed up separately, and put into moulds in layers; they may be turned out, and served the same as the potatoes and cabbage described above.

Subsect. 5.—*Cold sweet Dishes.*

5410. *Cold Rice Pudding.*—Over cold rice pudding pour a custard, and add a few lumps of jelly or preserved fruit. Remember to remove the baked coating of the pudding before the custard is poured over it.

5411. *Apple Tart.*—Cut into triangular pieces the remains of a cold apple tart; arrange the pieces around the sides of a glass or china bowl, and leave space in the centre for a custard to be poured in.

5412. *Cold Plum Pudding.*—Cut into thin round slices cold plum pudding, and fry them in butter. Fry also Spanish fritters (see "Receipts"), and place them high in the centre of the dish, and the fried pudding all round the heaped-up fritters. Powder all with lump sugar, and serve with wine sauce in a tureen.

Any kinds of jellies and blanc-manges may be, if broken into, dissolved over the fire, and put into fresh moulds to be turned out for another day's dinner.

CHAPTER II.

COOKING FOR THE INVALID.

Sect. I.—GENERAL OBSERVATIONS.

5413. Some apology may be considered requisite for introducing among the receipts of cookery for the sick and convalescent many which medical opinion and practice in the present day have brought into comparative disuse. The receipts for making animal jellies are of this number. Formerly calf's foot jelly was administered as the prop of the life of a debilitated convalescent; now it is almost as universally rejected, as conveying little nourishment, or, if given, as the medium only for wine or other cordials, not as a restorative in itself.

5414. On the receipts for *caudle* some remarks must also be made. This was formerly considered as indispensable in the lying-in room. Now it is seldom or ever admitted into it. Of such cases the treatment of the present day forbids all heating diet for at least the first fortnight, and by that time, the necessity for liquid food no longer existing in the same degree as at first, the patient, in all general cases, is beginning to return to her usual mode of living. Perhaps, in cases of extreme debility, this species of nourishment may be requisite, and especially to patients among the laborious poor. The physician is often obliged to reduce his opulent patients, whose usual diet is full and stimulating; but he finds the opposite course must be pursued to restore those to health whose lives have been laborious and diet spare. Their systems, when brought down by sickness, generally stand in need of every prop that can be safely administered. In the use of caudle, it may be safely and properly given to the poor lying-in woman, while to the affluent it may be equally prejudicial. But, while there are cases in which it may be useful, it is requisite that the mode of preparing it should not be overlooked in a work intended for general reference.

5415. *Many receipts for simple beverages have been given* in Book VIII., Chap. IX. In a family, sickness is sometimes long absent, and when it does come, the variety of beverages with which it may be permitted to alleviate the thirst of an invalid is either forgotten or unkn wn; and as the memory of the nurse may not be able at the moment to suggest the requisite variety, an enumeration here may be useful. The most usual, toast and water, and barley water, have been described in page 693.

Sect. II.—SIMPLE BEVERAGES FOR THE SICK.

5416. *Lemon Water.*—Cut into an earthen tea-pot, or a covered jug, two or three slices of lemon, with one lump of sugar and a spoonful of capillaire. On these pour a pint of boiling water, and cover it closely for two or three hours, when it will form an agreeable beverage for the thirst of a feverish patient.

5417. *Apple Water.*—Slices of apple and a little lemon peel and sugar, put into hot water, make a pleasant drink.

5418. *Raspberry vinegar*, a dessert-spoonful of which, in a tumbler of cold water, is liked by some invalids.

5419. *Tamarinds* and hot water, when cool, may, in some cases, be given; but no acid drinks should be given to patients without the knowledge of their medical attendants.

5420. *Milk Whey.*—Steep in a cup of hot water, for four or five hours, a small piece of rennet, about an inch and a half square. Pour the water, not the skim itself, into two quarts of new milk. When the curd is come, pour it into a sieve or fine earthen colander, and press the whey gently out of it into a jug. This may be given either cool, or made the warmth of new milk, whichever a patient prefers.

5421. *White Wine Whey.*—Dilute half a pint of new milk with an equal quantity of hot water; boil both together, and, while boiling, pour in at the moment two wine-glasses of white wine. A curd will form, which, after boiling the mixture for two or three minutes longer, will settle at the bottom of the sauce-pan. The whey must be strained carefully from the curd; it should be perfectly clear. Sugar may be added to please the taste. *Warm white wine whey* promotes perspiration, and hence is useful in the commencement of some complaints; but taken cold it has a different effect, and often in cases of low fever it is an excellent beverage; also, in the early stages of convalescence, it is as safe and sufficient a stimulant as can be given.

5422. *Lemon and Vinegar Wheys.*—Instead of wine, pour into the boiling milk and water a table-spoonful of lemon juice, or of vinegar. The whey obtained in this manner, being less stimulating than that of white wine, is sometimes given to an invalid in preference.

5423. *Nitre Whey.*—Pour into the boiling milk and water a dessert-spoonful of the sweet spirit of nitre. Sweeten it, and let the patient take it as warm as it can be drank. Its use is that of promoting perspiration in a greater degree than is effected by white wine whey, without being equally heating.

Sect. III.—Gruels and Caudles.

5424. *Gruel*, the basis of *caudle*, as well as a valuable species of nourishment for invalids, may be made either with *oatmeal*, with *common groats*, or with the prepared *Embden groats*.

5425. *Oatmeal gruel* is made by putting about three ounces of meal into a basin, and mixing enough of cold water with it until it becomes of a smooth consistency, thicker than that of cream, and then by putting it into a sauce-pan, and adding to it a quart of water; it is then boiled for half an hour, during which time it must be stirred frequently, and afterward strained off from the remains of the oatmeal. Another way of mixing the oatmeal with the water is, to pour half a pint of cold water on the oatmeal, and, straining it off into the sauce-pan, to add another half pint, pouring that off also into the sauce-pan. By repeating this process, the oatmeal will be soon washed into the sauce-pan, when it must be boiled twenty minutes, or even more, and strained off for use.

5426. *Common Groat Gruel.*—Wash three ounces of common groats, and add to them two quarts of water; put the mixture into a well-tinned sauce-pan, and after it has boiled up, draw it to one side of the fire, and let it simmer until it be reduced to half the quantity. Stir it frequently, and strain it through a sieve when done.

Gruel soon becomes sour, hence it should be made in small quantities at a time. For an invalid, or for a child fed upon gruel, it should be made daily.

5427. *Caudles.*—A caudle is made of fine, smooth, yet thick groat gruel. While it is cooling it should be occasionally stirred with a spoon. When it is wanted, it should be warmed up in small quantities, with enough of white wine, lemon peel, and nutmeg to flavour it, and of sugar to sweeten it to the taste.

5428. *Ale Caudle.*—To a quart of thick groat gruel add a pint of home-brewed ale, some allspice, and sugar. Boil all together for the space of five or six minutes, then strain it, and put it in a cool place till wanted. This caudle is frequently made for poor country neighbours in their confinement. It is useful as a nourishment for them at that period, and sometimes prevents them from resorting to stronger and more stimulating liquors.

5429. *Flour Caudle.*—This is for those who stand in need of astringent food. Put into a pudding basin half a pound of flour; cover the basin, and set it in a kettle of boiling water. Keep it boiling for two hours; the flour will be converted into a hard ball enveloped with a brown crust, which must be removed. The flour is then grated and put into a jar for use; and it is formed into a caudle by rubbing a dessert-spoonful of it into five table-spoonfuls of the purest cold water that can be procured. Set over the fire to boil five table-spoonfuls of new milk, with two lumps of sugar; when the milk boils, pour the flour and water into it at that very moment. Stir the whole over a slow fire for twenty minutes; it is then ready for use. Made in this way, it forms a good food for young children.

5430. *Rice Caudle.*—Boil a quart of water; mix one table-spoonful of ground rice with *cold* water, and pour it into the boiling. Continue the boiling until the caudle thickens, stirring it all the time. When it begins to thicken, add to it a wine-glass of brandy, some grated lemon peel, sugar, and nutmeg. Boil it a little longer, until perfectly smooth, and then strain it into a basin. Without brandy or spice, but with the addition of milk, this caudle forms excellent food for very young children.

Sect. IV.—Milk Nourishment for Invalids.

5431. *Milk porridge* is sometimes made by adding milk to fine groat gruel. Another way is, to mix a table-spoonful of oatmeal in a basin with cold milk, and to pour it, when perfectly smooth, into a sauce-pan containing half a pint of boiling milk. If this does not thicken it sufficiently, it must be boiled a little longer.

5432. *Scotch Porridge.*—Stir oatmeal and water together, and let it settle. Pour off the water, and add fresh to it. This must remain till the next day, when the water is strained away from the oatmeal and boiled. Milk is added while the porridge is boiling. The milk must be in the proportion of two parts of milk to one of water.

5433. *Onion Porridge.*—Boil an onion, sliced, in water for half an hour; pour away the water, and add to the onions half a pint of new milk. Boil together the milk and onions for half an hour, and serve all together in a basin. This, taken at bedtime, inclines a patient to sleep and to perspire.

5434. *Ground Rice Milk.*—Rub a spoonful of ground rice very smooth in a little cold milk; add to it three half pints of milk, some cinnamon, lemon peel, and nutmegs; boil all together for a quarter of an hour. Sweeten to the taste.

5435. *Sago Milk.*—Wash in cold milk a table-spoonful of sago, pouring off the milk, but adding to the sago a quart of new milk. Let both boil slowly together till reduced to a pint. Cinnamon may be added if required; but neither sugar nor spice is usually added to this food.

5436. *Arrow-root and Milk.*—Mix smooth, with a very little cold milk, one dessert-spoonful of arrow-root. Boil half a pint of new milk, and the moment it rises to the boiling point stir in gently the arrow-root and cold milk. It should be very thick when first made, or, on becoming cool, it will be too thin. If it does not thicken sufficiently at first, it must be boiled until it does thicken. But when milk and arrow-root are boiled together, it is supposed that it becomes of a more astringent nature than it is desirable it should be for invalids, generally speaking.

Sect. V.—meat and vegetable teas.

5437. *Beef tea* should not be made like common gravy or broth, but by a process which will prevent the fat from mingling with it. Cut half a pound of nice gravy meat into thin slices, and lay them in a hollow dish, pouring over them a pint and a half of boiling water; cover the dish, and place it near the fire for half an hour; remove it into a sauce-pan, and boil it for ten minutes over a quick fire; remove the scum which has risen in boiling; let it stand covered for ten minutes longer; strain off, and season it with salt only. Beef tea thus made is a light and useful nourishment to those whose stomachs are weak and irritable. It will serve also for the food of young children; and some persons habitually sick in a morning have found it useful as a breakfast.

5438. *Veal tea* is made in the same way, and in the same proportions of meat and water as beef tea. It is useful in the same cases as those in which beef tea is given.

5439. *Chicken Tea.*—Cut into small pieces a chicken, skin it very carefully, as well as any fat which may be visible. Boil it for twenty minutes in a quart of water; pour the broth away from the meat before it gets cold. This tea is generally given in cases of debility, after fevers, and at the commencement in an invalid of a state of convalescence.

5440. *Extract of Meat.*—When the pure juice of meat is to be given to invalids, it may be obtained by putting a little lean beef or mutton, cut small, into a glass bottle, corking it up and tying a bladder over the cork; the bottle must be put into hot water and boiled gently for an hour. On opening it, a small quantity of real gravy may be poured away from the meat.

5441. *Balm and Mint Teas.*—The young shoots of either of these aromatic plants make a pleasanter and more refreshing beverage for the fever patient than that made from the dried leaves. Boiling water must be poured on the leaves, and the tea-pot or vessel containing it must be covered over and set for an hour near a fire: during this process of infusion the aromatic properties of the leaves will be given to the water, making it a safe diluent in fever cases; and *mint tea*, of the fresh leaves, is sometimes useful in allaying nausea and vomiting.

5442. *Hyson Tea.*—A weak infusion of green tea, without milk or sugar, is a useful diluent in fevers, colds, and rheumatism.

Sect. VI.—egg nourishment.

5443. *Egg Mulled in Tea or Coffee.*—Beat the yolk of an egg very well in a tea or coffee cup; stir in it a little milk or cream; then pour in it, stirring it all the time, the hot coffee or tea, sufficient to fill the cup. If the hot liquid is poured in too hastily, or without stirring it at the time, the egg will curdle, instead of uniting with the tea. Invalids are recommended to try this mixture for breakfast, as being light and nourishing, without being heating.

Eggs may be mulled in hot water, or in hot wine, or in hot ale; the same precaution being taken in the mode of uniting them to any of these hot liquids which has been recommended above.

5444. *An Egg Draught for a Convalescent.*—Beat the yolk of a fresh laid egg, and mix with it a quarter of a pint of new milk previously warmed over the fire; add to this a spoonful of capillaire, one also of rose water, and a grate of nutmeg.

Sect. VII.—panadas.

5445. *Meat Panada.*—Take the meat of a chicken previously cooked, or the inside of a sirloin of beef, or of a loin of mutton, whichever is recommended by the medical attendant, mince it small, and pound it till it will pass through a sieve, when mixed with broth or hot water, which will be, according to the state of the patient, more or less rich and nourishing: unless ordered, no other seasoning than a sprinkling of salt should be added. When the panada is prepared, it should be put in an earthen vessel, and placed in a cool situation. A little of it, taken out as it is wanted, should be warmed up in a little panakin. It must be stirred all the time it is on the fire, and served with delicate thin sippets of bread.

5446. *Bread Panada.*—Grate a tea-cupful of bread, and mix with it some beef or mutton gravy, beating the bread with a spoon till perfectly smooth. Then boil it till it thickens, stirring it all the time it is boiling.

5447. *Another Receipt for Bread Panada.*—Boil a glass of white wine and the same quantity of water together, adding a little sugar and lemon peel to it, nutmeg, if approved of; but spices are rarely desirable for invalids. Grate a cup of bread crumbs, and, when the wine and water boil, pour in the crumbs; stir them together, and boil very quickly until the mixture thickens; take it off the fire and pour it into a basin.

Bread panadas may be flavoured with the juice of fruits, such as lemon and orange sirup, &c. Remember always that the ingredients must be boiled together, or they will not form into a jelly.

Sect. VIII.—Puddings for Invalids.

5448. *Light Flour Pudding.*—Take a spoonful of fine flour, boil a tea-cupful of milk, and mix the flour very smoothly with it. Let it stand till cold, occasionally stirring it, to prevent the flour from settling at the bottom. When cold, add to it the yolk of an egg, well beaten, with a very small quantity of salt; tie it up very securely in a buttered tea-cup, or small pudding basin; plunge it into a sauce-pan of boiling water, and let it boil fast for half an hour. It should be just firm enough to stand when turned out of the basin.

5449. *Bread Pudding.*—Pour a cup of boiling milk on two table-spoonfuls of bread crumbs; when cold, add the yolk of a beaten egg to it, and boil in a basin for a quarter of an hour or twenty minutes. Cinnamon boiled in the milk, or a bruised bitter almond, together with lemon peel, may be employed as flavouring ingredients.

Arrow-root pudding is made by mixing a table-spoonful of it in cold milk, then pouring it into boiling milk. It must then be allowed to cool, when the yolk (well beaten) of an egg must be added, and the pudding must be put into a basin and boiled for ten minutes. All puddings for invalids having eggs in them should be boiled in preference to being baked. Baking is supposed to render eggs less easy of digestion than boiling.

5450. *Tapioca.*—This vegetable gelatin requires to be soaked very long in water, and afterward steeped in milk. In all other respects it is prepared like arrow-root, whether in the form of pudding or jelly.

Sect. IX.—Blanc-manges and Jellies for Invalids.

5451. *Rice Blanc-mange.*—Steep a table-spoonful of rice in half a pint of milk for seven or eight hours. If the milk dries up too much, more must be added, but it must be no more than sufficient to make the rice soft and moist. Any flavour, either of almonds, lemon peel, cinnamon, or nutmeg, may be added. When the rice is entirely pulped it must be put into a mould until cold, when it will turn out.

5452. *Isinglass Blanc-mange.*—An ounce of isinglass dissolved in a pint of boiling milk, and flavoured with bitter almonds, lemon peel, &c., if boiled for some time together, will form an agreeable, nutritious blanc-mange for a convalescent. When put into a mould it should be stirred occasionally until it begins to stiffen.

5453. *Savoury Meat Jellies for Convalescents.*—Take the bones and gristle of a knuckle of veal, with about a pound of the meat, the scrag end of a neck of mutton, half an ounce of isinglass, two blades of mace, a little salt, and a gallon of water. Boil gently (scumming very carefully) for five hours, or longer, if not reduced to about a quart. Do not put the isinglass and mace in till the scumming is done. Strain the jelly away from the ingredients, and when cold remove the fat from the surface. A stiff jelly is thus procured, which is agreeable if eaten cold; if warm, milk or wine may be mixed with it.

5454. *Another savoury Meat Jelly.*—Chop a knuckle of veal and a scrag of mutton, so that they may be placed one bone on another. Scrape and slice three carrots and two turnips, cut small a head of celery, butter slightly the bottom of a stone jar or a well-tinned sauce-pan. Lay in layers the meat and vegetables alternately, packing them closely together. Sprinkle over each a very little salt; cover the jar closely, and put it into a slow oven for half an hour, then open it and pour in as much hot water as will cover the ingredients. Cover the jar again closely, quicken the oven, and let it remain in it for five hours. Strain the liquor away from the meat and vegetables; when cold, remove the fat from the surface, and the sediment from the bottom. The jelly will then be ready for use. It will not keep long unless boiled up again about the second day.

5455. *Dr. Denman's Receipt for Gloucester Jelly.*—Dissolve one ounce of isinglass in half a pint of spring water; bruise, and add to the jelly, half an ounce of nutmeg and half an ounce of cinnamon; let all simmer in a new pipkin until the isinglass be perfectly dissolved; strain it off, and set it in a cool place to jelly; cut it in pieces, add a bottle of good old port, and the spice before boiled in it; sweeten it to the taste, and let it simmer until the jelly be again dissolved, when it may be bottled and kept for use. Half a wine-glass may be taken at bedtime. Observe, the wine must not be simmered in a sauce-pan, but in an earthen jar, put into a sauce-pan of cold water, and set over the fire to warm gradually.

5456. *Another Wine Jelly.*—One quart of sherry, in which dissolve two ounces of isinglass (picked and broken into small pieces), two ounces of white sugar-candy (pounded), one nutmeg grated, one pennyworth of gum Arabic, finely pounded. Put these ingredients together in an earthen jar, and the jar into a vessel of water, which must be suffered to warm gradually. When the isinglass and gum Arabic are dissolved, strain the whole into a basin or deep dish; keep it dry and cool, and let the invalid have a piece about the size of a nutmeg a few times in the day.

5457. It must be here remarked that these strengthening wine jellies are very much in disuse; isinglass, one of the animal gelatins, is no longer regarded as nutritious, and strong foreign wines are much more rarely administered in the different stages of convalescence than they were a few years ago.

5458. *Carrogeen, or Irish Moss Jelly.*—Wash and nicely pick an ounce of this moss; boil it in a pint and a half of water for twenty minutes; strain it, and pour it into a basin to jelly. For invalids, and for children when weaned, it is an excellent food, mixed with warm milk.

5459. *Arrow-root Jelly.*—Put into a sauce-pan and boil together half a pint of water and one glass of sherry, or a table-spoonful of brandy, a little grated nutmeg, and fine sugar. When boiling, mix with them, by degrees, a dessert-spoonful of arrow-root, previously rubbed smooth in a table-spoonful of cold water; boil all together for three minutes, and then pour it into glasses or small cups. If the invalid is not allowed to take wine, the jelly may be flavoured with lemon or orange juice, or with the juice of any of the fruits which may be in season.

5460. *Tapioca Jelly.*—Wash a table-spoonful of large tapioca in two or three waters; then let it soak in fresh water for five or six hours; in the same water simmer it till it becomes a clear jelly; and to flavour it and render it palatable, any of the ingredients may be added to it with which arrow-root jelly is flavoured.

5461. *Fruit Jellies.*—Take the juice of three sweet oranges and of twelve Seville oranges, and boil it with its weight of sugar, and put it into jars or glasses for use. If required to be very firm, dissolved isinglass may be put into the quantity required at a time for use.

The juice of bottled damsons added to dissolved isinglass makes an agreeable change occasionally for invalids.

BOOK XVII.

ON THE VARIOUS TEXTILE FABRICS FOR CLOTHING AND FURNITURE.

CHAPTER I.

ON DRESS IN GENERAL; SPINNING AND WEAVING.

SECT. I.—GENERAL REMARKS.

5462. *Clothing, taken in its extended sense,* may be considered as an expensive, and, in every way, an interesting part of domestic economy. In the materials for dress we include not only all *cloths* and tissues used for male and female attire, together with the articles made from leather, from skins, and from furs, but also the ornamental parts of dress, as feathers, artificial flowers, and the multitude of decorative appendages comprehended under the term "jewelry." Some articles that enter into the composition of dress are of great intrinsic value; while others, though not costly in themselves, are attended with a very considerable expense from the frequency of change which the laws of fashion impose. Since this expenditure cannot be avoided, it is a matter deserving consideration how it may be most economically and properly regulated.

In this inquiry, attention should be directed rather to the *quality* than to the *price* of the materials, since cheapness, unless resulting from fair and open competition in trade, is a very equivocal criterion. Every merchantable commodity must yield a profit to the manufacturer, to the wholesale dealer, and to the retailer; and in the regular course of trade, no portion of these profits can be abandoned without a prospect of compensation in deteriorating the article. The substitution of machinery for manual labour may, from time to time, occasion a reduction of the original cost price, of which the public rarely fails to reap the benefit; but this causes very little change in the gradation of profits, which are small if the demand be constant, and considerable if the article be costly and slow of sale.

Here it will, perhaps, be objected that rules for purchasing the materials for manufactured goods are now rendered almost unnecessary, by the changes that have taken place in the mode of supplying the principal articles of fashionable attire. The tailor, invading the province of the woollen-draper, undertakes to furnish complete suits by contract at a stipulated price; and the milliner, by a similar extension of her original calling, supplies her customers with every novelty of the season in a finished state. Yet, even in these cases, it may be useful to possess such a knowledge of the qualities of goods as may enable the purchaser to discover whether an inferior article has been substituted for that which was ordered, or whether the terms of the contract have been strictly fulfilled. The same power of discrimination is highly useful in the selection of those fabrics which are still purchased by the piece or yard, and made up at home, or under the express direction of the purchaser; and it often happens that a mere hint, or a technical expression casually uttered, will frustrate many of those stratagems of trade which some dealers think themselves justified in practising on the unwary. In all transactions relating either to the purchase or disposal of jewelry, in particular, a certain degree of skill and experience is indispensably necessary, and may be acquired without much difficulty.

5463. *It is foreign to our object to enter into the history of dress or costume,* or to point out the numerous fashions that have existed among us of late; the prevailing taste of the day, in this respect, is well understood; but the forms of dress being continually subject to the arbitrary rule of fashion, are seldom permitted to be regulated by individual feeling of convenience or utility. There are, however, some philosophical or physical principles established respecting clothing that are permanent, and it is to these that we wish to direct the reader's attention.

5464. *The usual temperature of the body* is about 98°; and its warmth is derived from the decomposition of the air taken in by respiration, which is necessary to supply the continual loss of heat we are liable to. Clothing checks or prevents, in some degree, this loss; and it follows, of course, that the materials which are the best non-conductors form the warmest clothing. But there are several other circumstances to be taken into consideration in making choice of the materials most suitable for this purpose. The skin, by its structure, performs the functions of regulating the temperature; by perspiration through its pores the excess of heat is carried off; and hence, when this function is deranged, and the insensible perspiration obstructed, fever is the consequence. In addition to this use, the pores of the skin serve as an outlet for getting rid of matters no longer necessary in the animal economy, and which, if retained, would prove injurious. Besides this excretory function, the skin has likewise an absorbing power, by which it takes up matters in contact with it; and we may also observe that it is abundantly supplied with minute nerves, which are the source of feeling, and which demand a certain degree of warmth to preserve their vital action. From these facts, it is easy to deduce, that clothing should be of such a nature as not to impede the necessary escape of perspirable matter, but to suffer it to pass through its texture; that it should be of such a non-conducting quality as to confine the heat generated by the blood sufficiently to preserve the activity of the nervous system; and that, by its lightness, softness, and pliancy, it should permit the free motion of the limbs.

5465. *Our artificial clothing is chiefly obtained from four principal raw materials,* wool, flax, cotton, and silk. The fleece of the sheep was probably one of the first substances made into cloth; and that animal is supposed to have come originally from the mountainous regions of Asia; flax appears to have been indigenous in Egypt, and probably in other countries; the silk-worm was given to China; and the cotton plant to India and America. Wool, as the warmest material, is produced only in cold countries, while cotton, best calculated for a tropical climate, is only there found native.

Thus, while the bounty of the Creator has furnished these in inexhaustible abundance, his wisdom has given them in such forms as to exercise the industry and ingenuity of man in applying them to useful purposes, and in such situations as strongly to encourage the intercourse between different nations.

5466. *The earliest dresses of mankind* probably consisted of the skins of animals; and it appears that these were employed as clothing long after the invention of the art of weaving. Thus, Hercules is said to have worn the skin of a lion which he had slain; Virgil, when he describes Æneas as about to take his departure from Troy, represents him as having his outer vest formed of a similar material; and he depicts Acestes as formidably clad in the skin of a Libyan bear. The sacred writings also contain frequent mention of skins as furnishing some parts of dress. The same material is now used by some of the uncivilized nations of America; and, when prepared by the art of the tanner, skins are still partially employed as dress in various parts of Europe. But skins are liable to the objection we have mentioned, of being impervious to the cutaneous exhalations, although this property, by which they confine the heat, renders them valuable in those extreme northern countries where the warmth of clothing is paramount to every other consideration. In temperate and warmer climates, the rigidity of skins, the difficulty of cleaning them when soiled, and other circumstances, have caused them to give way to the use of tissues woven of threads made from various fibres, the superiority of which was recognised at an early period, and gave rise to the arts of spinning and weaving.

5467. *Wool, upon the whole, has several advantages over other materials for clothing.* From its filamentous texture and elasticity, it may be made into cloths of great warmth, yet very light. It is not so easily wetted as others; by its felting property it may be rendered extremely compact, and yet may be woven into fine stuffs that almost rival in thinness those of cotton, but having more warmth, and being less inflammable. In former times, in Europe generally, woollen, and not linen, was worn next the skin; and various opinions have been entertained with respect to each practice. The arguments in favour of flannel are that, from its loose texture, it is a better non-conductor of heat than a more compact substance, and hence its warmth, by preventing the heat of our bodies from escaping, and being thus more capable of preserving them in an equality of temperature, and protecting them against sudden external changes.

Its rough and uneven surface, likewise, gives, in every movement of the body in labour or in exercise, a gentle stimulus, in consequence of the friction, to the cutaneous vessels and nerves, which assists their action and maintains their functions. From its porous texture, it also absorbs the cutaneous exhalations to a greater degree than any other material in common use. On the other hand, it is thought to be more debilitating in warm weather, by increasing perspiration, and is considered to be less cleanly than linen, by not requiring change so often: the last argument, however, is nullified by changing it as frequently. It is, however, generally agreed that flannel is advantageous if employed properly; and the cases where it is found most beneficial are where the body is exposed to frequent changes of temperature, and for persons advanced in years, where the circulation has become more feeble, and is, consequently, more easily checked. The finer the wool, the warmer it is, and the less it irritates the skin. Some, instead of wearing flannel next the skin all the year round, leave it off in the summer; but, although this would seem most conformable to reason, it is said that the danger of change is greater than the inconvenience of continuing its use in the short period of warm weather which we generally have in our variable climate. Workmen and labourers, when engaged in operations that excite much perspiration, are particularly benefited by wearing woollen dresses next the skin; and its efficacy, as a preservative from disease, is not confined to cold climates; for several medical writers, particularly Sir George Bullingal, in his "Lectures on Military Surgery," speak of its advantages; and Sir James Macgregor, Captain Murray, and others, have found from experience that soldiers and sailors derive great benefit from it in the West Indies and other warm parts of the world, in consequence of its checking the bad effects of the variations of temperature.

Woollen clothing has been proved to be extremely serviceable in preserving those who are unavoidably exposed to the action of malaria and epidemic influences. A late writer on the malaria of Rome strongly advocates this opinion, and expresses his conviction that the ancient Romans suffered less from it chiefly because they were always enveloped in warm woollen dresses. This opinion, he says, is justified by the observation that, since the period at which the use of woollen clothing in that country came again into vogue, intermittent fevers have very sensibly diminished in Rome. Even in the warmest weather the shepherds in the environs of that city are now clothed in sheep skins.

5468. *The use of linen for inner garments* has been favourable to cleanliness, and hence it has become very general through modern Europe. It requires comparatively little trouble to keep it clean, and its whiteness enables us easily to see when it is soiled, while its cheapness renders it easy to be renewed. Linen does not absorb so much of the perspirable matter as woollen, being sooner saturated, and consequently leaving the pores of the skin partially clogged up; on which account it ought to be frequently changed. It feels colder to the skin than flannel; and that arises from the density of the fibres of flax, which renders it a good conductor of heat, consequently robbing us of a portion rapidly when just put on. From the experiments of Count Rumford (*Phil. Papers*, i., 267), it appears that linen does not attract dampness so readily as wool, hair, or other animal substances; nevertheless, when it is damp it is more prejudicial than these, and therefore requires good airing before it is worn.

5469. *Cotton cloth*, though differing little in appearance from linen, does not agree with it in all its properties. Calico, in its powers of conducting heat, holding a middling rank between linen and flannel, has been for some years gradually superseding the use of the former for shirts and other garments worn next the skin; but it is by no means a succedaneum for flannel. It is not so durable as linen, though its cheapness is a great recommendation.

5470. *Silk*, though warm and soft, is better calculated for outer than for inner garments, and for purposes of elegance and show than of mere utility. As a warm covering, however, it has some valuable qualities.

5471. *Furs* excel every other material for warmth; but with us they are chiefly used for appearance; wool, in general, answering every purpose where great warmth is required.

5472. *Although it is proper to adapt the warmth of our clothing to the season of the year*, yet change in this respect should be made with caution. Very light clothing during the summer months exposes the body to the effects of those sudden changes of weather which we experience in our climate. It is safer to wear the same clothing nearly all the year, than to make frequent and sudden changes: exercise, under too warm a dress, occasions violent perspiration, the effects of which are often dangerous. It is remarkable that, in some countries, the custom differs materially from ours respecting clothing. We dress, in general, somewhat warmer when we go out than when we sit in doors; the Turks, who seldom have fires in their apartments, keep themselves comfortable within doors by using warmer clothing than when they go out, considering the exercise of moving about as a source of warmth. The Chinese of rank, it is said, practise the same mode; putting on an additional garment in the house, which they throw off as the sun ascends to the meridian, and resuming it in the cold of the evening.

The young and vigorous require less clothing than the old and infirm, and can better resist changes in the weather; but it is said, and perhaps truly, that young people take too little care of their health with respect to heat and cold, and old people sometimes too much.

5473. *The choice of colours in dress*, though generally a matter of fashion, or mere caprice, has some foundation in physical principles. Certain colours naturally suit each other, or harmonize together. Of all colours, black reflects least, and absorbs more of the heat that strikes upon it than any other colour, which warmth it communicates to the body; but, on the other hand, it radiates more than any other colour, and of course gives out more of the heat which it receives from the skin, producing a counteracting effect. On the contrary, white is the least warmed by the sun, but is more effectual in confining the heat of the body by its imperfect radiation. The difference between them with respect to warmth is, that black clothes are the hottest when the sun is most powerful, and white the warmest when the sun has least power; while white is coolest in summer, and black the coldest in winter.

5474. *In the following account of the clothing manufactures* we shall not attempt going into all the minute details respecting them, but only say what is necessary to give an idea of their general history, and to point out the proper distinctions between the several fabrics. We shall class them according to the natural substances of which they are composed; and we shall preface our account with the processes of spinning and weaving.

Sect. II.—spinning.

5475. *The art of spinning yarn, or thread, is of great antiquity,* and must have preceded that of weaving cloth. The most ancient and the simplest mode of spinning is by the distaff and spindle; the distaff is nothing more than a stick that the spinner fixes in his girdle, supporting it with his left hand; round the top of this is the material to be spun, which, after being properly prepared, is lapped round, so that a few fibres at a time may be drawn off from it with the thumb and finger of the right hand, to form the thread. The spindle is a small piece of hard wood, made round and pointed at one end, to which the fibres to be twisted are attached; this being put into a twirling motion by the hand, twists these fibres together as fast as they are drawn out by the fingers, in an even manner. The motion of the spindle is constantly kept up by striking it as often as the hand can be spared from the operation of guiding the thread, which, as it is twisted, is wound round the spindle till it forms a ball.

5476. This very simple mode of turning the spindle was, in some places, superseded by the use of a wheel and band employed for that purpose, which forms a machine called the *one-thread wheel;* this has been long used in India for spinning cotton, and in Europe for spinning flax, cotton, and wool. But the wheels for spinning must be adapted in some degree to the nature of the materials operated upon.

5477. Flax, owing to the great length and straightness of the fibres, has merely to be dressed so as to bring the fibres parallel to each other, though of different lengths, and thus they are drawn down by the fingers, and united together by the twist of a wheel. This length of the fibres gives the yarn a greater tenacity than that of cotton, while, at the same time, it is more difficult to form them into a very regular and fine thread, because the fibres themselves have no natural determinate size, this depending a good deal upon the processes by which they are split or divided. The structure of the fibres, also, being more smooth and glossy, and having no entanglement, they require to be made adhesive by moisture or wetting, which renders them more pliant and easier to twist together. The fibres of flax have much less elasticity than those of wool; the latter will stretch to from one fourth to one half more than their length before they give way, whereas the fibres of flax will not stretch above one twenty-fifth of their natural length.

5478. *The flax wheel* is turned by a treadle moved by the foot; a catgut cord goes from a groove in the rim of this wheel, and over the pulley of a spindle on which the thread is wound, and which is turned by the motion of the wheel. A bundle of flax, prepared, is fixed to an upright fastened to the frame of the wheel, from which the fibres are drawn by hand and led to the spindle, being regularly disposed upon it by an apparatus called a *flyer.* When this spindle or bobbin is full of thread, it is taken off and an empty one placed there to supply its place. The length of the fibres of flax permit several of them to be drawn down together to some little length, which are afterward twisted into a thread by the revolution of the spindle.

Wool and cotton require a very different treatment from flax in spinning. The fibres of these materials are short, and they must be carded and made into a roll before they can be drawn out into a fine and even thread fit for the loom. Most of the vegetable fibres, as flax and hemp, require to be moistened during the spinning, to render them more supple; but cotton, wool, and silk are spun in a dry state.

5479. *The wheel for spinning wool* for cloth also differs materially from that employed to spin flax. In the former (*fig.* 777) the spindle is made of iron, and placed horizontally on the end of a wooden frame standing upon legs. A wheel is supported upon the same stand, and a band goes over the wheel and the spindle, the revolving motion given to the former being thus communicated to the latter. The cardings of wool are made into soft, fleecy rolls of about twelve inches long and three quarters of an inch thick, and this roll or carding has, at first, one end fixed to the spindle, while with the left hand of the spinster it is drawn out into a loose, coarse thread called a *roving,* about the thickness of a quill; the wheel is turned with the right hand by means of a cord that passes to the spindle. The motion thus communicated to the carding twists it spirally; when twisted, it is wound upon the spindle; another carding is attached to the last, drawn out and twisted, and thus, by adding one roll to another, is formed a continued thread, or roving. These rovings are next spun into *yarn* fit for the

Fig. 777.

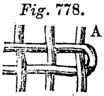
weaver by the same hand-wheel, and nearly in the same manner as the cardings were made into rovings. Worsted is spun in a different manner, and more resembling flax-spinning, from long wool prepared by the wool-comber.

5480. *Such were the spinning-wheels universally used in this country and on the Continent previous to the year* 1764, when, by a succession of inventions unparalleled in the history of the arts, spinning underwent a complete revolution, and was effected with an extraordinary degree of despatch by means of some of the most curious and complicated machinery ever devised by human ingenuity; in consequence of which, yarn is spun with an extraordinary degree of regularity, and of various degrees of fineness adapted to the different tissues for which they are destined, from the coarsest cloth to the finest cambric or lace. But as the great improvements in spinning by means of machines originated in the cotton manufacture, we shall reserve our account of them to the description of "Cotton Fabrics." Nevertheless, the spinning-wheel is a pleasing object in cottage scenery, and notwithstanding the superior cheapness of machine-made yarn, it is, perhaps, desirable that some employment should be reserved in a simple state, which may fill up the vacant hours of rural life, and offer some reward to humble industry; or which may be put into practice in places where complicated machinery cannot be obtained.

Sect. III.—weaving.

5481. *Woven cloth is always composed of two sets of threads*, or, as the weavers call them, *yarn*, crossing each other at right angles. One set extends the whole length of the web, or piece of cloth, and is called the *warp;* the other set runs from side to side of the web, or across the cloth, and is called the *woof* or *weft;* the latter is not a succession of different threads, but one continued thread through the whole piece of cloth; it passes alternately under and over each thread of the warp, until it arrives at the outside one, or edge of the web; it then passes round the edge, and returns back over and under each warp thread as before, but so that it now goes under those threads which it went over before, thus firmly knitting together the woven tissue. The outside yarn of the warp, round which the weft doubles, is called the *selvage* (*self-edge*), and cannot be unravelled without breaking the weft. This structure of cloth is easily seen by examining a piece of linen or calico with a magnifying glass (*fig.* 778, A), and may be observed on a large scale in matting, which is woven of coarse grass, or similar substances.

Fig. 778.



A

5482. *Indeed, some kind of matting made of the fibrous parts of plants*, as the stalk, such as the rushes and straws, was probably the first kind of cloth invented by rude and uncivilized nations; and the art of spinning threads from fine fibres was probably a refinement upon this, which led to the weaving of what we, at the present time, term cloth. Some nations are still ignorant of the art of weaving; for the cloth made in Otaheite, where it was first discovered by Captain Cook, was made by merely cementing vegetable fibres together, and was very analogous to our paper; and the Tartars make cloth by merely felting wool.

5483. *When the process of spinning threads* from the delicate and short fibres which animals and vegetables afford was discovered, the weaver was furnished with a material superior to any fibres in their simple state, and the foundation was laid of the art of producing woven cloth. When, and by whom, that discovery was made is not known; but it appears to have happened early in the history of mankind. The cultivation of flax was practised by the ancient Egyptians, and it is recorded that Pharaoh was arrayed in vestments of fine linen. The Hindoos have made cotton cloth from time immemorial, and the Hebrews were also in possession of the arts of weaving, dyeing, and embroidery.

5484. *Weaving was introduced into Britain by the Romans*, along with other arts of civilization; but, from various causes, so little did our British ancestors profit by the example which had been thus set, that for several ages a great part of their wool was exported to the Low Countries, where weaving had been successfully practised, and brought back in the form of cloth. At so late a period as 1331, this art was so little understood in England, that the arrival of two weavers from Brabant is recorded in the chronicles among the important events of that time. But it was the religious persecution under the Duke of Alva, and the revocation of the Edict of Nantes, that occasioned a great number of Flemish weavers to take refuge and settle in this country.

Weaving is performed by the aid of a machine called a *loom*, and the simplest kind, or common looms, vary but little as to their general structure, whatever may be the nature of the fabric they are intended to make, the chief difference in those for weaving silk or wool consisting in the greater stability and strength of the latter, on account of the greater coarseness and elasticity of the fibres and the thickness of the cloth woven. Great improvements have been made of late in looms, particularly in weaving cottons, muslins, and silks; nevertheless, the old-fashioned common loom is still employed, particularly in Spitalfields and other places, for weaving plain silks.

5485. *The first operation in weaving* is to extend the warp yarn in parallel lines. This

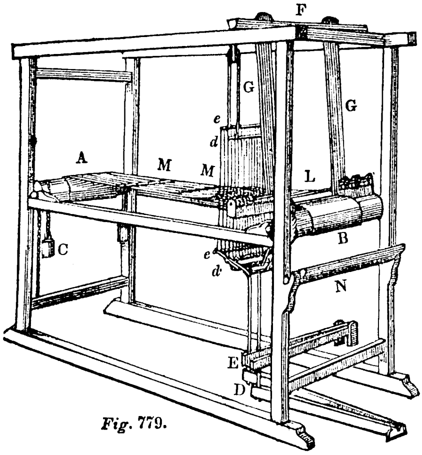


Fig. 779.

is effected by means of a contrivance called a *warp-mill;* and it is then rolled carefully round a thick roller in the loom (*fig.* 779, A), called the *warp-beam*, having a weight, C, suspended from it to keep the warp stretched. From this the warp, M M, forming the length of the piece, is stretched to another roller in the loom, called the *cloth-beam*, B, because the cloth is wound upon it when completed. Every thread of the warp between the two beams passes through loops in two sets of vertical threads, stretched in frames called *hiddles, d d* and *e e*, which are connected by strings at the bottom with two treadles, D and E, to be pressed up and down by the weaver's feet. The use of these treadles is to separate the threads of the warp by raising and depressing each thread alternately, and thus make way for the weft to pass through, the two treadles being so united by a rope and pulley that the depression of one must cause the raising of the other. The weft is driven from one side to the other through this space, called the *shed*, by means of a *shuttle* thrown from the hand. The shuttle, *fig.* 780, is a small box pointed at both ends, and contains a small bobbin of cane, called the *quill*, having the weft wound on, and which runs off as the shuttle is thrown. No sooner is a thread of weft thrown by the motion of the shuttle than it is driven up close to the last thread of weft by the blow of a comb-like apparatus called a *batten* (L, *fig.* 779), which consists of a long, narrow frame, with a number of slit pieces of reed, cane, or wires arranged perpendicularly, and so close that every thread of the weft passes through two of them: this batten is suspended in a horizontal position by two vertical laths, which are moveable like a pendulum, from a centre of motion at the top of the loom, F. The weaver, placed on the seat, N, lays hold of this batten, and, by pulling it towards him forcibly, he strikes the last-thrown thread of weft up to the cloth that is forming. When a certain number of threads of the weft are thus thrown by the shuttle, and brought up close by the batten and reed, so much cloth is made, and the cloth-beam is turned round to wind it up; this beam is prevented from going back by a ratchet wheel and click fixed on the end. Thus the operation in working the loom for weaving plain cloth consists of three simple movements: 1, opening the thread, or separating the threads of the warp alternately to admit the shuttle, which is effected by pressing the treadles that move the heddles; 2, throwing the shuttle by hand to form the weft; 3, pulling the batten and reed to strike home the weft, and again pushing it back to the heddles.

Fig. 780.

The fineness, or, rather, the closeness of texture in cloth depends upon the number of laths or *dents* which the reed contains within a given space, and which, of course, determine the number of threads of warp in the same space. The yarn of the weft is always somewhat finer than that of the warp, and the number of shoots of it in a given space must consequently always exceed the number of threads of warp in a similar space; that is to say, a square inch of cloth must contain a greater number of threads of weft than of warp.

5486. *The perfection of weaving depends* very much upon stretching the warp exactly parallel, and, likewise, on rolling them with great regularity upon the yarn-beam. It is necessary, also, that the weaver should exert the same force in every stroke of the reed frame, in order to make every part of the cloth equally compact.

Previous to warping, the yarn must be prepared by sizing or starching, called *dressing*, in order to cement all the loose fibres, and thus render it smooth, firm, and strong; and the weaver suspends his operation from time to time, in order to apply the dressing to his warp. The weft of muslins and thin cotton goods are generally woven into the cloth in a wet state, by which the fibres of the cotton are rendered smooth and parallel, the effect of which is similar to dressing the warp. The operations of hand-loom weaving are simple and soon learned, but it requires much practice to perform these with dexterity.

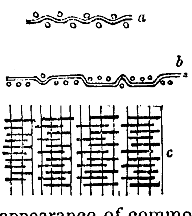
The great demand for cottons occasioned the power of water and of steam to be applied to the working of looms, which hence are termed *power-looms.* These perform the work with more expedition, economy, and accuracy than the common hand-looms, and threaten, at no distant period, the almost total extinction of that machine, a circumstance which has brought great distress upon many of the hand-loom weavers. Power-looms, worked without manual labour, were first tried by Vaucausin, 1747; but they were neglected till the idea again occurred to the Rev. Edmund Cartwright, in 1784; and it is remarkable that, at the time when he made the invention, he was imperfectly acquainted with the mechanic arts. After having expended between thirty and forty thousand pounds, he was unable to make his speculation profitable; and, to compensate him in some degree for his loss, Parliament granted him ten thousand pounds. Mr. Monteith was more successful, and in 1798 first applied the power-loom advantageously to the weaving of cottons. Various other looms of this kind have since been made, which answer completely for almost all the varieties of cotton fabrics, except delicate muslins. The steam-looms are chiefly employed in weaving printing cloth and shirtings; but they also weave thicksets, fancy cords, dimities, cambrics, and quiltings, together with silks, worsteds, and fine woollen or broad-cloth.

5487. *Plain weaving* is when the warp and weft intersect each other in regular order, so as to produce a uniform surface, as in plain linen or calico.

5488. *Figure-weaving is the producing of figures or patterns in cloth* by employing threads either of different colours or of different texture in the warp or weft. In weaving, the threads must be so disposed that some colours will be concealed and kept back, while others are placed in front; and they must occasionally change places, so as to show as much of each colour or texture as is requisite to make out the figure or pattern. Such changes of colour or appearance may be effected by three methods. First, differently-coloured threads, or threads of different sizes and substances, may be arranged in the warping, and require no change in the weaving: this will produce *stripes* in the direction of the piece; or the threads of the warp may be of one colour and those of the weft of another, which will produce a *shot pattern*. Secondly, several shuttles may contain threads of different colours and substances, and either of these may be used every time that a change of colour or appearance is required; this will produce *stripes in the weft*, or across the web. If this is combined with a variously-coloured warp, it will make *checkered* and *spotted* patterns of great variety. The third method consists in employing a number of heddle leaves instead of two only, each heddle having a certain portion of the warp passing through it, and provided with a treadle. When this treadle is pressed down, only a certain portion of yarns which belong to its heddle will be drawn up, and the rest will be depressed; consequently, when the weft is thrown, all those yarns which are drawn up will appear on the front or top of the cloth; but in the intervals between them the weft must appear over those warp threads which are depressed. The number of threads which are thus brought up may be varied as often as the weaver chooses to press his foot upon a different treadle, and in this manner the pattern is produced. By combining all these methods together, the most complicated patterns can be woven.

Tweeled or twilled cloth is a description of figure-weaving depending upon the arrangement of threads that compose the warp and the weft. These arrangements are very numerous, producing so many varieties of twilled fabrics, comprising satin, bombasin, kerseymere, diaper, damask, &c.; but it would be impossible, in a work like the present, to convey a clear idea of every variety. We shall confine ourselves, therefore, to a description of the general principle of this kind of weaving. We have stated above, that, on examining a piece of plain cloth, it will be seen that every thread of the weft passes alternately over and under every thread of the warp, as shown in the wood-cut, *fig.* 781, at *a*, where the little circles represent the warp, and the wavy line the weft. In twilled cloth the case is different; instead of the weft passing under and over each thread of the warp, it passes under one, and goes over more than one, sometimes two, three, four, or five, as *b*, according to the kind of twill or pattern. Instead, therefore, of the reticulated appearance of common calico, twilled cloth exhibits some of the threads passing along over several before disappearing; and *c* represents the surface of such cloth. When twilled cloth is composed of silk, it is called satin; when of cotton, fustian or jean; when it is composed of woollen, it is called serge, or kerseymere; and in linen it is distinguished by various names. It is easy to see how a great variety of figures, consisting of sprigs, flowers, or spots, may be produced by varying the mode in which the weft intersects the warp; and, in order that the weaver may clearly understand the intended texture of his piece, all the threads are drawn on paper before he begins, in a manner peculiar to themselves. Cloths may be twilled on one side or on both sides, as shalloon; and they may be made, by various dispositions of the loom, to exhibit the different stripes and figures seen in dimity, diaper, and damask.

Fig. 781.



5489. *Pile-weaving* is that by which velvets, various fustians, such as velveteens, corduroys, &c., are formed. In these, besides the warp and weft, another series of threads are woven in and fixed in loops, which are afterward cut to form the pile of these fabrics.

5490. *The draw-loom* is employed where the most intricate figures in cloth are required. These machines are necessarily complicated, though very complete; and it is by them that figured and spotted muslins, damask, whether of silks or linen, and even many carpets, are now woven. Those for damasks are the most curious, and their productions have justly excited the highest admiration. The most perfect loom of this kind was the invention of M. Jacquard, a practical weaver at Lyons; and the machine continues to bear his name. It has now superseded all other looms for figure-weaving, the skill and labour required being so much reduced by it, that they are little more than is required for plain weaving. It is lamentable to learn that this admirable invention did not benefit its author, who experienced the most bitter annoyances from his fellow-artisans.

5491. *Ribands* are woven in a manner analogous to cloth; but the looms are sometimes so constructed that upward of fourteen ribands may be woven at once.

5492. *Stocking-weaving* is of a different kind, and will be described under "Stockings."

CHAPTER II.

WOOLLEN FABRICS FOR CLOTHING AND FURNITURE.

SECT. I.—HISTORICAL AND GENERAL REMARKS.

5493. The substances employed for clothing are so numerous, and the ways of preparing them so various, that there are few arts in which more sagacity has been displayed, or where the inventive powers of man have been called more into action. The sheep, in early times, supplied clothing to many nations of antiquity; but it would be found that skin with its wool was too heavy and rigid, and that the latter, when separated, might be converted into cloth that was more flexible, and admitted of being made of various degrees of warmth.

5494. It is known that woollen garments, as well as those of linen, were worn by the ancient Egyptians. These also formed almost exclusively the attire of the ancient Greeks and Romans, though but little is known concerning their manufacture. We learn, however, that these nations bestowed great pains in improving their breed of sheep, and gave high prices for select animals; also, that they made woollen fabrics of great fineness.

5495. We have mentioned that though England had been long famous for its wool, yet that the art of weaving it into cloth, except that of the coarsest kind, was little known previously to the year 1331; the higher classes had fine cloths, but these were chiefly of foreign manufacture.

Little mention is made of this branch of trade in England prior to the reign of Edward III., who, having married Philippa of Hainault, found means to bring over a considerable number of woollen manufacturers from the Low Countries. These Flemings settled in York, Kendal, Halifax, Manchester, Norwich, and also in the west of England; but we have few records of the progress of the manufacture till the time of Henry VIII., when it had grown into considerable importance. Another advance was made in consequence of refugee weavers, who fled from the Netherlands to England, to avoid the religious persecutions of the Duke of Alva. These Flemings were graciously received by Queen Elizabeth, and obtained liberty to settle at Norwich, Colchester, Sandwich, and other places. Notwithstanding this, the manufacture of cloth made greater progress, for a long time, among the neighbouring nations than among ourselves.

5496. About the reigns of Edward VI. and Queen Mary, some kinds of woollen cloths began to be exported in considerable quantities; mixed cloth, in particular, for which the west of England has ever since been celebrated. In 1770, the exports of woollen fabrics of different kinds amounted in value to four millions annually; and in 1833, according to Mr. M'Culloch, the value of woollen goods manufactured was twenty-one millions sterling, of which about six millions are exported.

5497. *The inventions of Arkwright* for the carding and spinning of cotton wool were soon modified to suit the wool of the sheep, and produced an entire revolution in the woollen and worsted trade. Since that time, instead of the hand-spinning, described in Chap. I., the mechanical powers of water and steam have been applied to drive machinery for that purpose, and the localities of the woollen manufacture have moved into those counties where water and coal are plentiful; also the permission to export, which was formerly refused, being granted, English cloth and other woollen goods find markets all over the world. The improvements made within twenty years in the quality of our best broad-cloths are very considerable, partly on account of superior machinery, and partly from the several processes being better understood.

SECT. II.—ON THE NATURE OF WOOL, AND THE VARIOUS KINDS OF IT.

5498. *Wool is a kind of soft hair* which grows upon the skins of several ruminating animals, particularly sheep, the lama, the Angora goat, and the goats of Thibet. The distinction between wool and hair is rather arbitrary than natural, consisting in the greater or less degrees of fineness, softness, and pliability of the fibres. When the fibres possess these properties so far as to admit of their being spun and woven into a texture sufficiently pliable to be used as an article of dress, they are called wool. Both coarse and fine fibres are often found on the same animal, one of which might be called hair, and the other wool: many of the asses, and even oxen, of this country have soft woolly tufts on some parts of their skins; and this is more the case with the oxen of Thibet and the asses of Chili. The fleeces of sheep vary much in the degree of fineness in different parts of the body.

5499. *Sheep's wool, in its present state, appears to have been in a great measure the product of cultivation;* for we know of no wild animal that resembles the wool-bearing sheep. The argali, from which all the varieties of sheep are supposed to be derived, is covered with short hair, at the bottom of which, close to the skin, there is a softer hair or wool. This is not peculiar to the argali: almost all quadrupeds inhabiting cold climates are covered in the same manner with a soft hair, which is protected by a coat of longer and coarser hair. By removal to a temperate climate, or when placed under the fostering care of man, secured from the inclemencies of the weather, and supplied regularly with food, the coarse, long hair falls off, the animal retaining only the softer and shorter hair or wool. On the contrary, European sheep removed to tropical climates, and much exposed to the heat, lose their soft fleece, which is succeeded by a covering of short hair.

The goat of Thibet, which produces the extremely fine wool of which the Cashmere shawls are made, lives near to the tropics; but the country, from its height above the sea, is extremely cold. Sheep, in exposed situations in Europe, often produce short, coarse hairs intermixed with the wool, which fall off and do not grow again when the animals are removed to a warmer situation and to a richer pasture. These facts are sufficient to prove the effects of cultivation on the fleece; and, probably, finer wool-bearing sheep have originally become so by long-continued attention to those circumstances which have been found by experience to affect the fineness of the fleece.

It is probable, however, that climate and food alone will not produce the finest wool, although it assists greatly; and it has been shown that this is most completely obtained by a careful selection of such sheep as produce the best fleeces, and breeding from them for a few generations, until a new race is established that becomes permanent. In this manner have been procured those peculiar breeds that are now famous for their wool.

5500. *Sheep's wool may therefore be considered as much an object of cultivation as any vegetable product;* and it is never found of good quality except in those countries which have been the seat of the arts, and where a considerable degree of civilization and refinement exists, or has formerly prevailed. Where the culture has been long neglected, the product is uniformly found to be deteriorated. In the flocks of Barbary and the adjoining states may be traced the offspring of a fine-woolled race of sheep, degenerated by utter neglect, in a climate naturally unfavourable to the production of fine wool. In Sicily and the southern parts of Italy the remains of the ancient Tarentine breed preserve to the present day a race of fine-woolled sheep greatly degenerated by neglect. In Portugal the fine-woolled sheep retain more of their original purity, though in a state of degeneracy. In Spain, where the growth of fine wool has never entirely ceased to be an object of attention, the race of fine-woolled sheep exists in a high degree of perfection.

5501. *Wool, like the hair of horses and cattle, completes its growth in a year, and then falls off,* to be succeeded by a fresh crop; but, instead of coming off partially, as hair does, it is shed, if left to itself, nearly all at once at a particular period, leaving the animal covered with a short coat of young wool. To prevent this, and consequently the loss of the wool, this is shorn off when it has come to its full growth, and before it detaches itself naturally; the whole together constituting what is called a *fleece.* The time for sheep-shearing is regulated by the climate and the weather. In the southern parts of England it is generally about the middle of June. If sheep are shorn in cold weather, they suffer considerably.

The wool *shorn* from the living animal is called *fleece wool,* and is superior to that which is *pulled* off from the slaughtered sheep by the fellmonger, and which is termed *skin wool,* or *felt wool:* this is distinguished by its being harsher, weaker, and less capable of taking a good dye. The quantity of the latter in a country like England, where so much animal food is consumed, is very considerable. It is frequently too short to be worked by itself, and is then mixed in with longer wools. The process by which the wool is separated from the skins has a tendency to make it hard, and to destroy or injure its felting or milling property; on which account short-skin wools are seldom used for the manufacture of cloth, but more generally for flannels, serges, and those kinds of goods which require little or no milling; on this account, its value is less than that of fleece wool. The longer kinds of felt wool are used for hosiery yarns, or for hand yarn for the warps of serges and other goods having a warp of combed and a woof of carded wool.

5502. *The length of the fibre of wool constitutes an important distinctive character.* Sheep's wool is divided by manufacturers into two sorts, *long* or *combing wool,* and *short* or *cloth-*

ing wool; and these differ from each other materially in the uses to which they are applied. It is usual to speak of the length of the *staple* of wool. By the staple is meant the separate locks into which the wool naturally divides on the skin, each lock consisting of a certain number of fibres, which, collectively, are called the staple.

5503. *Long* or *combing wool* may vary in length from three to eight or ten inches; it is prepared on a comb with long steel teeth, worked either by hand or by machinery, which open the fibres and arrange them longitudinally, like those of flax; thread is therefore spun from this wool in the same manner as from flax, but the fabrics made of it are not fit to be subjected to the process of felting. The longest kinds of wool are manufactured into *worsted* or hand yarns, employed in worsted pieces, such as waistcoats, carpets, bombazins, crapes, poplins, and the finer kinds of worsted goods. The shorter combing wools are principally used for hosiery, and are spun into soft worsted yarn.

5504. *Short-stapled wool* is the only kind employed for making cloth, hence it is sometimes called *clothing wool;* it varies in length from three to four inches; if longer, it requires to be cut or broken to render it fit for carding and spinning into woollen yarn, and the subsequent operation of felting. This wool is always carded upon an instrument with fine short teeth, by which the fibres are opened and spread in every direction. The principal qualities required in clothing wools are, the regular fineness of the hair or pile, its softness and tendency to felt, the soundness of the staple, and the whiteness of its colour.

5505. *The fineness of the fibre of wool* has ever been considered as an important quality since the manufacture of cloth has been so much improved. The degree of fineness may be ascertained by the microscope: the thickness of a hair of the best Spanish and Saxon wool is not more than $\frac{1}{1500}$th of an inch, and that of the finest native English is from $\frac{12}{1500}$ths to $\frac{13}{1500}$ths. But the comparative fineness is sufficiently estimated by the eye of the wool sorter or wool dealer, who, by long habit, can discern minute differences which are quite imperceptible to common observers, and scarcely appreciable by the microscope; a difference in the size of the fibres, too minute to be noticed by persons not experienced, may occasion a difference of forty per cent., or more, in the value of the wool.

Fine wool was formerly valued because a finer thread could be spun from it, and a thinner fabric made than from the coarser wools; but since recent improvements in machine spinning have been introduced, it has been found practicable to spin coarse wools to the same length as the finer wools were formerly spun to. It is well known, however, to cloth manufacturers that, whatever be the fineness of the yarn, unless the wool also be fine, it is impossible to make a fine, compact, and even cloth, in which the thread shall be covered with a thick, soft pile; nor would a thin cloth made from coarse wool have the same durability or appearance as one from fine wool of equal weight per yard.

5506. *The finest of all wools* is that from the goat of Thibet, of which the exquisite Cashmere shawls are made; the finest of European wools are from the Spanish Merino breed, to which the best Saxon sheep belong. For coarse goods, indeed, such as blankets, carpets, and cloths called *duffels*, raised with a hairy pile, a considerable degree of hardness or elasticity of the fibre is an advantage; but in all the finer articles of the woollen or worsted manufacture, the fineness and softness are of great value. In some fleeces from the fine-woolled sheep of England there is sometimes an intermixture of coarse hairs, which proves very detrimental to the wool. In the Merino and Saxon sheep the fleece is more regular, whatever be the degree of fineness, than on any of our sheep.

5507. *The fineness of the fleece varies in different parts of the animal.* The finest is upon the spine, from the neck to within six inches of the tail, including one third of the breadth of the back or saddle; the second quality covers the flanks, and extends from the thighs to the shoulders; the third covers the neck and rump; and the fourth lies upon the lower part of the neck and the breast, down to the feet, as also upon a part of the shoulders and the thighs, to the bottom of the hind quarters.

Wool is sorted with great care into the various degrees of fineness, by persons much practised in this process; and they generally separate English fleeces into eight or ten sorts in a single fleece, which receive different names, and are applicable to different fabrics.

5508. *The softness of fine wool* for cloths is next in importance to the fineness of the fibre, but is not dependant upon it. It consists in a peculiar feel, which approaches to that of silk or down, but in which the wool of European sheep is inferior to that of Eastern Asia, or to the wool of the vicuna or lama of Peru and Chili.

The softness of the Indian wool is far superior to that of the very softest of the Merino fleeces; and yarn from Indian wool fetches a much higher price, sometimes even three guineas per pound, not on account of the superior fineness of the thread, but for the softness of the wool. In European wools there are different degrees of this property, even where the fibre is equally fine. In our English wools, a similar difference exists between the wool of one district and that of another, and which is imparted to the cloths made from each.

5509. *Fine clothing wool depending chiefly upon the peculiar breed* of sheep, and less upon soil and climate, may be grown, by care and attention, in every country where sheep will subsist and thrive; but it is different with the long combing wool: to grow this in perfection, rich pastures seem requisite, and these cannot be obtained under a parching sun, in tropical climates, nor could the animal exist clothed with a heavy fleece. Under such circumstances, the long-woolled sheep become feverish and diseased, and only recover by casting the fleece, which is replaced by a coat of short hair. The luxuriant pastures in England, particularly in Lincolnshire and Leicestershire, and in the opposite coast of Flanders, seem more favourable to the growth of long wool for combing than any other countries, and the wool of these places is highly prized for the worsted manufacture.

5510. *Lamb's wool* is generally softer than that of the sheep of the same flock; and as it has the felting quality in a high degree, is much used in the hat manufacture. The wool of dead lamb skins, called skin-lamb's wool, possesses less of the felting property, and is employed for flannels and lamb's wool hosiery. In the northern parts of Europe the lambs of some of the breeds of sheep possess a fleece so delicately soft, that it constitutes a most valuable fur, being dressed on the skin, and used as a costly article of attire, especially for morning gowns, among wealthy Russians.

5511. *The natural colour of wool* is white, gray, or brownish black. It is probable that all sheep's wool was at first of a dark colour, and previously to the invention of dyeing, coloured wool would have a preference to white; but after the discovery of a method of communicating beautiful colours to the fleece, white wool would be preferred as the most favourable for receiving bright colours, and those sheep which had white fleeces would be selected to breed from. Dark brown or black woolled sheep are not uncommon in many parts of Europe, and coarse cloths are made of their wool in its natural colour.

5512. *Wool, in the state in which it is taken from the sheep,* is always mixed with a great deal of dirt and foulness of different kinds, and, in particular, is strongly imbued with a natural grease, which requires to be removed. This is effected by the wool comber, by means of washing and combing, after which the wool becomes soft, clean, and springy, and is brought into the state adapted for the making of worsted and the manufacture of woollen stuffs.

5513. *The grease or yolk of the fleece* is an oily, or, rather, a soapy substance secreted by the animal. It is found to consist of animal oil combined with a little potash, forming of itself a kind of soap; hence it serves to facilitate the scouring of wool by water alone. It is most abundant in those breeds that have the softest fleeces, as the Merino; and while the animal is living, it serves to keep the wool in a sound state, and improves its softness; but, although so beneficial to the wool while growing, it becomes injurious to it after it is shorn, and should be removed as soon as possible; otherwise it will produce a fermentation, and render the wool hard and brittle, particularly in hot weather. Sometimes the fleece is washed with cold water on the animals before shearing; but when it is thick, as in the Merino breed, it is washed after it is shorn, either with hot or cold water, the former being most effectual. Wool loses in weight by this process from thirty to forty-five per cent. A copious supply of the yolk is necessary to the healthy condition of the fleece, and in some flocks it is nearly equal in weight to the wool.

5514. *The practice of greasing the sheep* with a mixture of tar and butter, practised in Scotland and the north of England, to preserve them from the effects of moisture and the inclemency of the weather, has been supposed to be injurious to the wool; but Mr. Bakewell has shown that, when the proportion of tar is not too great, the wool is greatly improved by this process, as the unguent preserves the wool in a soft state during the heats of summer, besides defending the animals from insects and cutaneous diseases.

5515. *The long-woolled sheep of England* are of four breeds: the Dishley, or new Leicestershire; the Lincolnshire; that of Teeswater, and of Dartmoor. The Lincolnshire and Leicester breeds produce the longest staple, being often a foot in length. The average weight of their fleeces is from eight to ten pounds. For the general purposes of the worsted manufacturer their wool is unequalled.

5516. *Our short-woolled sheep* are principally the Dorsetshire, Herefordshire, and Southdown. The sheep pastured on the Cheviot Hills, in Cumberland, though not of the finest-woolled English breed, yield fleeces of great softness.

5517. It is a remarkable fact, stated by several persons who have written lately on our manufactures, that *although Britain was long famous for its wool,* which was formerly considered as the staple article of British exports, yet at present the native wool of this country is deemed by our manufacturers to be unfit for making superfine cloth, and is not, in fact, used here for this purpose, all our superfine cloths being made with foreign wool. Prior to 1824, some good English broad-cloths were made of wool from Sussex, Norfolk, Suffolk, and Hampshire; but it is said that since that time our wool has deteriorated somewhat in its quality, and Saxon wool chiefly is employed. The great fault of English wool for cloths is the length of the staple as well as the coarseness

5518. The following table exhibits the various breeds of sheep in this country, with the quality and quantity of wool produced by each:

Breed.	Horns.	Colour.	Quality of the Wool.	Weight of Fleece.
				Lbs.
Dishley	No horns.	White faces and legs.	Combing, or long wool.	8
Lincoln				11
Teeswater				9
Dartmoor				9
Exmoor	Horned.	Ditto.	Ditto.	6
Dorset	Small horns.	Ditto.	Carding, or fine short wool.	3½
Hereford	No horns.	Ditto.	Very fine short wool.	2
Southdown	Ditto.	Gray faces and legs.	Ditto.	2½
Norfolk	Large horns.	Black faces and legs.	Fine short wool.	2
Heath	Ditto.	Ditto.	Coarse long wool.	3½
Hardwick	No horns.	Speckled faces.	Short wool.	2
Cheviot	Ditto.	White faces and legs.	Fine short wool.	3
Dun-faced	Ditto.	Dun faces and legs.	Ditto.	1½
Shetland	Ditto.	Colours various.	Fine cottony wool.	1½
Romney Marsh	Ditto.	White faces and legs.	Long wool.	8
Spanish, or Merino	Males horned, Females sometimes without horns.	Ditto.	Short wool, very fine.	3½

5519. *Spanish Wool.*—The finest woolled sheep in Europe, the Spanish Merino, may be traced to the Tarentine sheep, introduced by the Romans into Spain. This breed is said to have come originally from Asia, where, in the ancient seats of luxury, the utmost pains had been bestowed upon these animals. In the Middle Ages, so far back as 1243, Spain was celebrated for its fine woollen cloth, with which it supplied the Italian states. The males of the Merino sheep have horns, and the females are without them. They are covered by a great thickness of wool, and appear almost enveloped in it, scarcely giving way to the pressure of the hands. The number of these sheep in Spain is estimated to be about 5,000,000, and they belong to various wealthy proprietors; yet they are united together into one great flock, called the *Mesta*, which travels over the kingdom under the guidance of certain persons appointed to take care of it, feeding upon various commons or uncultivated lands, passing the summer in the mountainous districts, and the winter in the plains. This breed was tried in England by George III., but has not succeeded to the extent expected, although it has, in many instances, improved the English breed of short wool sheep. Formerly all our finest wool came from Spain; but Spanish wool is now almost entirely superseded by the Saxon and Australian. The Spanish flocks have suffered much in consequence of the war.

5520. *Saxon wool*, now so much employed in this country, owes its great improvement to the late King of Saxony when elector; on account of the superiority of the Spanish Merino sheep, he introduced them into his dominions, where they seemed to succeed even better than in Spain. Previously to 1800, our average annual imports of wool did not much exceed 3,000,000 lbs., mostly brought from Spain; but such has been the increase of the Merino breed by the Saxon wool growers, that the annual importation of wool from Saxony amounts to above 25,000,000 lbs.

This fact has excited the emulation of the states contiguous to Saxony; and the inhabitants of Silesia, Bohemia, and Austria have improved their flocks by the Merino.

Saxon wool is usually four or five inches long, but, from its tenderness, it admits of being easily broken down by carding to the proper shortness for clothing and fulling, which is from two to three inches, and is by much preferable for making fine broadcloths, kerseymeres, pelisse cloths, shawls, and such fabrics as require fine yarn.

5521. *Shetland Wool.*—A breed of sheep exists in the Shetland Isles, remarkable for the fineness of its wool. The sheep are small, and mostly without horns: they are suffered to run wild, and are not even sheltered in winter. In the summer they are confined to the hills, but after the crops are removed they are allowed to range over the country; and when the ground is covered with snow, the animals come down to the shores, and feed upon sea-weeds. For fineness and softness the Shetland rivals even the Spanish wool, while, being at the same time of longer staple, it is employed for the best worsted manufactures, as stuffs, the finest stockings, &c. The fleece attached to the skin is occasionally employed as an excellent fur. This peculiar breed is called *beaver* sheep. The colour of the wool is various, white, gray, brown, and black; but the quantity of this wool is not considerable. Some of the same breed occurs in a few places in the Highlands.

5522. *Australian Wool.*—A new locality for fine wool has been found in Australia. The Spanish Merino sheep were carried to New South Wales and Van Diemen's Land, where the climate appears peculiarly well suited to them: they are multiplying prodigiously; the wool is of the first quality, and these countries promise, at no very distant period, to be the principal wool-growing places in the world. Already our imports from Australia exceed 4,000,000 lbs. per annum. It is said that no wool spins so well, in consequence of the length of its staple and its softness; it is also better for combing purposes than any other description, and is, at present, altogether consumed in the finest worsted goods; most of those beautiful and soft woollen fabrics which go by the name of Indianas, Merinoes, and Challis, and which make such display in the shops of our haberdashers, are manufactured from this fine Australian wool.

Sect. III.—Manufacture of cloths and other woollen fabrics.

5523. *The term cloth, in its general sense*, includes all kinds of stuffs woven or manufactured on the loom, whether their threads be of wool, hemp, flax, or cotton, or any other material; but it is more peculiarly applied to those which are made of woollen threads. These differ in appearance considerably from cotton cloth. In the latter, the threads are distinctly visible; but in a piece of new woollen cloth they are completely concealed by what is termed the *nap*, or *pile*, of the cloth, and it is only after the nap is worn off that they are discerned, when the cloth is said to be *threadbare*.

5524. *The manufacture of cloth requires, as we have stated, the short or carding wool*, the elasticity and contractility of which render the cloth susceptible of the peculiar treatment of the fulling, felting, and teaselling operations, to raise and regulate the nap, or pile; and the qualities which distinguish cloth from all other manufactures, and which render it peculiarly suitable for elegance and warmth in the clothes made of it, are the compactness and density it acquires from fulling. Cloths are either superfine, second, or coarse.

5525. *A description of the mode of making superfine cloth* may serve for the whole, that of the inferior sorts differing little, except in the coarse and less delicate modes of performing the same operations.

5526. *The first operation is to clean the wool thoroughly.* For this purpose, being taken out of the bale, it is first picked, to clear it from the pitch which adheres to it, and from other extraneous substances. It is then scoured, by boiling it in three parts water and one of urine, from which it is afterward taken out and rinsed in running water; or it is soaked in urine, and rinsed frequently with clean water: it is then fit to be committed to the dye-house. After dyeing, it is again washed and dried, and then beaten with rods, to free it from the loose dye-stuff; but this operation is now generally performed by a wool-mill, or, as it is called, a *willy*, which, by means of revolving spikes, opens up and clears from sandy and other loose impurities the matted fleeces supplied by the wool stapler.

5527. *The wool, thus prepared, is now spread loose on a floor, and olive oil*, in the proportion of three pounds to twenty pounds of wool, evenly sprinkled over it, and beat into it with very heavy rods, to facilitate the future carding operation. But previously to the proper carding, it is carried to the scribbling engine.

Scribbling is merely a loose species of carding the oiled wool. The scribbling engine is a machine composed of several wooden cylinders of various sizes, covered with teeth or wire of different degrees of fineness, and bent and hooked in opposite directions. These are combined in a strong wooden frame, and so fitted as just to touch and work against each other, as they swiftly revolve on being set in motion by a common handle, adapted to be turned either by men's labour, or any sort of mill-work. By passing through this engine, the locks of wool, which before were close and matted together, are drawn out, the fibres are separated, and they are formed into light flakes, called *lap*.

5528. *The carding engine* receives this lap, works it over again, and delivers it in a narrow band, or *sliver*, which is preparatory to the spinning. Carding opens up and separates completely the woolly filaments, and renders the fleece lighter, more homogeneous; it also occasionally disentangles the connexions of the fibres, and causes the broken filaments to cross each other in every possible direction. By this the texture of the wool is rendered more downy, and the filaments made more elastic, and disposed to lay hold of each other, and thus put into a condition more favourable for the fulling process. Before the invention of machines for carding, to produce the roll, or sliver, this process was performed by hand-cards, which were mentioned in the description of spinning wool; but it is now done much better by the machine.

5529. *The cardings are next taken, in the form of light and delicate round rolls, to the slubbing or roving machine*, by which the separate lengths delivered by the carding engine are joined together by children, called *pieceners*, and drawn out in a continuous spongy cord to six times their former length, giving them, at the same time, a slight twist to maintain their cohesion and uniformity, thus forming what is called a *slubbing* or *roving*, which is, in fact, a very loose soft thread, that is afterward to be completed and made into yarn by spinning. This latter operation, now performed so expeditiously by machinery, which only requires the attendance of boys, was formerly done by hand on a spinning-wheel, as we have mentioned. Of course, various ingenious contrivances are necessary to prevent so tender a substance as wool cardings to draw out without breaking. Rovings for warp yarn must be more twisted than for weft.

5530. *The wool slubbing or rovings are now spun into woollen yarn* of the requisite fineness, either by the spinning-jenny or the mule, machines more particularly noticed in our description of the Cotton Manufacture, Chap. IV., Sect. III., for which they were first invented. In the structure and mechanical properties of its filaments, short or carding wool resembles cotton very closely, and therefore it may be spun by machinery nearly similar.

The asperities on the surface of the filaments render the spinning of wool difficult. This is in a great measure removed by besmearing it with oil, by which the inequalities are filled up, or at least the asperities become less sensible. When the wool is made into cloth, it is necessary to remove the oil, which is done by the process of fulling.

For the weaving of cloth, see "Weaving," Chap. I., Sect. III. From the similarity of the materials, the weaving of woollen cloth is not very different from that of cotton. We may just observe that what is termed the *list* of cloth, which is a strip of different colour at the edges, consists of a few stronger threads than the rest, to afford a firm hold for the hooks in tentering, to be described.

In the state in which the cloth is woven, the fabric would be too open, and the threads too apparent, to suit with the taste of the time, or to be as soft and comfortable as is required for dress. To render it more compact, and to improve its appearance, it goes through the next process.

5531. *It is the milling and fulling* that give to cloth that compactness and density which distinguish it from all other woollen fabrics. By this operation, a cloth of forty yards long and one hundred inches wide is so shrunk up, and consequently thickened, as to be reduced to thirty yards long and sixty inches wide, which renders it of the proper substance and thickness of common superfine cloth. The cloth to be milled is first cleared, by scouring, from the oil with which it was imbued for the carding; and as fullers' earth is used, this operation is termed fulling. Previously to the milling, a liquor is sprinkled on it, made of fine soap dissolved in water, and it is then laid in the mill-trough, where it is pounded or stamped on by heavy flat wooden hammers moved by wheel-work. The property of being rendered thicker by compression is peculiar to woollen substances; if fabrics of silk or cotton were subjected to the same process, they would not, in any length of time, be rendered thicker or more compact by it.

Fig. 782.

This property depends upon the peculiar structure of the fibres of wool. These, when viewed through a microscope of great power, appear like a number of rings inserted into one another (*fig.* 782), the edges of a longitudinal section being serrated or marked like a saw. By this peculiar structure of the fibres, they are disposed to move in one direction more easily than in another; and during the violent agitation which the cloth undergoes in the mill-trough, being at every stroke of the mill-hammer strongly impelled together, they are driven into the closest possible contact, and at length hook into each other, drawing closer and closer as the process continues, till they become thus firmly and inextricably united: thus each thread, both of the warp and the woof, being so joined and compacted with those that are contiguous to it, the whole is formed into a dense substance, that is not liable, like other fabrics, when cut with shears, to unravel and become ragged at the edges. It is supposed by some that this property, called *felting*, which is best seen in hat making, gave rise to the earliest kind of woollen cloth, before spinning and weaving were invented; since the disposition of wool to mat together and unite into a very compact body could not escape notice. The Tartar tribes at this day make a cloth, or felt, for their tents, merely by spreading out the wool on the ground and causing it to felt together by treading it with warm water, and beating it; and very lately this process of making cloth by felting only has been revived in this country, and very thick woollen fabrics, for various purposes, are made without spinning and weaving, and by felting only.

This process is essential to the beauty and strength of woollen cloth, and it is observed that the softer wools felt in much less time than the harder, and form a closer pile on the surface of the cloth, on which account it is a common practice to mix a certain quantity of soft wool with the hard, to enable the former to felt with more facility. The elasticity of the filaments has also a considerable effect in promoting the felting, as it causes them to curl. The furs of the hare, the rabbit, and the beaver, being naturally straight, cannot be employed alone for felting till they have acquired a curling texture at their points, by the application of nitrate of mercury. It is scarcely necessary to mention that, as the cloth shrinks so much in the fulling mill, it must first be woven so much wider, to allow of this shrinkage.

5532. *Cloth thus milled to its proper thickness must next be scoured* with clean water till it is perfectly free from the soap; and in this process a preparation of fullers' earth and bullock's gall is found very serviceable, rendering the cloth, at the same time, soft and mellow. It is then stretched on the tenter frame, and left to dry in the open air.

5533. *The dressing of cloth* is another operation it has to go through, which consists in bringing a nap on it, by drawing out all the fibres of the wool that can possibly be brought to the surface, which is afterward shorn as close and even as it will admit of, without laying bare the threads of the fabrics. The nap is raised upon the cloth either by teasels or by wire cards. The natural teasels are the balls which contain the seed of a large thistle called *Dipsacus fullonum*, which is cultivated on purpose; the scales of these balls project on all sides, and terminate in sharp elastic points that turn downward like hooks. When these are used by hand, the heads of the thistles are cut off, and set close together in small wooden frames, forming a tool not unlike a curry-comb. It is worked by two men, who, holding the teasel frame by the handles, scrub the face of the cloth hung in a vertical position. The first time of dressing the cloth they wet it with water, and work it by strokes in the direction of the warp, and next in that of the weft so as to raise up all the loose fibres from the felt, and prepare it for shearing. In large manufactories this operation is performed in what is called a *gig-mill*, which originally consisted of a cylinder set close round with teasels, but now sometimes covered with brushes of fine wire instead of teasels.

5534. *The next operation is shearing or cropping the cloth.* The cloth being laid on the shearing boards, which are made of wooden planks covered with coarse cloth, and forming a kind of hand cushion, the wool thus raised is cut off by long heavy shears, which are pressed close to the cloth with leaden weights, and gradually slide forward at every motion or cut, till they have proceeded from one list to the other. Lately, an improved kind of shears, of French origin, is much used. The cloth is then returned, to be again scraped, rubbed, and brushed; and these operations are repeated every time with finer cards, or teasels, till the wool becomes sufficiently raised. Shearing by machinery was first introduced in 1802, and finishes cloth in a more perfect manner than shearing by hand.

5535. *The cloth is then taken to the rack*, on which, being fastened by the lists with small hooks or tenters, it is drawn or strained, until it be of an even width throughout, and it is then sheared again to complete the surface. All the little bits of straw or lint that may adhere to it are now picked out, and any holes that may be discovered carefully fine drawn. After the shearing, cloth is subjected to the brushing machine and the calender.

5536. *Nothing now remains to be done but pressing*, preparatory to which, the cloth being doubled and laid in even folds, a leaf or sheet of glazed pasteboard is inserted between each fold of the cloth; it is then laid in the press, and covered with thin wooden boards, in which are placed iron plates properly heated; and on the whole the top of the press is brought down, with the degree of force judged necessary to give it the proper gloss. When cold, it is taken out of the press, folded and packed, ready for sale.

The satiny lustre and smoothness given by strong compression with much heat is objectionable, as it renders the surface apt to become spotted and disfigured by rain; this is taken off by steaming and brushing. The difficulties attending the manufacturing fine cloths, with the degree of perfection which the art has now attained, may be easily imagined from the number of necessary processes to complete it, every one of which demands workmen who confine themselves to one process, in order to acquire the requisite dexterity. The whole process occupies about six weeks. The French broad-cloths, particularly those of Sedan and Louviers, formerly surpassed those of all Europe in beauty and perfection. At the former place, blacks are admirably dyed; and at the latter, the wool is still dyed in a superior style, especially for blues.

5537. *The goodness of cloth consists*, 1, in the fineness and softness of the wool; 2, in the clearness, richness, and beauty of the colour; 3, in the yarn being evenly spun, always observing that the warp be closer twisted, and one fourth smaller than the woof; 4, in the cloth having been well wrought and beaten on the loom, so as to be in every part close and compact; 5, in being milled or fulled evenly, clean scoured, and of a proper thickness or substance; 6, in being well dressed, so that the hair, or nap of the wool, be fully and evenly drawn out and ranged on the surface, and in being shorn close, yet without laying the ground or threads bare; 7, in its not being overstretched in the rack, or pulled farther than is necessary to set it smooth, and bring it to its just length and breadth; lastly, in the cloth itself appearing smooth and neat on the face, free from small knobs, spots, and other imperfections; in being firm, yet pliable, and feeling soft and fine to the touch.

5538. *In making mixed cloths*, wool of the different colours, being weighed out in their requisite proportions, are first shaken together; they are then farther mixed by being well turned in the wool-mill; and, by being afterward twice passed through the scribbling engine instead of once, they are generally found sufficiently intermixed.

The dyeing of cloth is a subject on which we do not purpose to enter in this place; but something will be found on the subject under "Dyeing," Book XVII., Chap. II. We shall only observe that the most permanent colour is produced when the dyeing process is performed on the wool before it is woven. Cloth made in this manner is termed *wool-dyed* cloth; whereas cloth dyed after weaving is called *piece-dyed*. Black cloth being very much worn, it is useful to know that there is a very great difference in the durability of the black, according to the process made use of in dyeing it. The most permanent colour dyed in the wool receives a preparation of indigo blue; whereas what is dyed in the piece is prepared with logwood, and the colour is very fugitive; though it looks well at first, it will, after a little wear, turn to a rusty black or gray. To distinguish between such black cloths as have a permanent dye and those which will become rusty and brown after a little wear, provide a little pretty strong solution of oxalic acid in water in a vial; moisten the cork well with the solution, and press it firmly against the piece of cloth to be examined before purchase. If the dye is permanent, in consequence of the use of indigo, the spot that was moistened will, in a few minutes, appear of a greenish olive colour; but if the black be fugitive, the spot will become of a dusty orange or fawn colour.

Formerly, the west of England was the principal locality for the manufacture of superfine cloths; but, of late, Leeds, where, some years ago, only second cloths were made, has become the chief place for the best; and, through the use of so much machinery, the price of superfine cloth has been reduced fifty per cent. Fine cloths may now be purchased for 12*s.* a yard that would formerly have cost 24*s.*

5539. *The worsted or long wool manufacture* is very different from that of cloths. Worsted stuffs require a fine, smooth yarn, which shall have little or no tendency to shrink, curl, or felt when woven. Hence the fibres must be disposed as nearly as possible in parallel lines by the operation of the comb already described, instead of being entangled and crossed by carding, as is required for making cloth. Worsted yarn for warp and weft requires to be even, slender, and hard.

The qualities most required in this kind of wool are length and soundness of fibre; the fineness of the hair is a secondary quality, required only in certain kinds of goods.

The first process in the worsted factory, where *stuffs* are made, is to clean the wool thoroughly, to render it fit for the comber by washing it with soap and water; after which it is spread out upon the floor and dried. The next operation is to comb it, in order to bring the fibres straight.

The old process of wool-combing was this: the wool was oiled, and was first drawn upon the teeth of the wool-comb, with the hand, until the comb was sufficiently loaded; the comb was then placed upon the knee of the comber, and another comb of a similar kind was drawn through it—an operation which was repeated till all the hairs or fibres were brought in one direction. This process required considerable strength, and was generally carried on in rooms which were much heated, because it was necessary that the combs should be kept hot, that they might easily be drawn through the oiled wool; and the workman had a pot made of clay, with holes in its sides, in which he heated them to a certain temperature. At present, wool-combing is chiefly performed by machinery. The first invention of a wool-combing machine was made in 1790, by the Rev. Dr. Cartwright; and patents have been taken out for others, which, owing to the economy of time and material which they produce, have almost wholly superseded combing by hand.

5540. *Worsted was formerly always spun by hand*, as we have already mentioned, as it still is in some places; but when the method of spinning cotton by rollers, invented by Arkwright, was introduced, it was soon applied to the spinning of worsted yarn; and, at present, in factories, it is all spun by machinery, nearly in the same manner as cotton.

SECT. IV.—DESCRIPTION OF THE PRINCIPAL WOOLLEN FABRICS.

5541. *Cloths* are the most important articles in the woollen manufacture. *Broad-cloths* are the stoutest and best, and are seven quarters wide; they are of various degrees of fineness, superfine, second, and inferior. *Narrow cloths* are half the width of the last, or three quarters, or seven eights. *Habit cloths* are a lighter and thinner kind, generally seven quarters wide. *Royal cachmere* is used for summer coating, and is a fine narrow cloth made of Saxon wool in worsted weft.

We have already stated that all our best superfine cloths are now made of Saxon or Spanish wool; an inferior superfine cloth is manufactured from English wools; as also the seconds, chiefly used for liveries, together with coarser sorts, varying in quality and price. The goodness of cloth consists mainly in the quality of the wool, the durability of the dyeing, and the degree of perfection in which the various processes in its manufacture have been performed.

5542. *To judge of the quality of broad-cloth*, particular attention must be paid to the fineness of the fibre and the closeness of the texture. If, on passing the hand lightly in the direction contrary to the nap, there be a general silkiness of feel, uninterrupted by harsh roughness, there are grounds for concluding that the cloth is made of fine wool. The texture should not only be composed of fine threads, but it should have an even consistency, produced by the operation of felting, by which the fibres of the wool are so perfectly incorporated that they conceal the tissue of the threads, and give the entire web the appearance of felt; or, to use a familiar comparison, a piece of cloth made of fine wool, and well wrought and finished, should exhibit no more indications of the loom than a sheet of wove paper does of the apparatus employed in its fabrication. Dealers judge of its quality by an expedient which is more easily understood by observation than description. A portion of the cloth is taken up loosely with both hands; a fold of it being then pressed strongly between the thumb and forefinger of one hand, a sudden pull is given with the other, and according to the peculiar sharpness and vibrating clearness of the sound produced by the slipping or escape of the fold, the goodness of the cloth is judged. Another way is the comparison of various pieces of different fabrics and of different prices; the soft and even consistency, together with the flexibility of fine broad-cloth, will be rendered more evident on being contrasted with that of an inferior cloth. The gloss on cloth is better not to be too satiny, as this causes it to spot with rain.

5543. *Kerseymere*, or *cassimere*, is a twilled cloth that has a greater degree of pliability than plain cloth, and used for garments that are required to be thin and very pliable. From its peculiar texture, one third of the warp is always above, and two thirds below each shoot of weft. It is either single milled or double milled, the last being the stoutest. It is usually woven of the width of thirty-four or thirty-six inches, and reduced by milling to twenty-seven inches. Kerseymeres, and other lighter kinds of cloth, are to be judged of also by the feel; and, as their texture is sometimes not wholly concealed, their quality may be more easily ascertained by inspection. From their twilled structure, they are rendered more durable than plain cloth would be of equal lightness. *Cassimerette* is a variety of the above.

5544. *Pelisse cloths* are twilled and made soft, about seven quarters wide.

5545. *Frize*, or napped coating, is a kind of woollen cloth, or baize, of which one side is covered with little tufts or burrs, called the *frizing*, which is performed by a machine.

5546. *Bearskin* and *dreadnaught* are thick cloths of a long pile, and dyed, intended for very strong, warm dress.

5547. *Bath coating* and *duffel* are light cloths, with a long nap like a double-raised baize, used as winter's dress, for great coats, &c. It is of various colours; also white for women's petticoats. Widths, $\frac{4}{4}$, $\frac{7}{4}$, $\frac{8}{4}$.

5548. *Tweed* is a woollen fabric, of a light structure, lately much employed for summer coating, and for surtouts.

5549. *Swanskin* is a very thick, closely-woven fabric, much used for clothes by seafaring men and labourers; it is employed also as ironing-cloths by laundresses for their tables.

5550. *Hodden gray* is a cloth peculiar to Scotland, manufactured from the natural fleece; throughout the farming districts, the housewives contrive to have one black lamb retained among the flock, as the wool takes on the dye more kindly, and is, indeed often spun into thread for the stockings of the family, without receiving any additional tinge.

5551. *Plush* is a kind of stuff having a sort of velvet nap on one side, composed regularly of a woof of a single woollen thread and a double warp; the one of wool, of two threads twisted, and the other goat's or camel's hair. Some plushes, in imitation of these, are made of other materials. Plush is much used for liveries.

5552. *Flannel* is a woollen stuff, loosely woven, much used as warm clothing. Its warmth is increased by the laxity of its structure; for, as the fibres of the wool touch each other slightly, leaving numerous interstices which are filled with air, heat cannot readily pass through it, as has been shown by Count Rumford. (See "Remarks on Clothing in general.") *Welsh flannel* has the reputation of being the best; but much of what is sold for Welsh flannel is made in various parts of England; a great deal of flannel is made in *Lancashire*. *Patent flannel* is a very fine kind, said not to shrink in washing, an inconvenience which common flannel is liable to. *Gauze flannel* is a flannel of a very loose, porous texture, not so warm as ordinary flannel, and therefore useful for some persons. *Domett* is a kind of flannel, the warp of which is made of cotton and the woof of wool. It is very thin, and useful for some purposes, as linings, and for shrouds for coffins, &c.

5553. *Baize* is a coarse, open, woollen stuff or flannel, having a long nap; sometimes frized on one side, and sometimes not, according to the uses for which it is intended. It was first introduced into England, together with sargs, serges, &c., by the Flemings. It is used for a variety of purposes, for linings, &c.; a good deal is exported. It is generally dyed green and other colours, and is of various width, from a yard to two yards.

5554. *Blankets* are made light, and loosely woven, on which their warmth partly depends. Witney, in Oxfordshire, has been long famous for this manufacture, and the best blankets were formerly, and we believe are still, made at that place. Some blankets are made of felt wool that is wool from sheep-skins, which is divided into several sorts. Of the head wool and bay wool they make blankets of twelve, eleven, and ten quarters broad; of the ordinary and middle sort, blankets of eight and seven quarters broad; of the best tail wool, blankets of six quarters broad, commonly called *cuts*, serving for seamen's hammocks. But the long staple of foreign wool is now much used for the best blankets, and therefore admits of a deeper pile being raised on the surface. As blankets are bulky articles, and go through the same processes as cloth, the machinery is larger, and more easily seen than those used in cloth-making. There is an extensive manufactory at Dewsbury, in Yorkshire, where coals are cheap, driven by steam engines. Nearly 3,000 pair of blankets are made there weekly. Blankets are made of all sizes, up to fourteen quarters wide and fifteen quarters long. Those made for exportation contain two thirds of the low-priced wools of Russia, Germany, Italy, and the Levant: if made all of British wool, they would be too expensive for this purpose.

In the manufacture of blankets, after being woven, they are slightly fulled till they are reduced a sixth. The pile, which is very important, is raised by passing each side of the blanket twice or thrice over rollers covered with brass pins; after this, they are carded, or brushed; but it is to be observed that though by the improved machinery the pile is raised very completely, and the warmth of the blankets is undoubtedly increased by it, yet this does not improve their durability, but the contrary. To be durable, blankets must have a certain weight, a closeness of fabric, and a sufficient quantity of wool in them. It is necessary, therefore, in choosing blankets, to look not merely at the rich appearance of the pile, but also to the weight and texture. Fine blankets are made stouter and heavier than coarse ones.

Stuffs.

5555. The term *stuff* is frequently applied to any woven fabric, whether of gold, silver, silk, wool, hair, cotton, or thread; but is more particularly used to express certain kinds of thin woollen stuffs, used for women's wear, or for linings, as linseys, ratteens, &c. Stuffs properly include all the thin fabrics of long or combing wool known by the general name of *worsted*, as shalloons, lutestrings, florenteens, tammies, moreens, callimancoes, camlets, plaids, merinoes, &c. Their most important distinction is, that they have not their surface covered with a nap or pile. They are woven either plain or twilled, or spotted or figured of various patterns, but in all the varieties the thread is left bare. After the operation of weaving, each side of the piece is drawn rapidly over a convex plate of red-hot iron, to singe off the superfluous fibres of the wool; it is then rolled tight, soaked in hot water, and boiled. Afterward it is scoured, stocked or milled, and pressed between rollers to take out the moisture; it is then dyed, after being passed through a mordant. The subsequent drying is effected by rolling it round iron cylinders filled with steam; and then it is pressed by Bramah's hydraulic presses.

5556. *Moreen* is a very stout stuff made for furniture, and chiefly for window-curtains: it is plain or watered. Some moreen is of a very rich quality, almost resembling silk damask. It may be had so low as 8*d.* per yard, and from that to 3*s.* Width, 26 to 27 inches.

5557. *Lasting* has a double warp, sometimes of two and sometimes of three threads: it is made of various patterns, plain, twilled, or figured, and is distinguished by different names, according to the figures and quality: as *Prunella, Amens* (*probably* from *Amiens* in France), *Florentina*, and *draw-bays*. Width, 18 inches. Generally black: used for shoes.

5558. *Denmark satins* are also used for shoes. Width, 27 inches.

5559. *Ratteen* is a thick woollen stuff, quilled, woven on a loom with four treadles, like serges and some other stuffs. There are some ratteens dressed and prepared like cloths; others left simply in the hair; and others where the hair or nap is frized. Mostly used in linings.

5560. *Merino* is an extremely fine twilled stuff made of the finest wool, used for dresses and shawls. The French excel in the manufacture of this article; some of theirs approximate to Cashmere.

5561. *Merino damask* is a beautiful stuff lately introduced, and much used for window-curtains, covers for sofas, chairs, &c. It is in rich and elegant patterns, in imitation of silk damask.

5562. *Bombazet* is plain and twilled, with warp of single thread, pressed and finished without glazing. Width, 21 or 22 inches.

5563. *Tammies* or *durants*, with single warps, are twilled, and generally coarser than twilled bombazets. Width from 32 to 36 inches. They are highly glazed: mostly used for women's petticoats.

5564. *Callimanco* is nearly the same; plain, highly glazed, twilled, or raised in stripes: used for petticoats.

5565. *Shalloon* is a loosely-woven stuff with a twill, much used for lining various articles of dress. Width from 32 to 36 inches. The name is probably derived from Châlons, in France. It is of various colours.

5566. *Cubica* is a very fine kind of shalloon.

5567. *Serge* is a twilled stuff, of various colours, manufactured in the manner of ratteen; much used for linings of clothes, particularly cloaks. One sort has one side smooth and the other woolly. The longest wool is chosen for the warp, and the shortest for the woof; the former being more twisted than the latter.

5568. *Plaid.*—This term is often applied in England to the colour of stuffs, whereas the term means a peculiar ancient dress worn in the Highlands of Scotland, and was merely an oblong piece of stuff wrapped round the body to defend the wearer from rain. It is always made of a checkered pattern of various colours, there called *Tartan.* Tartan is the name of the colour; plaid is that of the dress. Instead, therefore, of saying "plaid ribands," we should say "Tartan ribands." The true Scotch plaid is a coarse, strong stuff, well calculated to keep out the wet, and is still used by some persons in Scotland, and particularly by our Highland regiments. The stripes and squares formerly varied in their patterns and colours according to each clan; but this distinction is now little attended to. Modern luxury has imitated the pattern of tartan in silk. *Tartan*, or as it is called, plaid, of worsted, is made in various parts of England, and is occasionally used as a cheap and useful material for cloaks.

5569. *Camlet* was originally an Oriental manufacture, a stuff made from the fine hair of the camel; but another material is also used, the hair of the Angora goat, which is of remarkable beauty, being milkwhite, glossy, formed into long spiral ringlets, and exceedingly soft. Angora is a district in Asia Minor, where almost all the inhabitants are employed in the manufacture and commerce of camlets. We have no camlets made in Europe of goat's hair alone. In Brussels, which excels in the manufacture of this article, they find it necessary to mix woollen thread with the hair. Camlets, in imitation of the genuine, are made all of coarsely-twisted worsted yarn, or of worsted and silk, or of these with hair. In some the warp is silk and worsted twisted together, and the woof hair. It is both plain and twilled. What is known here by the name of *mohair* is made of worsted and hair: it is superior to the common, and is used chiefly for military cloaks. An inferior article, made all of worsted yarn strongly twisted, is also called camlet, and is used for ordinary cloaks. Camlet was formerly much in wear; and, from its thickness and warmth, is well calculated for winter clothing for females. It turns the wet better than any other unprepared stuff.

5570. *Mousseline de Laine.*—This is a new species of woollen fabric, of an extremely light texture, first introduced into this country about three or four years ago. It was at first wholly imported from France on payment of a heavy duty, and was sold at a price only within the reach of the wealthier classes; it is now manufactured in this country at a much cheaper rate. It possesses an advantage, that, with great elegance of appearance, it does not ignite on coming into contact with flame, like muslins or chintses. A mixed fabric is likewise made in imitation of it, composed of cotton and wool.

5571. *Challis*, an elegant, twilled, fine, woollen fabric, used for ladies' dresses, ornamented with coloured flowers, which have much the effect of velvet painting.

5572. *Carpets and druggets* have been described under "Furniture," Book V., Chap. X., Sect. III.

5573. *Shawls* are an important part of Eastern dress, and in Asia, among the Arabs, people of Egypt, and Persia, and other countries, are worn by men as well as women. The finest shawls in the world are made in Cashmere, in India: the genuine Cashmere shawl of the finest quality is very costly, and sells in London for from 100*l.* to 200*l.* The material of which they are made is a species of fine hair or wool that grows on a goat which is a native of Thibet, a region which, though situated between the tropics, is yet extremely cold, from its height above the sea. The animal has two kinds of hair; one long and coarse, and another extremely fine, soft, and silky, like down, close to the skin; of the latter the shawls are made. The down produced by a male is about four ounces, and by a female about two ounces. It is estimated that one shawl, fifty-four inches square, requires two pounds of down, and will therefore require the produce of ten goats. The real Cashmere shawls are woven by the natives of the country, and by the Hindoos, in a very simple manner, but become expensive from the slowness of the operation, each loom requiring two persons, and for superior kinds four. These shawls are usually of three sizes; two of which, the long and the small square, are in common use in India; the other, long and very narrow, with a large mixture of black in it, is worn as a girdle by the Asiatics. The manufacture of shawls in Cashmere has decreased of late, owing to the decline of the Persian and Mogul empires. During the existence of the latter, there were 40,000 shawl looms in Cashmere; at present there are not above 16,000; there are still 60,000 persons employed in weaving them. But it appears that in the romantic Cashmere itself not more than 80,000 shawls are manufactured in a year; and from the prodigious number of so-called Cashmeres sold in Europe, they must multiply themselves in an extraordinary manner on their way from that country.

Great pains have been taken to introduce the shawl-goat into France, and with considerable success. M. Joubert found them spread from Cashmere to the Ural Mountains, and he purchased them in Bucharia and Independent Tartary, from which he transported them to the Crimea in 1819, and thence by sea to Marseilles. Though many died on the voyage, four hundred arrived in France safe. It is proper to state that it was M. Ternaux who planned the importation, and furnished the funds for executing it at his own expense and responsibility. The goats have thriven and propagated in France, and shawls have been manufactured from them equal to those of Cashmere. The wool is also brought to Europe from Cashmere by way of Casan, the capital of a Russian province on the Volga; it is spun and woven in France, either mixed with silk or without. At first they succeeded in imitating the real Cashmere shawl only on one side, but they are now able to imitate perfectly the texture of the true Oriental fabric. Women are employed in weaving the *French Cashmere*, and it requires the work of four hundred days by a woman and two apprentices to complete one. Various other shawls are likewise made of mixtures of the Cashmere wool with silk, extremely beautiful, and nearly equal to the Oriental. The best are made in Lyons, and some inferior at Nismes. The extraordinary passion of the French ladies for these shawls is well known. Four Cashmere goats were introduced into Essex by Mr. Towers, of Weald Hall, in 1828, and had increased in 1833 to fifty; they thrive very well, feeding like sheep, but chiefly on furze, and their wool has been manufactured in England; but it is not probable, from the small quantity produced by each goat, that the manufacture will be profitable in this country. Cashmere wool is also brought here by our East India shipping, and sent to France to be spun into yarn for the weaver; some also has been spun here by machinery. Lately, a breed has been produced in France between the Angora goat and the Cashmere, which promises great success, producing a considerable quantity of wool, long, fine, and glossy, combining the softness of Cashmere with the lustre of silk, being the most beautiful filaceous material known, and in every respect fitted for the purposes of shawl weaving. Some of these goats yield thirty ounces of fine wool in one season. A few of these have lately been brought to England.

5574. *Excellent imitations of Cashmere shawls* are now manufactured in this country of the finest Saxon wool, particularly by Messrs. Frost, Nelson, and Co., at Leeds; the fringed borders are made in London and in Scotland, and are sewed on.

5575. *Shawls of a cheaper kind*, of great variety, are likewise made in various parts of Britain, particularly at Huddersfield, Norwich, Paisley, &c.; in the latter place they are manufactured of very elegant patterns. From their convenience, they are now worn by all classes, and the cheapest kinds are too well known to require description.

5576. *The manufacture of worsted stuffs was first introduced into England* in the reign of Henry I., by some Dutchmen who had been driven from Holland by an inundation of the sea. They settled at Worsted, in Norfolk, whence the name; and a charter was granted for the manufacture of worsted stuffs, in consequence of which that city became one of the most flourishing in the kingdom, and there these stuffs were long made in the greatest perfection.

At Leeds are sold a large quantity of worsted stuffs at prices thirty per cent. cheaper than they were twelve or fourteen years ago, owing to the use of machinery and the low price of British wool. The worsted is chiefly spun and woven at and near Bradford, and in Lancashire; the finishing and dyeing are performed at Leeds. It is said that in the West Riding of Yorkshire 40,000 pieces of stuff are made per week. Perhaps the most considerable stuff manufactory in the kingdom is at Burley Mill, two miles west of Leeds: in this there are four hundred power-looms, which weave six thousand yards a day; and it is reckoned that twenty times as much more is made by hand-looms in the adjacent country.

For carpets, see "Furniture," Book V., Chap. X., Sect. III.

5577. *Fleecy hosiery* forms a very useful kind of manufacture: it consists in interweaving fine fleeces of wool into pieces of the common stocking texture. It is not confined to stockings; but webs of it are woven, which can be cut up and made into under waistcoats, socks, or other articles. Its warmth exceeds any other woollen fabric, and hence it is a valuable material for valetudinarians, or for common use in a very cold climate.

CHAPTER III.

LINEN FABRICS FOR CLOTHING AND FURNITURE.

SECT. I.—HISTORICAL AND GENERAL REMARKS.

5578. *The use of linen is extremely ancient: it was the national manufacture of the Egyptians in the time of the Pharaohs;* and the prolific borders of the Nile furnished, from the remotest periods, as at the present time, abundance of the finest flax, the plant from which linen is prepared. The Egyptians exported their "linen yarn" and "fine linen" to the kingdom of Israel in the days of Solomon, and their "fine linen with broidered work" to Tyre, as also the same kind of cloth to Greece in the days of Herodotus. It appears from sacred and profane history, that linen continued to form the most esteemed clothing in Egypt till after the Christian era.

5579. *Specimens of Egyptian linen*, at least three thousand years old, are preserved in abundance in the numerous swaddling-bands in which the mummies are wrapped up, and these show that the arts of spinning and weaving had advanced to great perfection; for not only is the linen very similar in every respect to what is made at present, but some of it is of extreme fineness, resembling fine muslin or cambric, though evidently made of flax. It is also met with striped and dyed blue and yellow. The quantity of mummy-cloth found in the mummy pits and sepulchres of Egypt is so great that it has even become an object of speculation in Egypt to employ it for making paper.

5580. *From the Egyptians, the neighbouring nations, the Jews, Greeks, and Romans*, learned the manufacture of this material, which was held in such high esteem that it was used as raiment for royalty; but linen was among them extravagantly dear, being either imported or made by slaves, few of whom were sufficiently skilful.

5581. In modern times, the manufacture of linen arrived at the greatest perfection in Flanders; and it was not in common use in England till 1253, when it was introduced by the Flemings, woollen shirts having been worn before that time. In 1368, a company was formed in London for manufacturing it, and Lord Wentworth introduced it into Ireland in 1634. The inhabitants of the Netherlands, however, long excelled us in its fabrication, and the finest linens, called *Holland*, were imported. At present very little comes from abroad, the production of the Irish and Scotch looms being more than sufficient for home consumption. The linen trade of Great Britain has been more than doubled within the last forty-five years, owing greatly to improvements in flax-spinning. The manufacture here may now be valued at eight millions sterling annually, employing 180,000 hands, young and old. The value of the export of linen and yarn may amount to a million and a half sterling.

Sect. II.—Description of the Flax Plant, and Preparation of Flax

5582. *Flax* (in Latin *linum*, whence the word *linen*) *is a plant* of which there are several varieties; but the common flax plant (*Linum usitatissimum*, *fig.* 783) is an annual, having a slender, smooth, hollow stalk, rising to the height of about two feet; the stem then divides into several branches, which are terminated by handsome, blue, glossy, veined flowers, to which succeed roundish pods or seed-vessels, about the size of a pea; each of these contain ten little seeds full of meal and oily matter. The leaves are long, narrow, and sharp pointed. Flax is cultivated more or less in most countries of Europe, and succeeds best in a rich, deep, loamy soil, with a good deal of moisture; but good crops are also produced upon stiff land. Flemish flax is the best; but vast quantities are also imported from the Baltic. Owing to the cheapness of foreign flax, little is grown in England.

Fig. 783.

5583. *The filaments of flax employed for making thread* are composed of the bark, or fibrous covering of the stalk. The plant is suffered to grow till its seeds are ripe, and is then plucked up by hand and laid in little bundles to dry.

5584. *The first process in preparing flax* is termed *rippling*, and consists in forcing off the seed-vessels; this is done either by beating them off or by pulling the plants through a kind of comb with iron teeth, set so close that the heads cannot pass, and are consequently pulled off. To obtain the seeds, the pods, or capsules, are broken by treading or threshing, and the whole is winnowed to drive off the chaffy matter. The seeds afford oil by pressure, and the refuse oil-cakes serve to feed cattle, and for manure.

5585. *The next operation is to obtain the flaxen fibre clean and free from all other material.* We stated that this fibre is the bark of the plant, and some process must be employed that shall destroy the parenchymatous matter, or the internal part of the stem, and leave the fibre uninjured. This is effected by several methods. 1. The flax, tied lightly in bundles, is put into a reservoir of soft stagnant water to steep; by this a slight fermentation takes place in the inner substance, and in a few days it begins to rot; as soon as this occurs, the flax is withdrawn from the water before the decomposition has had time to extend to the fibres themselves. This process is the most disagreeable thing belonging to the management of flax, since the smell arising from the rotting, or *retting*, as it is called, of the gummy or mucilaginous matter which holds the fibres together is extremely offensive and prejudicial to health, and the infected water is apt to kill the fish which swim in it. Endemic fevers are common in districts where much flax is steeped. Great skill and precaution are necessary in this part of the operation; if the flax be left too long in the water, the filaments will become rotten and useless, and if not long enough, they will not separate with sufficient ease; it is better to take it out rather at an earlier period than to leave it too long in the pits. The time it should remain will depend upon the degree of ripening of the flax, and the temperature of the water. The mode in which the skeletons of leaves are prepared will illustrate this process. If leaves of trees be suffered to lie for some weeks in water, the pulpy matter will decay, so as to be removed by the slightest rubbing, while all the veins of the leaves remain uninjured; these veins are similar in point of strength to the bark of the flax, and both remain equally entire after the soft matter has rotted. It is the acetous fermentation that takes place in retting, and the flax is to be taken out as soon as this fermentation is finished, and before the putrid begins. 2. The flax is sometimes laid in running instead of stagnant water; in this case the decomposition does not go on so rapidly, and it will be several weeks before it is sufficient, but the fibres will be very strong. 3. Instead of laying the flax in water, it is merely spread upon the grass, and the joint action of rain and dew effect the same thing in about six weeks that took place in the steeping process. This method is practised in Devonshire, and in various places on the Continent, and is favourable to preserving the strength of the fibre, though steeping is the most general process. After steeping, the flax is spread out upon the grass, for the purpose of rectifying any defect in the watering, and for carrying on the decomposition to that point when the fibre will separate from the *core*, or *boon*, as it is called, with the greatest ease, which is known by rubbing some between the hands.

5586. After the retting, the *harl* still contains, besides the textile filaments, a certain portion of the glutinous cement which is not soluble in water; and the destruction of this by putrefaction alone cannot be carried to the last without injury to the flax; it is, therefore, effected by exposure to the weather. Dew-retting is the safest, and does not produce the same noxious air; the length of time required is the only objection. Mixed retting is sometimes preferred, where it is begun in water and is finished by the dew.

5587. *The smallest filaments of flax* readily separate from each other when delicately washed with hot water or an alkaline lye, or when a thread of cloth is dissected with a needle point. They have an average diameter of $\frac{1}{2500}$ of an inch. Different specimens of flax separate into these minute fibrils with different degrees of facility, and thereby create different grades of value for the fine spinner. Good flax should be long, fine, glistening, and soft like silk, of a silver gray, neither greenish nor blackish.

5588. The flaxen fibre, having been thus rendered easily separable by the retting, is next to be *dressed*, a term which includes the various processes for bringing it into a state proper for the fabrication of cloth and other articles.

In flax-dressing the first process is the *scutching*, or separating the fibre itself from the core. This was formerly effected by an instrument termed a *brake*, which has blunt teeth or knives that are forced down upon the flax. This was formerly worked by hand, but the operation was afterward more expeditiously executed by machinery turned by water or other power; rollers are now frequently used in Britain instead of the brake. But the whole of the woody matter is not detached by the brake or the hammer, and rubbing is also employed; this is done by laying some flax upon the knee and scraping it with a blunt knife. There are some slight modifications in the dressing, according to the kind of cloth to be made from the flax, whether linen, lawn, cambric, &c.

5589. *Hackling* is the next operation in flax-dressing. The hackle is a strong comb composed of several rows of iron or steel teeth several inches long, fixed upright in a block of wood as a base, made fast to a bench, and the workman strikes a lock of flax across the pointed summits of these, and draws it through. Coarser and wider-toothed hackles are used first, and then others progressively closer-toothed as the fibres become finer by separation. In manufactories the hackling is now performed by machinery. By this process the filaments are separated from each other; the shorter fibres unfit for spinning are taken out, and the longer ones are arranged in a parallel manner. To assist the hackling in splitting and separating the filaments several methods have been resorted to. In some places, flax is beat with a wooden mallet, having a fluted face, upon a block, after and between the hackling. Brushing with a very stiff brush made of swine's bristles is another method.

The coarse entangled fibres which are separated by the hackle are called *tow*, and the hackled flax is termed *line*. The line is now carried away to be sorted, according to the various qualities in respect of fineness; it is then ready to be spun.

5590. Since subjecting flax to the process of retting is not only tedious, but liable to injure its strength, attempts have been made to hackle and dress it without retting, by means of machines; but it has been found that the flax thus prepared was not equal in quality to that which has been retted by the old processes.

Sect. III.—Manufacture of linen fabrics.

5591. *The spinning of flax by the domestic or flax wheel* was described in page 932; but this process is now effected in factories nearly in the same manner as cotton by more complicated machinery, which produce yarn with much greater rapidity. But the spinning of flax by machinery has been found more difficult than that of cotton or wool, and therefore it is but lately that manufacturers have succeeded in it. It was in Leeds that this was first effected, in a degree little short of the spinning of cotton. The flax is then first formed into a *roving*, and that again made into *yarn*. But in spinning this material it is necessary to pass it through water, which occasions a dewy spray to be thrown, extremely inconvenient to the spinners, as it wets their clothes. Hot water is now used instead of cold, which in some degree obviates this inconvenience, and produces a smoother thread. The thread, or yarn, is of various degrees of fineness, some of which is twisted hard to serve for warp, and the rest has a softer twist given to it, that it may have the yielding consistence of weft. A pound of flax is divided into so many hanks; and the number of hanks is the commercial name or number of the thread. Low numbers are used for sail-cloth, sacking, &c.; from 20 to 40 for sheeting, drills, table-cloths, &c.; Irish linens from 60 to 100 and upward; cambrics require from 120 to 200.

5592. *The process of weaving linen cloth* by hand-looms is the same as has been described under the article "Weaving," which see; but of late the power-looms have been adopted for weaving all but the finest and most costly fabrics. Figured or fancy cloths, as damask, diaper, &c., are wrought by a particular modification in the draught of the loom and cording of the harness, the effect of which is to produce alternations in the twill or flushing of the warp and woof at certain intervals, according to the pattern prescribed The plain cloth most in demand for personal use is principally manufactured in Ireland.

5593. After the making of linen cloth has been completed by the weaver, it has to go through the important process of bleaching, to render the cloth perfectly white; but as the proper bleaching of linen now seldom becomes an affair of domestic economy, and as its principles are very important to throw light on the operations of the laundry, we have considered that the most useful arrangement would be to connect it with them; and therefore we refer the reader to the subsection "Bleaching," in Book XXII., "Laundry."

SECT. IV.—DESCRIPTION OF FABRICS MADE OF FLAX AND HEMP.

5594. *Linen.*—The cloth so named, from the Latin *linum* (flax), is the principal fabric manufactured from flax, and is used mostly for shirting and sheeting. The fineness of linen is determined by the relative length of yarn in a given weight, and also by the number of threads of warp contained in a certain space of the reed in weaving, to which the threads of weft in a similar space must bear a fixed and regular proportion. In judging of linen of whatever fineness and price, particular attention should be paid to the evenness of the threads, and also to the firmness and closeness of the texture. The colour should be perfectly white, and the surface glossy; but this gloss should be principally, if not wholly, the effect of the calender employed in finishing the cloth. Many inferior fabrics are rendered marketable by a large proportion of starch, from which they receive not only a fine gloss, but also a factitious hardness, or *body*, as it is termed, qualities which disappear after the first washing; and the cloth, having lost in this ordeal all its vellum-like consistency, becomes, to use a familiar expression, "as poor as a rag." Hardness and smoothness, therefore, can never be safely depended upon as a criterion; the eye must be rather closely applied to discern whether these qualities actually proceed from the strength and fineness of the fabric. The threads must not only be even, but must have a certain wire-like roundness; a magnifying glass is very useful to examine the texture of linen by; but the purchaser should be in the habit of using it, otherwise he will be misled. Some linen is sold free, or nearly so, from this *dressing*, and such is to be preferred. The kinds of linen for shirting manufactured here are *Irish*, *Scotch*, and *English*, of which the first is reckoned the best.

5595. *Holland*, a fine kind of linen imported from the Low Countries before our manufactures had arrived at such perfection, was in great request for wearing apparel; at present very little foreign linen is imported.

5596. *Dowlas* is a very strong, coarse Irish linen cloth, made for shirts.

5597. *Drill* is a very stout twilled linen, made for summer trousers.

5598. *The linens usually selected for sheeting* are, Irish, union Irish, which has a mixture of cotton, Lancashire linen, and union Lancashire, Russia, imitation Russia, Yorkshire, Barnsley, and Scotch sheeting. The widths of these are from $\frac{7}{8}$ to $\frac{14}{4}$. The principal requisites in sheeting are strength of thread and closeness of texture. The strongest coarse sheeting is that of Russia, which may be had of various widths, from an ell to two yards and a half.

5599. *Unbleached linens* are used for various purposes. *Brown Holland* is much used for upholstery, Widths, $\frac{3}{4}$, $\frac{4}{4}$, and $\frac{5}{4}$. It is glazed, and of various degrees of fineness; and there is also a *rough brown Holland*, not glazed. *Silesia* is a fine brown Holland, glazed, for roller window-blinds, of various widths, from 28 to 90 inches. *Hessia* and *Forfar* are very coarse linens, used for various purposes, as straining on sofas, &c.

5600. *Brown damask* is a coarse damask, unbleached, used for table-cloths for the nursery, &c. It is reckoned stronger and more durable than what has been bleached.

5601. *Linen Damask.*—This name is given to a twilled linen fabric of a similar structure to the silk fabric of that name. It is very generally used for table-cloths and napkins. In respect to fineness of fabric and beauty of designs, the French damask long bore the pre-eminence, but it is now surpassed by that of Silesia, some of which are eight yards long and two wide. Considerable quantities of damask are made in Scotland, particularly at Dumfermline, in Fifeshire, and likewise at Lisburn and Ardoyne, near Belfast; some superb examples have been executed at these places. Dutch and Italian damasks are also imported. The designs for this fabric are first drawn upon paper, and any patterns can be executed, such as family arms, &c., with the admirable machinery now in use; although, when the patterns are complicated, the article becomes very expensive.

5602. *Diapers* are allied to damasks, but of simpler and smaller patterns; they are made for inferior table-cloths, and for napkins, towels, and various domestic purposes. Those distinguished by the name of *union* are composed of linen and cotton; and there are also cotton diapers.

5603. *Dorrock* is a coarse linen fabric used for common household wear, nearly resembling diaper, and ornamented with squares. It derives its name from the town of Dorrock, in Scotland, where it was first manufactured for table-cloths.

5604. *Huckaback* is something similar, but has no beauty to recommend it; it is, however, a most durable and economical linen, and much used for towels.

5605. *Tick* is a well-known cloth used for bed, bolster, and pillow-cases.

Besides the above, there are an infinity of smaller articles made of linen, too well known to require being described in detail; as *girths* and *tapes* of various kinds, viz., Manchester, Holland, black tape, pink or red tape, stay-tape, &c.

5606. *Cambric* is an intensely fine and beautiful cloth of flax, first made, it is said, by Baptista at Cambray, in the Netherlands, from which it is named *Batiste* on the Continent.

5607. *French cambric*, when genuine and of the best kind, is still superior to our manufacture. It possesses a peculiarly beautiful silky appearance, and is imported in boxes of twenty-five pieces, each containing 7½ yards, of ⅝ or ⅞ widths, but are liable to a heavy duty. Much more was formerly used when frills and ruffles were in fashion for shirts. *French cambric handkerchiefs* are of three widths, ⅝, ¾, and ⅞. The finest are sometimes fringed.

5608. *Irish and Lancashire cambrics* sometimes come nearly up to the French in quality; but little of this is made.

5609. What is called *Scotch cambric* is, in fact, a cloth made of cotton, in imitation of French cambric, which we stated s of flax. It is much inferior in retaining its whiteness. Some of the best Scotch cambric handkerchiefs are made of flax intermixed with cotton.

5610. *Lawn* is also originally of French manufacture; it is thinner and more transparent than linen, and comes near to cambric. The thread for it is made so as to be as cylindrical as possible, and it is not pressed so much as calicoes. The Irish is next to the French: there is also Scotch lawn.

5611. *Fine canvass* is the coarsest fabric made from flax; common canvass, of various degrees of coarseness, and used in furniture, for papering, &c., being made from hemp.

5612. *Hemp* (*Cannabis sativa*, Linn.) is a plant, the fibres of which are coarser and stronger than those of flax. Hemp was originally a native of Persia, but has been naturalized in Europe. It grows about three feet high, the stem branching with alternate leaves on long foot stalks, and flowers in clusters, male and female distinct. The coarsest canvass is used for sail-cloth, for tents, and similar purposes; and the preparation of yarn from hemp is so similar to that from flax as not to require a particular description. Some hemp is grown in Britain, but by far the largest quantity is imported from Russia and Poland. Other articles are likewise made from hemp, as a kind of huckaback, and some sorts of cloths for husbandmen and labourers; likewise, cords and ropes of various kinds. *Buckram* is a sort of coarse hempen cloth, woven very open, and stiffened with gum: it is used for stiffening various parts of dress.

CHAPTER IV.

COTTON FABRICS FOR DRESS AND FURNITURE.

SECT. I.—GENERAL AND HISTORICAL REMARKS.

5613. Cotton, from its great abundance and comparative cheapness, as well as from the facility with which it may be wrought up by machinery, has, to a considerable extent, superseded wool, silk, and linen as a material for many articles of dress, both useful and ornamental. The more common fabrics made of this substance have, in general, obtained the preference over the light worsted and linen stuffs that were formerly used for linings. Cotton cloth is found eligible both for shirtings and sheetings; fustians have been found a more durable kind of raiment than the common woollens for labourers; while muslins, having been very extensively adopted as an article of dress for ladies, have greatly diminished the consumption of those silk and linen fabrics to which the choice of female dress was formerly limited. It may be added that the more common manufactures of cotton, after being dyed and printed, have supplied the middle ranks with a cheaper and more elegant material, both for dresses and furniture, than were in general use in former times.

5614. The cotton manufacture in this country likewise exhibits a striking example of the advantages to be derived from the exercise of the inventive faculty. Within the memory of persons now living, it has sprung up from insignificance, and has attained, in the space of forty years, to be one of the most flourishing and important branches of our national industry; in this respect surpassing the manufactures of wool and linen, which have existed among us for centuries. But the utility of cotton fabrics is too generally understood to require any detailed eulogium; and the varieties of them will be best understood after we have described the general processes by which they are produced.

5615. *The history of the manufacture of cotton cloth* will properly precede our account of the improvements which have caused it to come so extensively into use, and will enable us to throw light upon many circumstances respecting the varieties of the fabric that would otherwise be, in some degree, obscure. The earliest accounts given by historians and travellers of the intertropical countries of Asia describe the inhabitants to have been acquainted with the fabrication of cotton cloth; but the commencement of its use is unknown. Herodotus, who wrote 440 years before our era, distinctly notices cotton fabrics as the common clothing in India; and he observed that the material was the produce of a plant. Cotton is again mentioned by Arrian, who lived in the second century, in his account of the voyage of Nearchus down the Persian Gulf; and likewise by Strabo, who speaks of flowered cottons and chintses. Pliny describes the cotton plant very accurately, stating it grew in Upper Egypt; yet the manufacture of it does not appear to have been practised by the early Egyptians, since no cloth of this kind is found among the numerous swaddling-bands wrapped round their mummies. It is, indeed, a remarkable fact, that the cotton manufacture remained insulated in India for many centuries, even after a considerable intercourse with the East had been established by Europeans, and notwithstanding the vicinity of Syria and Egypt to that region. The Arabian traders brought Indian cottons of various kinds, as calicoes, muslins, plain and flowered, to Aduli, a port in the Red Sea, and thence they found their way into Europe; but they were probably extremely rare for several centuries, as well as the silks of China. At length, cottons and muslins came into general use among the Arabians and the neighbouring nations, and the manufacture itself was spread, through their commercial activity and enterprise, throughout the extensive territories subdued by their arms.

We learn from the travels of William de Rubriquis, in 1252, that cottons were then articles of trade and dress in the Crimea and Southern Russia; and Marco Polo, the Venetian traveller, observed cotton cloth to be woven in the province of Fokein, in China; but it was not until after the conquest of that country by the Tartars, in 1368, that cotton became the general dress of the lower classes, as silk was, and continues to be, that of the wealthy. The Chinese at present, however, do not grow cotton sufficient for their own consumption, but import a great deal from Surat, Bombay, and other parts of India, and, of late, from this country.

The cotton plant grows wild also on the borders of the African rivers Senegal, Gambia, Niger, &c., and on the coast of Guinea; and the barbarous or semi-barbarous nations there are clothed in their own cotton manufactures, often dyed and figured, and sometimes interwoven with silk. In 1590, cotton cloth of native manufacture was brought to London from Benin, on the coast of Guinea; and many centuries before that it had been made in Morocco and Fez.

It is deserving of notice that, before the discovery of America by the Spaniards, cotton formed the principal article of clothing among the Mexicans, who had neither wool nor silk; and though they possessed flax, yet they did not employ it in clothing. An ancient Mexican dress of cotton is preserved in the British Museum.

5616. The introduction of this manufacture into Europe was originally effected by the Arabs or Moors of Spain, who brought the cotton plant to that country, as well as the sugar-cane, rice, the mulberry, and silk-worm, in the ninth century. Fustians were first made at Barcelona, the name being derived from the Spanish "fuste," substance; and stout sail-cloth was also manufactured of cotton at the same place. But the arts of Spain did not spread throughout Christian Europe, and finally were lost by the expulsion of the Moors. It is remarkable that the Europeans alone continued destitute of this admirable produce of industry for many thousand years after it had been possessed by nations whom they looked down upon as inferiors.

5617. Cottons and muslins were brought from India by the Portuguese, after their discovery of the Cape of Good Hope; and the Dutch and Flemings, who rivalled them in this branch of commerce, began to fabricate cotton cloth at home.

5618. *The first notice we find of the importation of cotton into England* is that from the Levant; and it appears to have been employed chiefly in making candle-wicks; if at all woven, cloth was made only in very small quantity. The Protestants, driven by persecution from the Low Countries, brought the cotton manufacture to Bolton and Manchester in the reign of Queen Elizabeth, who saw the policy of protecting and patronizing so valuable an art. But it is not to be supposed that the cottons at first manufactured in England resembled in any degree the delicate fabrics of India. Those which were made at first in Manchester appear to have been chiefly fustians, in which only the weft was of cotton, the warp being of linen yarn, chiefly from Germany and Ireland. Owing to the rudeness of the spinning apparatus at that time, cotton yarn, sufficiently strong and regular, could not be produced for the warp (which is always the principal portion of the web), and, consequently, such fabrics, consisting of linen warp and cotton weft, could scarcely be denominated cottons. In the mean time, importations from India, by the Dutch and East India Companies, of calicoes, muslins, chintses, and other fine fabrics increased; and articles from that country became so fashionable that the dress of the ladies and the furniture of the houses were almost supplied by the Indian trade, to the great discouragement and prejudice of our home manufactures, particularly the woollen. This occasioned a loud outcry in 1700, and produced an interference of the Legislature. Silks and printed calicoes for domestic use, either as apparel or furniture, were prohibited, or loaded with heavy duties. As the cotton manufacture slowly increased, it was found difficult to procure linen yarn for the warp without inconveniencing the linen weavers; nor could the cotton weft be produced in sufficient quantity by the wheel then in use. The demand by the merchants set invention to work, and the discovery of machines by which, instead of the one-thread wheel, at that time the only one, twenty, fifty, or even a thousand threads could be spun at once by a single pair of hands, produced a new era in the manufacture of cottons.

But before we proceed with the history of this interesting event, and the various improvements by which the cotton manufacture has arrived at its present perfection, it is necessary that we describe the nature of the raw material, and the process by which the downy substance produced by the cotton plant is converted into such a variety of beautiful fabrics.

Sect. II.—NATURAL HISTORY OF THE COTTON PLANT.

5619. *The fleecy substance called cotton wool grows upon a plant of which there are several species,* which, however, may be generally included in three classes: 1. An annual or herbaceous plant, usually two or three feet in height, or about the size of a gooseberry bush; 2. A shrub, six or seven feet high; 3. Tree-cotton, rising to the height of twenty feet. This last is found only in tropical countries. The Linnæan name of this genus of plants is *Gossypium*, and it belongs to the natural order of Malvaceæ or Mallows. The leaves of the herbaceous varieties, which are the most common, much resemble those of the vine, but are smaller. The blossoms expand into a pale yellow flower (*fig.* 784), which changes to red, and then to brown. When the cotton plant has arrived at maturity, and the flower falls off, a capsular pod appears, approaching the triangular shape, with a pointed end, and supported by three triangular leaves. It increases to the size of a large filbert, and becomes brown as it ripens. The expansion of the wool causes the pod to burst in two or three gaping segments, when it discloses a ball of downy cotton, of a white or pale yellow colour, consisting of three locks, which are contained in as many cells in the pod. This wool encloses and adheres firmly to the seeds, which in form resemble those of grapes, but are larger.

Fig. 784.

5620. *The natural colour of cotton is white,* or cream coloured, iron yellow, or tawny. The filaments vary in length from half an inch to one inch and three quarters, according to the variety of the plant, tapering to a fine point at the ends, and are about the two thousandth part of an inch in diameter; they are pretty uniform in the same crop. They are sufficiently long and tenacious to bear twisting into an extremely fine thread; and, of all the materials for this purpose, they are the easiest twisted. Under proper cultivation, cotton may be raised in such abundance as to form the cheapest material for clothing. When examined by the microscope, the fibres appear to be flattened cylinders, and rather two-edged or triangular, and not to be straight, but contorted; a structure which causes the fibres slightly to adhere together, and thus give warmth to cotton clothing.

5621. *The cotton plant requires great care in its cultivation,* as it is delicate and easily injured; but it does not demand a rich soil. It is produced from seeds, which are sown rather thick, and the plants are thinned as they grow up, and transplanted at proper distances. The plough is used in some countries, and a good crop produces thirteen pounds of cotton per acre. In every country cotton grows best near to the sea. In India, the best cotton is not far from the coast; when tried at Benares, four hundred miles inland, it failed. The finest cotton of America is from the seacoast. In some places the plant is an annual; in others it is perennial; the difference of longevity being partly owing to climate and partly to husbandry. Some shrubs will thrive for eight or ten years, and some of the finest cotton of India grows on trees which rise to the height of fifteen or twenty feet.

Sect. III.—PREPARATION OF COTTON WOOL FOR THE MANUFACTURER.

5622. *The operation of gathering the ripe cotton demands great care;* as all the pods do not get ripe at once, the people must go through the plantation, and select such only as have been opened a few days. Fine weather is chosen for this purpose, because wet would cause the cotton to become mouldy, and to prevent which it is thoroughly dried in the sun.

5623. *As the downy fibre adheres to the seeds, to detach it from the latter is a work of some difficulty,* and must be performed before the cotton is packed. A man with his hands only could not clean more than a pound in a day; therefore all nations who have advanced from barbarism use some kind of machinery for the purpose. In India, a rude hand-mill, or pair of wooden fluted rollers, is employed, by which from forty to sixty-five pounds per day may be cleaned. In other countries wooden rollers of a somewhat similar construction are employed, but they are moved by machinery instead of the hand. The cotton wool is then carefully sorted and freed from any imperfect parts or particles of dirt; after which it is well dried, put into bags, and pressed into bales in a small compass, for the greater convenience of transportation. It is brought to the mills in Britain in bags weighing from 330 lbs. to 350 lbs., just as it is packed up, and is then stowed in warehouses, being arranged according to the countries from which it may have come. From the very great pressure to which it has been subjected in packing, it is found to be in hard, matted lumps; and it also still contains some seeds and dirt. It is, therefore, put into a machine called a *willow*, which, by its revolving spikes, tears open the cotton, and, by the blast of a powerful fan, or *blowing* machine, frees it from most of its seeds and other impurities. It is next taken to the *scutching* machine, by which it is more completely opened and cleaned, being beaten with metallic blades revolving on an axis; in this way all the fibres are opened, and the seeds and dirt fall down through a frame of wire-work. Before the invention of this last machine, the cotton was beaten with switches, which is still practised with the finest kinds. The cotton is now taken to the *spreading* or *lapping* machine, the effect of which is to spread it out equally into a broad, soft, fleece-like wadding, and to roll it upon a roller, so as to be in a proper state to be conveyed to the *carding* machine.

5624. *The object of the carding operation is to separate the fibres*, which, in their imported state, are entangled in small tufts and knots, and which have been but imperfectly opened by the last operations; by carding they are drawn in a parallel direction, and all residuary impurities are removed. The cards are a kind of brushes formed of little bent pieces of wire fixed in leather, which is attached to wood. At first, these cards were flat, and were worked by hand; but they are now made in the form of cylinders, which move against each other with different degrees of velocity, being turned by machinery. By the carding machine the cotton is likewise brought into the forms of a sort of ribands, called card ends or slivers, preparatory to spinning.

The Spinning of Cotton.

5625. *The spinning of cotton* is that part of the manufacture which has gone through the greatest revolutions; and these have led to an extraordinary change in the production of cotton cloth.

Previously to the year 1760, the cotton manufacture of England was nearly as simple as that of India, though the loom was better constructed, and the carding of the cotton had been imitated from the wool manufacture. The spinning of cotton was all performed in this country on the one-thread wheel (see "Spinning," Book XVII., Chap. I.), nearly in the same manner as wool, a process far too slow to supply the weavers with weft in sufficient quantity to enable them to answer the demand for cotton cloth; and the weft spun of cotton by hand in this manner was a very irregular thread, produced by women of various degrees of skill. The spinning was effected by the female part of numerous cottages dispersed through the country, while the families were employed in weaving the yarn or thread into cloth; this, when finished, was disposed of to agents sent round by the Manchester merchants. But the weaver's own family seldom could supply him with a sufficient quantity of weft; and he had with much pains to collect it from neighbouring spinsters, which occasioned a loss of time, and greater expense for yarn. This difficulty was likewise aggravated by an invention which John Kay had made in 1738, of a machine called the "fly shuttle," by which the process of weaving was expedited, enabling the weaver to make twice the quantity of cloth in a certain time; but it was only in 1760 that this invention was adopted in cotton weaving.

5626. *The first great improvement in the manufacture of cottons* was the construction of a machine called the *spinning-jenny*, by which, instead of one spindle and one thread at a time, a single person could spin eight threads at once with the same facility as one. This ingenious piece of mechanism is generally ascribed to James Hargreaves, a weaver in Lancashire, in 1767; and it was subsequently so improved that a little girl could work from eighty to one hundred and twenty spindles. The spindle in the common wool and cotton wheel was always horizontal, but the spindles in the jenny were upright, or very slightly inclined from the vertical, a position essential to its due operation. But the jenny was applicable only to the spinning of cotton for weft, being unable to give to the yarn that degree of firmness and hardness which is required in the warp: consequently, although it made up for the slowness of the common wheel, enabling the weavers to produce much more cloth, still this cloth remained, as before, composed of a linen warp and cotton weft, and no goods could yet be made all of cotton. Hargreaves contented himself, for some time after, with spinning weft, with the assistance of his family, for his own loom, receiving his warp, according to the custom of the weavers of that time, from the wholesale manufacturers. The secret of his invention at length, however, transpired; and the facility and quickness with which yarn could be produced by its means, excited such a tumult among the neighbouring spinsters, that they broke into his house in a riotous manner, and destroyed his machines. He then removed to Nottingham, took out a patent for his machine, and dispersed them through the district. It has been said that he died in poverty, but it appears from the account of Mr. Baines (to whose excellent work we are indebted for many of the facts detailed respecting the cotton manufacture) that this is an error, and that he was enabled to leave a decent provision for his family. Still no fabric could be executed entirely of cotton, and another invention was wanted to produce cotton yarn sufficiently firm for the warp of cloth.

5627. *The discovery, in 1768, from which only can be dated the proper manufacture of cotton cloth in England, was made by Arkwright, afterward Sir Richard,* a native of Lancashire, and who, though originally a barber, and uneducated, yet possessed a strong natural genius for mechanics. It has been said that he was not solely the inventor of his machines; but this statement has probably originated from the assistance he obtained from various mechanics, which almost every inventor requires in order to perfect his work. Indeed, supposing that he was not entitled to all the merit that has been claimed for him, it must be allowed that he possessed a very high inventive talent, as well as great sagacity in estimating at their true value the mechanical contrivances of others, in combining them together, and arranging a complete series of machinery. Nor did his genius confine itself to the invention of machines only; he improved every part of the process of manufacturing cotton, and, being a man of business, he, in conjunction with Messrs. Strutt and New, whom he took into partnership, introduced an order and system into factories before unknown. Mr. Strutt had made many improvements in the manufacture of stockings at Derby.

5628. *Arkwright's first invention was the water-spinning frame* (so named because worked by the power of water), a wonderful piece of machinery, which spins a vast number of threads of any degree of fineness and hardness; leaving to hands merely to feed the machine with cotton, and to join the threads when they happen to break.

5629. We observed under "Spinning" that, in the process of spinning cotton, the thread is formed by two steps; in the first, the flattened roll delivered by the card, called a "sliver," is drawn out and only slightly twisted into what is termed a "roving;" and afterward this roving is stretched to a great length, and sufficiently twisted into a fine cohesive thread. Arkwright's spinning machine consists of two pairs of rollers. The lower roller of each pair is furrowed, or fluted, longitudinally, and the upper one is covered with leather. If there was only one pair of equal rollers, it is clear that a carding of cotton passed between them would be drawn forward by the revolution of the rollers, but it would merely undergo a certain degree of flattening from their action. No sooner, however, has the carding begun to pass through the first pair of rollers than it is received by the second pair, which are made to revolve with a greater velocity than the first pair. By this contrivance the cotton is formed into a kind of riband. It is obvious that this machine by Arkwright is entirely different from the previous methods of spinning, either by the distaff or by the jenny, which was only a modification or multiplication of the common wheel. Spinning by rollers was another idea, which, though perhaps not originating with Arkwright, was first reduced to practice by him, and this was accompanied by other contrivances equally ingenious, by which the process was perfected.

5630. *One of these is the drawing frame,* which was intended, previous to spinning, to straighten and lay at their full length all the fibres of the cotton more perfectly than it had been possible to do by the carding alone, as formerly was practised.

By drawing and doubling, the irregularities of the ribands left by the cylinders are lessened. The united drawings are now passed through a trumpet-shaped funnel, and thence conducted into a tin canister, round the interior of which it coils itself, being still very slightly coherent, and thus formed into a loose spongy thread, called a "roving," a slight twist being also given to it.

Several roving machines have been invented, but the most perfect at present in use is that called the bobbin and fly frame, contrived by Mr Houldsworth. Another excellent invention is Danforth's tube-roving frame.

5631. *The roving is now to be finally twisted* sufficiently, and spun into a thread. This was effected by Arkwright's water-frame, already mentioned.

When these machines of Arkwright were completed, yarns were produced far superior in quality to any before spun in England, as well as lower in price. Weavers could now obtain an unlimited quantity of yarn at a moderate rate; and they could use warps of cotton much cheaper than the linen warps, and fabrics altogether of cotton, rivalling the calicoes of India, could be manufactured at a low price. The consequence was a great demand for them, and a prodigious increase of weavers and manufacturers. Capital was embarked, and a business of vast extent was created; and then also commenced the factory system. The excellent yarn thus produced was first employed with success, when woven into stockings, at Derby; afterward they made proper calicoes, but the Legislature at first prohibited printing these, and afterward laid on a duty; and it was not till 1774 that English cottons were permitted to be made without linen warp.

5632. *After the invention of Arkwright's machinery, Hargreaves' spinning-jennies were still used;* the former was best adapted for spinning twist, a hard and firm thread, to be employed as warp instead of linen, and the latter produced a softer thread, fittest for the weft. These two inventions did not interfere with each other; but by neither of these admirable machines could the finer kinds of yarn be made, since a thread of great tenuity had not strength sufficient to bear the water-frame.

5633. *Another invention, made in 1779, by Samuel Crompton, a weaver at Bolton, enabled manufacturers to spin yarn of the first quality, and gave rise to the fabrication of British muslins.* This machine, from its combining the principles of Arkwright's water-frame and Hargreaves' jenny, was named the *mule*, or *mule-jenny*. Like the former, it had rollers, and like the latter, spindles, to give the twist. This excellent machine has superseded the jenny, and to a considerable extent the water-frame, having subsequently been much improved, and worked by steam. Some of these machines, now at work in Manchester, turn from 1100 to 2200 spindles. Mules have even been made, called *self-acting mules*, that perform their work without the aid of a single spinner, and the only manual labour employed in them is that of children who join the broken threads. Mule-spinning is the least laborious, owing to the slowness with which the machinery moves in making fine threads. A spinner manages two of them at a time; the pair has from 500 to 2000 spindles.

5634. *Another machine for spinning is also now used, called a throstle*, and the qualities of the yarn, or thread, made by the mule and throstle are somewhat different. The mule is generally used for all numbers to thirty, throstles being now seldom used to spin so high as forty. The mule yarn is of a soft and downy nature, and is employed for the weft in coarse goods, and for both warp and weft in finer fabrics. The yarn made by the throstle is smooth and wiery, and is known by the name of *water twist*, from having been first produced by the water-frame. It is used for the warps in heavy cloths, such as fustians, cords, or for making sewing thread. This kind of thread is made with scarcely any manual labour; a large quantity is exported. By means of these various machines several sorts of thread are manufactured, adapted to different purposes; some factories make only one kind, and others several, besides weaving them by power-looms. We may observe that, besides the machines and processes we have mentioned, which are the principal ones, there are a great many others of inferior importance, the description of which would have rendered the leading ideas less easily conceived, and which we have purposely omitted.

5635. *It is usual to describe the degree of fineness of cotton yarn*, or thread, by a certain number, and the method is this: the yarn is made into hanks, each containing 840 yards of yarn, and, according to the number of such hanks which it will require to weigh a pound, so is the number of the yarn; thus, No. 40 denotes a yarn of which 40 hanks weigh a pound. No. 40 may be considered as the staple of cotton yarn.

SECT. IV.—THE WEAVING OF COTTON.

5636. For the general principle of weaving cotton cloth, whether plain, twilled, or figured, we refer to Sect. III., on "Weaving." At first, the common loom was made use of; but the spirit of improvement, which had carried spinning to so high a degree of perfection, was next directed to the weaving department.

5637. In 1785, the Rev. Dr. Edmund Cartwright first invented a loom that was worked by mechanical power instead of the hand, called a *power-loom;* and, although his was imperfect, it was the parent of others, which are improvements, and which are now in use. Horrock's loom is that which is now generally employed; it is constructed entirely of iron, and is a neat, compact, simple machine, moving with great rapidity, and occupying so little space that several hundred may be worked in a single room of a large factory. It appears that the power-loom has several advantages over the hand-loom for some fabrics, not only producing them with greater expedition and at a cheaper rate, but of better quality, the regularity of the machinery being commanded with more certainty than that of human force. But it is chiefly in making cottons and other strong fabrics that they can be used; fine muslins are yet made mostly by hand-looms. At present, there are in England and Scotland above 100,000 power-looms; and it is supposed that there is an equal number, if not greater, of cotton hand-looms.

5638. But, notwithstanding the ingenuity of these several inventions in the manufacture of cotton described above, of which the principal is undoubtedly the spinning machine of Arkwright, yet it must be admitted that we are indebted to the steam-engine for the vast extension to which the cotton manufacture has arrived, being the moving power of all its machinery.

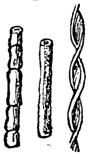
5639. *The printing of cottons* should naturally be next described; but as that depends upon the art of dyeing, and cannot be explained without reference to the latter, we shall reserve the account of calico printing until we have treated of "Dyeing" in general.

SECT. V.—QUALITIES OF GOOD COTTON WOOL.

5640. These are fineness, length of fibre, strength, softness, and equality of the filaments, and freedom from knots and impurities. The more remarkable cotton is for these qualities, and the less waste it suffers in spinning, the higher price it fetches. To judge of its quality, a specimen is pressed and drawn through the fingers, by which its fineness and length may be estimated. The cotton broker and spinner acquire by practice a remarkable delicacy of tact in this way, so that they can pronounce upon the quality, though in the dark. Soft, short filaments are best adapted for spinning into wefts; firm, long, and cylindrical ones are best for making the wiery warps, and lace thread yarn. Formerly, cottons were divided into white and yellow, but improved modes of manufacture have rendered colour of less importance than length of fibre, and the broad distinction, at present, is into "long stapled" and "short stapled."

5641. *With respect to the possibility of distinguishing between the fibres of cotton and of flax*, some very interesting observations have lately been published in the "Transactions of the Royal Society," in a paper by James Thomson, Esq., "On the Mummy Cloth of Egypt." It appears that it has been a matter of doubt whether some of the cloth wrapped round the Egyptian mummies is not of cotton, notwithstanding the general opinion that they are entirely of linen; and that we find no mention among ancient authors that the ancient Egyptians were acquainted with the use of cotton. Nor did it seem easy to determine this question, even upon the actual examination of a variety of specimens of the cloth which had been so employed; some persons pronouncing a piece to be cotton which others contended was linen. It appears, therefore, necessary to discover some test by which the one material could be distinguished from the other when woven into cloth. Simple inspection proves insufficient, nor do chemical means offer any assistance. Mr. Thomson conceived the idea of subjecting the fibres of cotton and of linen to examination by a powerful microscope; this task was performed by the accurate Mr. Bauer, with the assistance of the improved achromatic microscope of Ploessl, of Vienna. Mr. Bauer states that the fibres of flax are cylindrical, and jointed like a cane, as *a*, *fig.* 785; whereas those of cotton, although when in the green or unripe state they are cylindrical, but not jointed, as *b*, when ripe, and in the state in which the cotton is manufactured, are flattened and twisted like a corkscrew, as *c*. This corkscrew form distinguishes the fibres of cotton from those of all other vegetables, and gives an easy and accurate method of determining whether any material is cotton or flax. All the specimens of mummy cloth so examined proved to be of linen.

Fig. 785.



Sect. VI.—COTTON OF VARIOUS COUNTRIES.

5642. Although the cotton plant is the spontaneous production of all the tropical regions, yet the quality of the downy fibre varies in some degree, according to the kind of plant and the country where it grows.

5643. *The American cotton* is reckoned the best, and of this the finest is raised upon a group of low, sandy islands on the coast of Georgia, whence it is termed *sea-island cotton*. It is remarkable for its long staple, the filaments being three times the length of the Indian cotton wool. It has a silky softness, and, when well cleaned, is preferred here to every other for spinning fine yarn; indeed, it is indispensable for the finest, though it is not very white; it is also highly prized by the manufacturers of lace. What is raised upon the seacoast of Georgia is also excellent. The cotton of Berbice, Demerara, Surinam, and Cayenne is of good quality, and long stapled. The chief market for American cotton is Liverpool.

5644. *The West Indies* produce some tolerable cotton, particularly in the Bahamas.

5645. *India* produces every variety, but the ordinary cotton of India is of the herbaceous kind, and an annual: it grows principally in Bengal and the Coromandel coast, where the best cotton goods are manufactured. The cotton of India, in general, is inferior to that of North and South America, being short, though strong in fibre, and the common kind can be spun into fine yarn only by the delicate fingers of the Hindoo women; little of it is imported into England.

5646. *Egyptian cotton* is now cultivated by Mehemet Ali in considerable quantity, and is of excellent quality, but seldom well cleaned.

5647. *The Levant cottons* are, in general, little esteemed, being fit only for coarse yarns and candle-wicks. In the infancy of the cotton manufacture, England received her supply of the raw material from the Mediterranean and the Levant.

5648. *In our cotton mills* the several sorts of cotton are generally mixed together; thus the cheap and short-stapled cottons of India are carded along with some of the longer American cottons, to make them work to the best advantage; and much depends upon the skill of the cotton spinner in making one kind conceal or supply the defects of another.

Sect. VII.—THE COTTON MANUFACTURE IN INDIA.

5649. The Hindoos have not only manufactured cotton cloth from time immemorial, but they have excelled all the nations of the world in the almost incredible perfection of their fabrics; a circumstance the more remarkable, when we consider the extreme simplicity of their apparatus, and their entire want of the ingenious machines by means of which we have endeavoured to rival them. Almost all the varieties of cotton fabrics which we have are made in India in abundance, and the coarse cloths worn by the natives are produced in almost every village; but the finest fabrics of India are the muslins. For this elegant cotton fabric Europe has long been indebted to India, where, through the long lapse of ages, the manufacture has arrived at the utmost perfection. Various kinds of it, originally brought to this country from India, are distinguished by the names of the places where they are made; as jaconet, mullmuls, betelles, tarnatans, tanjeebs, bukes, terridams, doreas, &c., of which we now make imitations.

The exquisite fineness of some of the muslins which have been made in some parts of India would scarcely be credited, were not the fact well attested. Dacca is a place celebrated for its extremely fine muslins, which are not imported, and are scarcely known here. Of their exquisite delicacy, extraordinary accounts are related. Tavernier states that the turbans of some of the rich Mohammedans at the court of Delhi were of so fine muslin that thirty ells did not weigh four ounces; and it is said that some of their broad webs might be drawn through a ring of moderate size, the tissue being so exquisite that it seemed more like the work of insects than of men, and, according to the hyperbole of the East, resembled "the woven wind." A specimen of this manufacture may be seen in the museum of the East India Company. The threads, however, when examined with the microscope, though surpassing in fineness, and spun only by the distaff and spindle, have not the regularity of our machine-made thread. Sir Joseph Banks weighed a portion of the yarn of which this is formed, and found that twenty yards weighed only one grain, and a pound of it would reach 115 miles. In England, yarn has been spun so fine that a pound would extend to 167 miles in length; but such yarn could not be woven here. This extremely fine muslin of Dacca, however, was made only by a few families, and was not permitted to be exported, being intended chiefly for the great and wealthy, at the court of Delhi, under the imperial government. It is said that the art of making it is now in danger of being lost, the orders for it being so few that many of the families who possess the hereditary instruction in the mode of weaving it have desisted, on account of the difficulty they afterward experience in disposing of it. The Dacca muslins are made of a peculiarly fine, long-stapled cotton that grows on the banks of the River Magna. A hundred rupees were the price of a piece of this fine muslin, but some brought to England has cost ten or twelve guineas per yard. In India, they not only excel in the art of weaving white calicoes (calicuts) and muslins of every description, figured as well as plain, but they likewise excel in the flowered and glazed cottons called chintses.

The cotton manufacture of India is not carried on merely in a few large towns; in the cotton districts, formerly, the growth of this material was nearly as general as that of food; everywhere the women spent a portion of their time in spinning, and almost every village where cotton was cultivated contained weavers, and supplied its own inhabitants with the scanty clothing they required.

5650. *The method of fabricating cotton cloth in India is as follows:* The downy fibres being separated from the seeds by fluted rollers of wood, and opened by the stroke of a string fixed to an elastic bow, the cotton is spun by the women; the coarse yarn on a heavy one-thread wheel of teak wood, and of the rudest construction, the finer yarn with a metallic spindle and a distaff. The spinster keeps her fingers dry by the use of a chalky powder; and in this manner are yarns produced, which are finer and far more tenacious than any of the machine-spun yarns of Europe. Then follows the process of warping, which is performed by young persons running nimbly with the bobbins in their hands, and winding the thread round sticks of bamboo fixed in the ground; the warp is then dressed with rice water. The yarn having been thus warped, the weaver's business begins, and his loom is as rude an apparatus as can be imagined. It is thus described by Mills, in his "History of British India:"

The loom (*fig.* 786) consists merely of two bamboo rollers, one for the warp and the other for the web, and a pair of geer, or treadles, for parting the warp. The shuttle performs the double office of shuttle and batten for driving home the weft; and for this purpose is made like a large netting-needle, and of a length somewhat exceeding the breadth of the piece. This apparatus the weaver carries to a tree, under the shade of which he digs a hole large enough to contain his legs and the lower part of the treadles. He then stretches his warp, by fastening his bamboo rollers at a due distance from each other on the turf by wooden pins. The balances of the treadles he fastens to some convenient branch of the tree over his head; two loops underneath the geer, in which he inserts his great toes, serve to move the treadles. Finally, he sheds the warp, draws the weft through it, and afterward strikes it up close to the web. There is not so much as an expedient for rolling up the warp; it is stretched out at the full length of the web, which makes the house of the weaver insufficient to contain him. He is, therefore, generally obliged to work continually in the open air, under the shade of the tamarind or mango tree, and every return of inclement weather interrupts him.

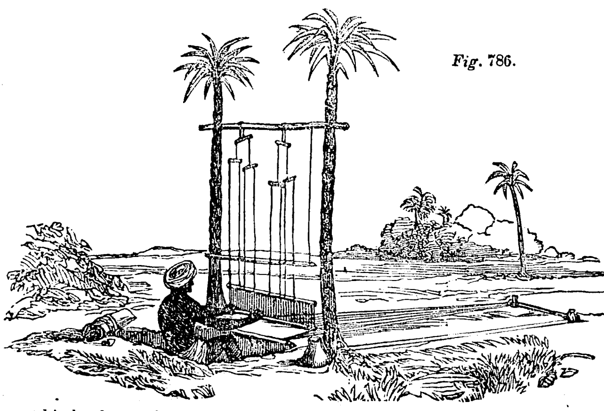


Fig. 786.

In some parts of India, however, as on the banks of the Ganges, the weavers work under the cover of sheds, fixing the geer of their looms to a bamboo in the roof. They size their warp with rice starch. When checkered muslins are wrought, three persons are employed at each loom; one pulls the thread to form the pattern, another twists it, and the third weaves. Spinning and weaving do not disgrace any one; the first is practised even by women of rank, and the weaver takes place of all other mechanics, ranking next to the scribes; yet were he to perform any drudgery of another kind, he would lose caste. A journeyman cotton weaver earns from 2 to 2½ rupees (4*s.* to 5*s.*) a month; a woman spinning coarse yarn can earn only 1⅜*d.* per day. It is truly surprising that, with machinery so rude, this people should produce such delicate fabrics, which, indeed, are scarcely rivalled by those skilled in the mechanical arts. But this is partly explained by the fine sense of touch possessed by the Hindoos, by their patience and gentleness, and by their children having been trained up from their infancy to an art which has been practised by the same family from generation to generation.

5651. *The finest muslins are produced in Bengal.* The Coromandel coast is celebrated for the best calicoes, and Surat for strong and inferior goods of every kind. Condaver furnishes the beautiful handkerchiefs of Masulipatam. The chintses and ginghams are chiefly made at Masulipatam, Madras, and Paliamcotta. The long cloths and pullicots are produced in the presidency of Madras. Besides these, there is an endless variety of fabrics, each district in India producing something peculiar.

5652. *The change that is taking place in the cotton manufactures of India* deserve a few remarks. From what we have already stated in our history of this manufacture, it is seen that no real cotton cloths were made in England previous to the invention of the spinning machines by Arkwright; before that time, all fabrics entirely of cotton, all calicoes, chintses, muslins, &c., were imported from India. Even after the discoveries of Arkwright, Indian cottons were prohibited, not so much for the protection of our cotton, but of our woollen manufacture; and afterward, to encourage calico printing, plain Indian calicoes were admitted under a duty, and were printed in England; but at that time all muslins, which were much worn by ladies, were Indian, and no attempt to imitate them was made until the invention of Crompton's spinning machine, called the mule, which spun, for the first time, cotton yarn sufficiently fine and strong for muslin. From our improvements in machinery, by which cotton thread is spun with such facility, this manufacture in India is now suffering to a great extent. Not only do we undersell Indian cottons in foreign markets, but actually a great quantity of yarn spun by British machinery is sold to the Indian weavers at one half the price which they pay to their own women, notwithstanding the extreme cheapness of their living. The consequences to the natives of India must be extremely injurious, since their hand-loom weavers cannot compete with our steam-engines.

SECT. VIII.—DESCRIPTION OF THE VARIOUS COTTON FABRICS.

5653. It is scarcely possible to convey any adequate idea of the variety of cotton cloths or fabrics that have issued from the loom and the printer, since the commencement of this manufacture to the present time. The pattern cards of Manchester goods sent out to the Continent by the most considerable manufacturers have presented specimens of upward of 1500 different kinds, varying in strength and pattern from the coarse cloths to the finest muslins, and in colour from the richest chints to plain goods, including many figured in the loom. The following descriptions include only those in general use.

5654. *Calico* derives its name from the province of Calicut, in India, where it was chiefly made, and from which it was obtained when originally imported into Europe. It was first brought hither from India in 1631, and was first manufactured in this country about 1772.

5655. *The various kinds of calicoes made in this country are common plain white calico,* usually called cotton cloth; *fents* are remnants, or pieces of this sewed together, and sold as low as 2*d.* or 2½*d.* per yard. *Duck* is a stouter kind; and *double warp* is still stouter. *Calico shirting,* or twine cloth, is a very even made calico, to imitate linen; a superior kind is called *patent twist;* the yarn is closer twisted than in common calico. *Sheeting calico* is a stout fabric, much used as a substitute for linen, and by many persons preferred, particularly in cold weather. *Printed calicoes,* or, as they are called, *prints,* originally made in imitation of those from India, are now manufactured here of an infinity of patterns, of which each year produces some new ones. Vast quantities are exported to every part of the world. See "Calico Printing," Book XVII., Chap. XII.

Calicoes are frequently so full of the dressing, a preparation of lime put in by the manufacturer, to make them of a better colour, that it is difficult to ascertain their quality; it is best, therefore, to choose calico, if possible, free from dressing, and to see that the threads are straight and evenly woven.

5656. *Chints* is a peculiar style of printed calico, in which the figures are of at least five different colours, impressed upon a white or coloured ground. They were originally from India, but are now made here of great beauty.

5657. *Muslins.*—India muslins were first introduced into this country about the year 1670, before which time cambrics and Silesia lawns were used instead, and such fine linens from Flanders and Germany as were brought back in exchange for our woollen manufactures. The manufacture of muslins was attempted at Paisley as early as 1700; but it was not till eighty years afterward that British muslins became a rival to those from India. In 1785 they were much improved, since which period their progress has been rapid beyond all example. In the year 1787, it was computed that not less than 500,000 pieces of muslin, including shawls and handkerchiefs, were annually made in Great Britain. The manufacture has, from that time to the present, continued progressively to increase, and bids fair to become the most lucrative and extensive of any in this country. Glasgow and Paisley, in Scotland, and Bolton, in Lancashire, are the chief seats of this manufacture. It is proper to observe that the Swiss had succeeded, long before us, in the manufacture of muslins at Zurich and St. Gall; yet our inventions in spinning gave us a great advantage over them; these improvements, however, they have lately adopted. Considerable muslin manufactories are established in Germany.

The muslins and other cotton goods of India, notwithstanding the simple and primi tive processes of spinning and weaving by which they are produced, still retain, in some degree, their superiority over those of British manufacture, particularly for durability and retaining their whiteness; but in our finer fabrics the imitation is so close as scarcely to be distinguished from the original; and it requires a practised eye to discriminate between an India and a British mull. Some depend upon the supposed marks of the manufacturer, or the perfume of the cedar boxes in which the India muslins are imported; but these are circumstances easily counterfeited where fraud is intended.

5658. The following are the varieties of muslin now generally known here:

Jaconet is a very general fabric of the lighter description of muslin, very open and soft, but somewhat stouter than the mullmul. The name is supposed to be a corruption of Jaghernout, the district in India where these muslins are chiefly made. It is the thickest of the soft muslins used for dresses, neckcloths, &c.

Nainsook is a still thicker kind of jaconet. These are plain and striped, the stripe running the way of the warp.

Mull muslin is a very thin and soft kind, used for dresses, trimmings, &c. *Swiss mull* is dressed and stiffened.

Scerhand is between nainsook and mull, particularly adapted for dresses, on account of its retaining its clearness after washing.

Buke muslin (erroneously written *book*) is a plain, clear kind of muslin; it is either lawn buke, or stiffened to imitate the French clear lawn; or hard, and more stiffened and dressed; or it is soft, to imitate the India buke. Buke muslin is woven for working in the tambour.

Foundation muslin is a very open-worked muslin, used by dressmakers for stiffening dresses and bonnets. It may be had either in white or black.

Leno is thinner and clearer than buke muslin, and may almost be called a cotton gauze, often employed for window blinds.

Cambric muslin is an imitation of cambric. It is sometimes glazed white, black, and coloured, for linings, and it is also twilled. It is figured, striped, or corded.

Cord and fancy checks are cambric muslins with stripes and cords placed across each other checker-wise, by thick threads being introduced into the warp or weft.

Figured muslins are wrought in the loom of various widths, to imitate those worked in the tambour.

Tamboured muslin must be distinguished from the last, being embroidered by hand on the tambour.

The more open kinds of muslin are best fitted for being ornamented with figures by needle-work on the tambour, the lightness and transparency of the fabric forming a contrast with the closeness of the needle-work. Scotland is the chief seat of the manufacture of tamboured muslins.

Cotton cambric is separated into two kinds: cambrics to be used for dresses, either white or printed, and cambric to be used for the same purposes as French cambric. The first is made in Lancashire, the other at Glasgow.

Scotch Cambric.—One might suppose from the name that this was made of flax; but it is a fine cloth made of cotton to imitate French cambric. From the confused language of shopkeepers, it is necessary to keep in mind that cambric is properly a manufacture from flax, and not from cotton.

Common gauze is a variety of woven texture much used for light purposes. It is formed by the warp being twisted somewhat like a rope during the operation of weaving, by which the cloth acquires a considerable resemblance to lace. The texture of this gauze is always open, flimsy, and transparent, but, from the turning of the warp, it possesses an uncommon degree of strength and tenacity, in proportion to the quantity of materials which it contains. This quality, together with its transparency, fits it for ornamental purposes of various kinds, particularly for flowering or figuring, either with the needle or in the loom.

Nankeen was originally a Chinese manufacture only, and, it is said, derived its agreeable pale salmon-coloured tint from the natural colour of a kind of cotton grown in that country. English nankeen looks equally well at first, and even better, as it is more evenly woven; but it loses its colour, obtained from being dyed, and becomes pale after being several times washed.

5659. *Cotton damasks* are made in imitation of linen damasks, which see; though they answer very well for many ordinary purposes, and are cheap, they are not so durable as linen, nor do they preserve their whiteness except frequently bleached.

Huckabacks and diapers of cotton are made in imitation of the same articles in linen, and are used for the same purpose. They are cheaper, but less durable.

5660. *Cotton ticks* are plain and twilled, in imitation of linen ticks, to which they are inferior. There is also a kind named *union*, composed of linen and cotton.

Gingham is a thin, checkered cotton.

Counterpanes, evidently a corruption of *counter-point*, have little protuberances on the surface, dispersed after a certain pattern.

5661. *Marseilles quilts* are a more elegant kind of bed-quilts, and lighter than common white counterpanes of cotton. This fabric is a double cloth with a third of softer material between, which is kept in its place by the quilting done in the loom.

5662. *Cotton quilting* is made for waistcoat pieces, strong and thick, and much resembling the pattern of diaper.

5663. *Jean* is a twilled cotton, striped as well as white. Satin jeans are of a superior make, wove in the manner of satin, with a smooth, glossy surface, and used much for ladies' shoes.

5664. *Dimity* is a well-known article, made with various stripes, and either twilled or plain; much used for white curtains.

5665. *Fustian* is a species of coarse twilled cotton, but may be considered as a general term which comprehends several varieties of cotton fabrics, as corduroy, jean, velveret, velveteen, thickset, thickset cord, and other stout cloths for men's wearing apparel; from their strength and cheapness, they are very serviceable to agricultural people. It is generally dyed of an olive, leaden, or other colours. Fustians appear to have been first manufactured in Barcelona, and were so named from the Spanish "fuste," strong. They were first brought to this country from Flanders, where they were also made, probably in consequence of the connexion between that country and Spain. They were much in request formerly, though it does not appear that they were made here to any extent until the manufacture was brought over by the religious refugees, several of whom settled in Bolton and Manchester, and gave rise to the cotton manufacture of these places. But the fustians of that time were not made wholly of cotton. Cotton could not then, as we have already stated, be spun in Europe fit for the warp, which was obliged to be of linen, and the weft only was of cotton. Till the inventions of Arkwright furnished water twist for the warp, fustian was a mixed manufacture of linen and cotton. At present it is made entirely of cotton. Fustians are either plain or twilled. Common plain fustain, called *pillow*, is sold as low as 7*d.* a yard; when of a strong twilled texture, and cropped or shorn before dyeing, it is called *barracan* and *moleskin*; when shorn after being dyed, it is called *beaverteen*. These form strong, durable, and cheap materials for clothes for labouring people.

Cantoon is a fustian with a fine cord visible on one side, and a satiny surface of yarns running at right angles to the cords upon the other side. The satiny side is sometimes smoothed by singeing. The stuff is strong, and has a fine aspect.

Corduroy is classed among fustian, but is ribbed or corded, the projecting part having a pile. The best kinds are twilled. It is a strong wear. Cutting or cropping fustians by hand, to give them a corded appearance, is a very laborious and delicate operation; and a machine has been invented which effects the purpose with great precision and despatch; hence the price of these articles has lowered, and a great variety has been introduced.

5666. *Velveteen*, or cotton velvet, is an imitation of velvet in cotton; it is of various colours, and much used for the same purposes as velvet, being much cheaper. *Velveret* and *thickset* are modifications of velvet.

5667. *Cotton handkerchiefs* are made of a vast variety of kinds. Some are printed in imitation of India handkerchiefs, and are called *Malabars*, *bandanas*, &c.; others are spotted in white; *navy blues* and *Monteiths* are dyed all of one colour, and have spots of white, through discharging the colour by a particular process. The manufacture of cotton bandanas, by Messrs. Monteith, of Glasgow, is a remarkable instance of what may be done by mechanical and chemical means combined. A great number of cotton handkerchiefs, dyed of a brilliant Turkey red, are laid upon each other and subjected to a press, and a liquid capable of discharging the colour is let into them through apertures in the press. Such is the expedition of this process, that in ten hours 1600 pieces, of 12 yards each, equal to 19,200 yards, are converted into bandanas by the labour of four workmen.

CHAPTER V.

SILK FABRICS FOR DRESS AND FURNITURE.

SECT. I.—HISTORICAL REMARKS.

5668. Mankind must have been far advanced in civilization and the observation of nature before they discovered a material for clothing in the labours of a caterpillar, and perceived that the little yellow ball which adhered to the leaf of the mulberry tree could be unwound into slender filaments, and these made to form tissues of endless beauty and variety. China, one of those countries in which the arts of life have long arrived at a high degree of perfection, appears to have been the first to make use of silk. We are told that the empresses of that country, many years ago, surrounded by their women, employed their leisure hours in the rearing of silk-worms, and in the weaving of silk tissues and veils; but numerous must have been the experiments and trials made before the thick velvet, the stiff brocade, and the thin gauze could have been formed from this material. From China, or, as it was then called by the Greeks, the country of the *Seres*, this valuable commodity was conveyed into India and Persia; and after the conquest of that empire by Alexander the Great, it was brought into Greece; from thence it was carried to Rome, where, as we are informed by several historians, it was so rare, and deemed of such value, as to be sold for its weight in gold. Vopiscus tells us that the Emperor Aurelian, who died A.D. 275, refused the empress a suit of silk, on account of its high price, although she solicited it with much earnestness. For several centuries the Persian merchants supplied the Roman empire with silk, which was brought overland from China by means of caravans that traversed the vast continent of Asia in 243 days. It is said, indeed, that at that time the raw material was brought from China and woven in manufactories established in Persia, Tyre, and other places of the East.

But, notwithstanding an immense trade in this substance, which was for a series of ages carried on between the Roman and Persian empires, and after the seat of the former was transferred to Constantinople, the nature of the silk-worm and the manner in which the silk was produced remained secret with the Chinese, and was entirely unknown in Europe until the reign of Justinian, A.D. 555. At this time, two Persian monks, who were employed as missionaries in some of the Christian churches already established in India, penetrated into China, where they observed the labours of the silk-worm, and became acquainted with the art of working its productions into a variety of elegant fabrics. On their return to Constantinople, they were encouraged by the emperor to undertake a second journey for the purpose of procuring these wonderful insects themselves. This they effected by conveying, in a hollow cane, a quantity of the eggs, which were afterward hatched; and it is remarkable that these became the progenitors of all the generations of silk-worms since reared in Europe and the western parts of Asia.

Manufactories of silk were soon afterward established, not only at Constantinople, but at Athens, Thebes, Corinth, and other parts of Greece; and for six hundred years these were confined to the territories of the Greeks. Its first diffusion was the consequence of the invasion of Greece by Roger I., king of Sicily, who carried a number of silk weavers to Palermo; and the silks of Sicily are described as having been of great excellence. The Venetians afterward, in consequence of their commerce with the Greek empire, supplied all the west of Europe for several centuries. By degrees this manufacture was introduced into Italy, Spain, and France.

In 1521, the French, under Francis I., being supplied with silk-worms and work-people from Milan, began a silk manufacture at Lyons, which has flourished ever since that time, and the demand for Eastern silk has diminished in consequence. In Spain, the culture and manufacture of silk was introduced at an early period by the Moors; and it was there that silk knit stockings were invented, whence they were brought over to Henry VIII.

5669. *The use of silk in dress was extensively adopted in England by the wealthy soon after the Norman conquest,* but was then confined to occasions of ceremony. The destruction of the city of Antwerp in 1583, by the Duke of Parma, drove a third part of the silk weavers to England, and they laid the foundation of the art in this country. Another political event, the revocation of the Edict of Nantes in 1685, produced a similar effect, and the Spitalfields silk weavers date from that time. But it was the introduction of the throwing machine by Sir Thomas Lombe that completely established the silk weaving in the British dominions.

5670. *Great hopes were at one time entertained that native silk could be produced in England;* but though the silk-worm works very well in this climate, and may be reared for amusement, and silk obtained with great care, yet the necessary food, the white mulberry tree, requires greater warmth than that of our usual summers; hence, all the attempts to raise silk for manufacture have not afforded profitable results. Some have supposed that the animal degenerates here, and lettuce-leaves are a poor succedaneum for the mulberry. If, indeed, by due care, silk could be produced in England in sufficient quantity, still the high price of labour would prevent its culture from becoming a source of profit to the producer. Notwithstanding this, the English manufacture has gone on improving steadily, and affords one of the most remarkable instances where an art, borrowed from other nations, and employing a material of foreign growth, has at length equalled that of the countries from which it was derived.

Of late, several causes have contributed to improve our silk manufactures; one of the principal has been the removal, in 1826, of the prohibition of importing French silks which has compelled our weavers to improve their art, in order to compete with French ingenuity. Indeed, in point of substantial excellence, plain silk manufactured in England is now considered at least equal to that of France; while in all mixed fabrics of silk and wool, silk and cotton, silk and linen, &c., our superiority is admitted by the French themselves. But we do not yet rival our neighbours in ribands, figured gauzes, and light fancy articles. The greater attention paid to the art of designing in Lyons, the consequent better taste of the artists, and the superior brightness and lustre of their colours, give them advantages with which it is difficult to contend.

SECT. II.—FORMATION OF SILK.

5671. *The silk-worm*, which produces the most splendid article of raiment, is an animal not more remarkable for the precious matter which it furnishes for this purpose than for the many forms it assumes. Like many other insects, it goes through four metamorphoses. In its most perfect state, it is a white-coloured moth (*Phalæna Bombyx mori*), which lays a number of small eggs, each about the size of a pin's head, from which, in the warmth of spring, the caterpillars are hatched. No sooner does the worm burst its shell than it begins to eat greedily, its food being the leaves of the mulberry tree, of which there are several species; but the white is preferred. For about thirty days it continues to feed upon them, casting its skin either three or four times. At the end of this period, having attained its full size, it ceases to eat for the remainder of its life, and prepares for one of the metamorphoses which it is to undergo, by spinning a ball of fine silk filaments round itself as a defence from injuries during its chrysalis state, in which it lies dormant like a swaddled mummy, and apparently dead, for fifteen or twenty days. At length it breaks through this covering, and comes abroad provided with wings, antennæ, and feet; in short, a butterfly, as above described, which lives only a few days, lays its eggs, and then dies.

5672. *In our description of the formation of silk*, we shall begin with the hatching of the eggs, which we have just said are deposited by the silk-worm. These are generally about five hundred in number by one insect, and when first deposited are covered with a liquid which glues them to the leaf, cloth, or paper on which the female leaves them: they may be freed from this by dipping them in cold water, and afterward drying them. To preserve the eggs, the temperature should be between 54° and 59°; and when the warmth of spring commences, they should be kept in the cool, not exceeding the above heat, lest they should be hatched before the mulberry leaves come out to supply their food. When required to be hatched, they are laid in a room with a stove, and exposed to a warmth gradually increasing till it reaches 86°, the temperature at which the caterpillar appears, and which takes place in eight or ten days. Previously to this, the eggs should be covered with sheets of paper, pierced with holes about one twelfth of an inch in diameter, having mulberry leaves laid on the top. The young caterpillars instinctively find their way through these holes to come at the leaves, which they instantly begin to devour greedily. The leaves, loaded with worms, are then laid regularly on wicker shelves in a well-aired apartment, which should be kept at a temperature from 68° to 86°. Much care is required in managing the silk-worms; their food should be regularly supplied, and everything about them should be kept perfectly clean; also, the proper ventilation of the room is essential. During each moulting or casting of the skin, the animals fall into a languid state, and eat little; but the appetite revives on acquiring a new skin. The caterpillars indicate the commencement of their spinning silk by ceasing to eat, abandoning the leaves, trying to crawl up on the upright parts, and to conceal themselves in corners. Twigs of heath, broom, or other shrubs are now laid in rows on the shelves, and the little creatures begin to construct on these their coverings of silk, called *cocoons*.

5673. *The material of which the silk is formed is a clammy liquid existing in the body of the worm*, which it ejects through two apertures, and which hardens in the air. The filament is at first double, but is immediately agglutinated into one. This liquid matter may be extracted in a lump from the body of the worm, and drawn out artificially into threads of various diameters. At the commencement of spinning the cocoons, the filaments are thrown about without any regularity, constituting what is called the *floss silk*; but soon the animal spins its thread and winds it about in a very regular manner, forming the cocoon into an egg shape, and about an inch and a quarter in length. This is completed in about three or four days; and the animal within has changed from the state of a caterpillar to that of a chrysalis or aurelia. If the cocoons were suffered to remain about eighteen or twenty days, the next metamorphosis would take place, and the butterfly or moth would burst through the cocoon, breaking the filaments asunder, thus rendering the silk useless. To prevent this, the animals within the cocoons are killed before they are ready to break out, by exposing the cocoons for five days to the sunshine or hot weather, or by placing them in a hot stove, or in tin cases surrounded by the steam of boiling water. A heat of 202° is sufficient to destroy their vitality.

The filaments vary in diameter from $\frac{1}{1800}$ to $\frac{1}{2500}$th of an inch, and the silk from one cocoon weighs about two and a half grains. The colour of the silk is yellow, and though of different shades, there is no necessity for sorting it, as this difference disappears in the subsequent processes for preparing it.

Besides the common silk-worm, there are two other varieties that are partially cultivated; one smaller, and the other larger, rarely attaining the length of three inches. When in its indigenous state in China, the silk-worm performs its transformations and spins its cocoons on the growing leaves of the mulberry trees, from which they are taken; but this silk is not so fine as what is produced in artificial cultivation; and the Chinese bestow great care in attending the whole of the processes. On account of the difficulty of procuring food in sufficient quantity in England from the white mulberry tree, other leaves have been tried: of these, the leaves of the lettuce are most relished by the animals; but though they eat and subsist on them for some time, they then spin but a small quantity of silk.

SECT. III.—MANAGEMENT OF THE SILK TO FORM THREAD.

5674. *To wind off the threads or filaments from the cocoons* would appear, at first sight, to be a very difficult operation, yet it is performed in a very simple manner. The cocoons are thrown into a flat basin of copper filled with water, kept heated by means of a charcoal fire, or by steam. In this the gummy matter with which the fine threads are naturally cemented together is dissolved, which permits the filaments of the cocoons to be drawn off and wound upon a reel. But if each cocoon were to be reeled off separately, the thread would prove so slender as to be unfit for use. To make it sufficiently strong, several are wound off together, adhering by their natural gum, and forming one thread. In order to find the ends of the cocoons, on beginning this process the winder employs a whisk of birch; drawing this through the water, several loose ends of the filaments stick to it, and are thus brought out. To unite them together before they reach the reel on which they are wound, a sufficient number are made to pass through a small hole in an iron plate. The reel is of the common kind. It is reckoned that each cocoon yields on an average about three hundred yards of silk. Two hundred and fifty average-sized cocoons weigh about a pound; and eleven or twelve pounds of cocoons give one pound of reeled silk, the remainder consisting of the weight of the enclosed chrysalis, floss silk, waste, dirt, &c. It has been estimated that a pound of the silk filament, as elaborated by the silk-worm, would measure five hundred miles in length.

5675. What is simply drawn from the cocoons in the above manner by reeling is denominated *raw silk*, and a thread of this may contain from three to thirty filaments, the thread being sometimes composed of several groups, which have first been formed of five or six filaments each, the whole being afterward united into one quantity, the thread being thicker according to the number of filaments. When a sufficient length is reeled, it is taken off the reel, and is called a *skein*.

It frequently happens, in the course of this process, that the delicate filaments break, or that one comes to an end before the rest; in that case the winder must join on another to keep up the number; this is done simply by laying on another filament, as it readily adheres to the rest by means of its natural gum; but it requires great attention and skill to preserve the thread of a uniform size. The reeling off the cocoons is a very important part of the preparation of raw silk, as the evenness of the thread, and the absence of knots or knobs, are points of considerable importance to the manufacturer.

In those countries where silk forms a considerable article of commerce, those who rear the silk-worm do not wind off the cocoons themselves, but sell them to others, who make the reeling off a distinct business. It is in the state of raw silk in skeins that this material is imported from the countries where it is produced, as Italy, Spain, Portugal, Turkey, India, &c.

5676. *The various operations by which raw silk is brought into a state fit for the weaver* are briefly the following: 1. It may be twisted in the single thread of raw silk; it is then called *singles*, and is used for some kinds of weft, as in ribands and common silks. 2. Two or more singles may be twisted together, but not very closely; this is called *tram*, which constitutes the usual weft or shoot of the best woven goods, such as gros de Naples, velvets, flowered silks, &c. 3. *Organzine*, or *hard* silk, which is the strongest and most valuable sort, used for the warp of such goods as have tram for the weft. 4. *Sewings* are compound threads of silk, wound, cleaned, doubled, and thrown, with especial reference to their ultimate use as sewing silk.

5677. *Organzine is used for the warp of the best quality of silk*, and is of the utmost importance to the manufacturer, as none of the principal articles can be fabricated without it; it usually contains from two to four threads of raw silk twisted, and so combined as to be of the greatest strength; for this purpose, each thread of raw silk is twisted separately by a mill, and then two of these are twisted together, forming a thread like a rope. The Italians, from whom we formerly imported silk in the state of organzine, kept the art of forming it, called *throwing*, a profound secret. The throwing of silk was introduced into this country in 1719, by the enterprise and skill of Messrs. Thomas and John Lombe, the latter, who was a good mechanic, having, at the risk of his life, and with wonderful ingenuity, taken a plan secretly of one of these complicated machines in the King of Sardinia's dominion, from which, on his return, he established a similar set of mills in the town of Derby.

Lombe lived only a few years after he obtained his patent, being succeeded by his brother William; but the construction of the mills, and the instruction of the various workmen employed, occupied so much time that the speculation was unprofitable; on which account, the cousin, afterward Sir Thomas Lombe, to whom the property descended, petitioned Parliament for the renewal of the patent. This was refused, but the government granted him the sum of £14,000, upon condition that he should deposite a complete set of all his machinery in the Tower of London, for the inspection of the public.

5678. *The mills for throwing silk* are often of most elaborate construction. Lately they have been remodelled by various ingenious mechanicians upon the cotton throstle plan, driven by steam-engines; and these are incomparably superior to what were formerly used in this country, and still are upon the Continent. The machines which they employ abroad for this purpose are small, and are turned by hand, containing about a dozen spindles each. In consequence of these improvements here, little thrown silk is now imported, that produced at home, chiefly at Derby, being sufficient.

5679. *Marabout* is a peculiar kind of thrown silk, often made of three threads of raw silk. Being white as it comes from the worm, it takes the purest and most delicate shades of colour at once, without the discharge of its gum.

5680. *Floss silk is that portion of waste silk* which is drawn from the cocoons that are reserved for breeding, and from which the moths eat their way out by holes, which, cutting the silk into pieces, renders it impracticable to wind it, together with such cocoons as will not wind off. This silk, when carefully spun by a spinning-wheel, in the manner of flax, is termed *spun silk*, the thread of which is little inferior, for some purposes, to the regular silk which is wound off from the cocoons. It is often made into stockings, which are very durable; also into shawls, handkerchiefs, and other articles.

Sect. IV.—Bleaching and weaving silk, and preparing it for the dyer.

5681. *Raw silk is bleached white* by first immersing it in a solution of good soap in river water. After boiling for two or three hours, the silk is taken out, beaten, and then rinsed in cold water. It is then wrung, dipped in soap and water, and boiled again; after which it is suspended in a kind of stove constructed for the purpose, containing burning sulphur; the fumes from this give the last degree of whiteness to the silk. Were it not for the dearness of spirits of wine, silk might be bleached by it, according to M. Baumé, and thus made to rival the finest specimens from Nankin.

5682. *Silk is woven chiefly by the hand-loom*, as power-looms do not offer the same advantages in the weaving of this material as they do of cotton; from the delicacy of its texture, it is continually giving way, and requiring repair in some part or other; a considerable portion of time is also employed in removing all roughness of the warp, during which the actual weaving must be suspended. The saving of time which a power-loom would give would therefore be small, and ceases to be an object of great importance. Figured silks are now woven by the admirable Jacquard loom; and patterns which formerly required the greatest skill, and the most painful labour, are produced by this machine by weavers of ordinary skill, and with little more labour than that required in weaving plain silks. This loom has been much improved in England.

5683. *Silk is sometimes embossed*, by passing the plain stuff between rollers, the surfaces of which contain the desired pattern, which on one cylinder is raised and on the other sunk, so that the eminences of the one coincide with the depressions in the other. Ribands are frequently embossed in this manner.

5684. *Watering silk* is producing an unequal and peculiar wavy appearance by placing together, lengthwise, one on the other, two pieces of silk, and passing them, thus circumstanced, between two cylindrical metal rollers, one of which is made hollow for the purpose of containing a heated iron in its cavity. The two surfaces of the silk not absolutely coinciding, one part will be subjected to more pressure than another, which gives rise to the peculiar appearance.

5685. *To render silk thread fit to receive the dye*, and also to make it soft and glossy, after the operation of twisting or throwing, it requires to be boiled in soap and water to discharge the gum. After the boiling, it is washed in clear water to discharge the soap, and, when dried, will be found to have lost about one fourth of its weight; at the same time, the silk has acquired that soft texture and glossiness which are the principal beauties of it. In the first instance, the gum gave the only adherence of the fibre to form a thread, but by the twisting the fibres are firmly united, and no longer require any cement. It is also necessary, in order to give a fine dye to the silk, that the gum should be removed, because it would prevent the entrance of the dyeing matter to the centre of the thread, and thus impair the beauty of the colour. If the silk was thus boiled before the twisting, nothing but a fine entangled down, or wool, would be obtained, and it would require spinning, by a similar process to that of cotton, before a thread could be obtained.

5686. *One pound of reeled silk* may be converted into sixteen yards of gros de Naples, and is produced from twelve pounds of cocoons, the produce of the labours of 2800 worms, which have consumed 152 pounds of mulberry leaves.

Sect. V.—Chemical properties of silk.

5687. *The chemical properties of silk are* these: The gum with which the raw silk is coated is soluble in hot water, and the colouring matter, which is a kind of resin, may be dissolved by digestion in alcohol; the silk itself would then be white. This varnish, altogether, amounts to about 23 per cent. of the raw material. The remaining fibrous matter has not been well examined by chemists. Caustic alkalies corrode and dissolve it. Silk is of a very imperishable nature, and has resisted the ordinary causes of putrefaction when buried in a grave. It is a powerful electric, or is capable of being excited so as to give out sparks of electricity when rubbed; it is likewise a non-conductor of electricity, and is therefore always employed in electrical machines. The electricity of silk stockings, when pulled off, has frequently excited surprise.

Sect. VI.—silk of various countries.

5688. *Chinese Silks.*—A large quantity of both raw and wrought silks is annually imported from China. In 1829, it appears from the custom-house, 600,000 pounds' weight of raw China silk came into this country. The silk-worm in China is reared in the greatest quantity in the neighbourhood of Nankin, the more southern provinces being unfavourable to its growth. Sir George Staunton tells us that, in the city of Han-choo-foo, a great number of women are employed, in extensive factories, in the fabrication of flowered and embroidered satins. China silk excels every kind in its brilliant whiteness, the cause of which is not yet understood here.

5689. *The silks brought from Italy* are partly raw and partly wrought. Wrought silks come from Piedmont, Novi, Bergamo, and Bologna, but a part of the silk we have from Italy is thrown. The raw silk of Piedmont is superior to that of France, which is attributed to certain regulations respecting uniformity in the mode of reeling it, which have been imposed by the government of the country at an early period of the silk cultivation; whereas in France every farmer is permitted to reel as he pleases; the consequence of which is, that there is no uniformity among the silks of different cultivators. It has been generally thought that there are some qualities in Italian thrown silk that rendered it superior to our own for certain purposes; but this idea appears not to be very correct, and some of our manufacturers use English thrown silk for all kinds of goods.

5690. *French Silks.*—France possesses a great advantage in her climate of being able to rear the silk-worm, and thus obtain native silk in her southern provinces, not, however, in sufficient abundance to supply all her manufactories. Lyons, the great silk manufacturing city of France, from whence the principal merchants of Paris obtain their silks, furnishes very little from French materials. Its prosperity has suffered much from political revolutions, but it still maintains its superiority over other places, particularly for the richest silks and fancy goods. In the manufacturing texture we equal, if not excel, the French, on account of the superiority of our machinery, but they surpass us in the taste of the patterns of such silks as are figured, which is probably owing mainly to the care which the French government has taken in establishing schools of design. The looms at Lyons for weaving fancy goods have greatly increased in number, while those for plain goods have as much decreased. In plain silks we now equal the French. As good gros de Naples can be bought in Manchester as in Lyons, and as cheap.

5691. Raw silk, of its own growth, is not allowed to be exported from France, and, as some of the Italian states likewise prohibit the exportation of their raw silk, the greater part of what we receive through France is said to be smuggled from Italy; the latter country also supplies to France the greatest part of the organzine silk used there, the Italian being superior to the French.

5692. *The superiority of the French silk weavers in point of design* may be accounted for, if the following relation, given by Dr. Ure, in his "Philosophy of Manufactures," be not too highly coloured:

"Among the weavers of the place, the children, and everybody connected with devising patterns, much attention is devoted to everything any way connected with the beautiful, either in figure or colour. Weavers may be seen, in their holyday leisure, gathering flowers, and grouping them in the most engaging combinations. They are continually suggesting new designs to their employers, and are thus the fruitful source of elegant patterns. There is hardly any considerable house in Lyons in which there is not a partner who owes his place in it to his success as an artist. The town of Lyons is so conscious of the value of such studies, that it contributes 20,000 francs per annum to the government establishment of the school of arts, which takes charge of every youth who shows an aptitude for drawing, or imitative design of any kind applicable to manufactures. Hence all the eminent painters, sculptors, and even botanists and florists of Lyons, become eventually associated with the staple trade, and devote to it their happiest conceptions. In the principal school, that of St. Peter's, there are about one hundred and eighty students, every one of whom receives from the town a gratuitous education in art for five years, comprehending delineations in anatomy, botany, architecture, and loom-pattern drawing. A botanical garden is attached to the school. The government allows 3100 francs a year to the school of Lyons. The school supplies the scholars with everything but the materials, and allows them to reap the benefit of their works. Their professor of painting is a man of distinguished talents, well known to connoisseurs.

"The French manufacturer justly considers that his pattern is the principal element of his success in trade; for the mere handiwork of weaving is a simple affair with the improved Jacquard loom. He therefore visits the school, and picks out the boy who promises, by taste and invention, to suit his purpose the best. He invites him to his home, boards him, and gives him a small salary, to be gradually advanced. One gentleman told Dr. Bowring that he had three such youths in his employment, to the youngest of whom he gave 1000 francs, or £40 per annum. After three or four years, if the young artist's success be remarkable, he may have his salary raised to double or treble that sum; and, when his reputation is once established, he is sure of the offer of a partnership. Such is the general history of many of the schoolboys of Lyons. Even the French weaver, who earns only fifteen or twenty pence a day, prides himself upon his knowledge of design; he will turn over several hundred patterns in his possession, and descant on their several merits, seldom erring far in predicting the success of any new style. By this disposition, the minds of the silk weavers in France become elevated and refined, instead of being stultified in gin-shops, as those of England too frequently are. In flower patterns, the French designs are remarkably free from incongruities, being copied from nature with scientific precision." "There are also weaving schools, containing from sixty to eighty scholars. In these, a pattern being exhibited, they are required to exercise their invention immediately as to the best means of producing the design on a piece of silk goods. The master removes such difficulties as are occasionally encountered, and leads them to the successful accomplishment of their task."

Notwithstanding this agreeable picture, the author just quoted admits that the silk trade of Lyons is extremely fluctuating, being one of orders, and not of stocks; and that unpleasant differences frequently take place between the master manufacturers and the workmen, from the "mania for creating new designs," which proves a serious inconvenience to both masters and men. "In consequence of the low wages and great expense of living at Lyons, many of the weavers betake themselves to arms, and abandon a trade which gives them no prospect of improvement. It appears that there has been a constant depreciation of the wages of silk weaving in France from the year 1810 down to the present time. The average expense of changing each pattern loom is twenty-five francs, and, in general, it falls chiefly on the weaver, rendering him often the victim of ignorance of the state of trade, and of want of taste in the manufacturer." Simond, who visited Lyons in 1817, has described the poverty of the silk weavers resident in and near that city as being more abject than anything within the experience of our own artisans. There, as with us, the manufacture is, in a great degree, domestic, most of the weavers executing their labour in their own dwellings. The abodes of the French weavers are, however, wretched in the extreme; one room, twenty feet square, not unfrequently serving every purpose, both as a dwelling and workshop, for three entire families.

5693. *Much silk is produced in Sicily*, but scarcely any of it comes to England. *Turkey* supplies us with a considerable quantity of raw silk, chiefly Persian, from the borders of the Caspian; this comes by the way of Smyrna. Silk is extensively manufactured in *Switzerland*. Velvets are made in *Prussia*, and even *Russia* is beginning to weave silk. Of late, a good deal of raw silk has been imported from *Bengal*, and this has been regularly improving in quality, so as at present nearly to equal that from Italy. In India, instead of having one annual crop, as in Europe, there are no less than three. From some specimens of *American* silk lately sent over to this country, there appears to be some reason for supposing that, before long, this material may be produced to a considerable extent in that country. The silk-worm and the white mulberry tree thrive in all the states of the Union.

Sect. VII.—Description of the various silk fabrics.

5694. *General Remarks.*—Manufacturers distinguish many hundred varieties of silk fabrics made at home and abroad, and even those made in this country are extremely numerous. Silk being an animal substance, it is capable of readily receiving every possible tinge of colour, and may, consequently, be wrought into tissues of any desired hue. The loom also may be arranged so as to produce, not only all kinds of twills, satins, spots, &c., but the richest and most complicated figures. It would, therefore, be futile to attempt an enumeration of all the fabrics now produced in the foreign and domestic silk manufacture, and we shall notice only some of the principal kinds in use among us.

5695. *Silk Damask.*—This is a twilled fabric, and made in the same manner as the well-known linen damasks used for table-cloths, with flowers and other ornamental patterns formed upon it. Formerly silk damask was much used for dress as well as furniture, but it was too expensive a material to have ever come into common use, and was principally confined to the high born and wealthy of the land; not but that, on occasions of ceremony, persons in the middle ranks sometimes displayed silk damask garments, which were handed down as heirlooms from one generation to another. From its name, it has been supposed that the art of weaving damask came originally from Damascus. Its introduction as a manufacture into England was owing to the French weavers, who took refuge here in the time of Queen Elizabeth.

Damask is employed in furniture, such as hangings, chair and sofa covers, &c. Formerly it was wrought with various colours, and it is so still occasionally on the Continent, which sometimes had a rich effect; at present it is not usual with us to have more than one colour, and richness is produced by the elegance and beauty of the pattern.

The weaving of damask puts into requisition all the skill of the weaver for the production of the elaborate patterns which they sometimes bear. Some of these patterns require upward of 1200 changes of the draw-looms for their completion; but the damask employed at the present day for curtains and similar articles of furniture is generally made of a mixture of silk with flax, cotton, or wool, the warp being of the more costly material.

5696. *Brocade.*—An excessive love of rich and splendid stuffs for dress appears to have been a taste originally Oriental. In China and India it has long been the fashion to ornament silk and muslin with threads of gold and silver. These gradually found their way into Europe, and were imitated and improved upon. Silks which have gold or silver threads, or a mixture of these, are called *brocades*, and were highly esteemed by our ancestors, who paid more regard to the richness and value of the material than to the form of the dress. Taste has so much altered in this respect, that it is only in the writings of the last century we can discover the degree of estimation in which this kind of finery was once held. Pope, in his "Rape of the Lock," and Addison, in "The Spectator," have satirized this taste for finery, which we may perceive proofs of in pictures and ancient wardrobes. The richest brocades appear to have been made in Italy;

a considerable manufactory of them was carried on at Lucca during the thirteenth century. The French government afterward engaged a celebrated mechanician, Vaucausin, to contrive machinery for producing similar fabrics at Lyons, an account of which is published in the Memoirs of the French Academy for 1757.

5697. *In the manufacture of gold brocade*, a silver wire is gilt, drawn out to great fineness, and flattened. This is twisted by a machine round a silk thread dyed of a colour as near as possible to that of the metal. The principal art in preparing these gold threads consists in applying the flattened metallic wire so as just to cover the silk completely without any overlapping, and, consequently, making the whole look like a thread of gold. At Milan they had a secret process by which the exterior side only of the flattened wire was gilt; and the Chinese, more economical, instead of flattened gilt wire, often use slips of gilt paper, which they interweave in their stuffs, and twist upon silk threads; but it is obvious that this can have little durability, and is confined to tapestries, or such stuffs as are not exposed to moisture.

In some brocades the ground is plain silk, and the gold and silver are applied by being worked in flowers or other ornaments; afterward, this name was given to rich silk stuffs which were adorned with worked flowers, without gold or silver; and at present it is the custom to apply the term brocade to various silks, as satins, taffetas, lutestrings, and even to stuffs and grograms, if they are adorned with flowers or other figures. Brocades, into the composition of which metals are admitted, are very liable to become tarnished, particularly silver, or where the gold has not been quite pure. When this has happened, their lustre may sometimes be restored by washing them with a soft brush dipped in warm spirits of wine.

The use of brocades in ordinary dress has long been discontinued, but they are occasionally employed in furniture. So late as 1788, some very elegant pieces were woven in Spitalfields, to be used as chair-seats in Carlton House, which proved that the art had not deteriorated.

Besides the perfect brocade, the Venetians made a kind which they called *damasquète*, which, though it had only half the quantity of gold or silver, looked even richer. The flatted wire was neither wound close together on the silk threads, nor the threads stuck close in the weaving; yet, by passing the stuff between rollers, the tissue, or flower, was made to appear one entire brilliant plate of gold or silver. At Nuremberg, a kind of thread for brocade was made by spinning gilt copper wire on threads of flax.

5698. *Satin* is a glossy silk twill of peculiar description, the soft and lustrous face of which is given by keeping a large proportion, frequently even as many as seven out of every eight threads of the warp, visible. In the manufacture of other silken stuffs, each half of the warp is raised alternately; but, in weaving satin, the workman only raises the fifth or the eighth part of the warp, which, presenting an even, close, and smooth surface, is capable of reflecting the rays of light very entire, and the fabric thus acquires that lustre and brilliancy for which it is so much distinguished; but this is assisted by another process. When first taken out of the loom, satins are somewhat flossy or rough, and they are dressed by being rolled on heated cylinders, which smoothes down the face and imparts to them their brilliant lustre. Satin is always woven with the face downward, the labour of the weaver being thereby abridged, as it is easier to raise the harness with one eighth of every cart than it would be to raise seven eighths.

Satin exhibits, in the highest degree, the beautiful lustre of the material of which it is made; no other article of dress has the same beauty in its shadows and reflected lights; hence it has always been a great favourite with the painter, though difficult to represent. Some satins are quite plain, others are figured, and the latter are often of exquisite beauty. Some of the best description are made in Spitalfields. The Chinese are very fond of satins, and some of their make are brought to this country; they are inferior to those made in Europe, but possess the property of being easily cleaned and bleached; they are sometimes flowered with gold and silver. The Chinese excel in the production of flowered satins, as well as damasks.

5699. *Silk fabrics are sometimes woven quite smooth and plain*, as lutestring, gros de Naples, Persian, Ducape, Levantine, sarsenet, &c., which differ from each other only in their thickness, or the quality of the silk.

5700. *Lutestring* is a plain, stout silk, much used for ladies' dresses. There are many qualities and colours.

5701. *Gros de Naples* is the French name of silk, and means, literally, "thick," or "stout," of Naples; it is very similar to the last, but not so stout, and was formerly imported, but is now made plentifully in Spitalfields: it is plain and figured.

5702. *Persian* is a very thin plain silk, the width about half a yard, used for the lining of bonnets, pelisses, cloaks, &c.: it is of all colours.

5703. *Sarsenet* is somewhat thicker, and made twilled as well as plain: it is used for the same purpose as the last, but sometimes also for dresses.

5704. *Taffeta*, under which term the French manufacturers include lutestring, is a smooth silken stuff, having usually a remarkably wavy lustre, imparted by pressure and heat, with the application of an acidulous fluid to produce the effect called watering.

There are taffetas of all colours, some plain, others striped with gold, silver, silk, &c., others flowered or checkered. The chief consumption of taffeta is in summer dresses for ladies, and a particular kind is used for curtains and other drapery. The Chinese manufacture different sorts of taffeta, among which is a substantial kind adapted for drawers and other kinds of wearing apparel; it is so thick and pliant, that it may be folded and pressed by the hand without receiving any crease or mark, and will retain much of its lustre after washing.

5705. *Tabby* is a coarse kind of taffeta watered by pressure between the rollers of a cylinder, so as to produce the wavy effect already mentioned.

5706. *Tabbinet* is a variety of the former, more delicate in its texture.

5707. *Tabarets*, a stout satin-striped silk, used for furniture, as chair-covers, women's shoes, &c.

5708. *Tobine* is a stout twilled silk, used for dresses: it much resembles the Florentine.

5709. *Levantine* is a stout rich black silk, twilled and very soft, and used for dresses: its face and back show different shades. If the face is blue black, the back will be jet black, and *vice versa*.

5710. *Silk serge* is a twilled silk used mostly by the tailors for lining parts of gentlemen's coats.

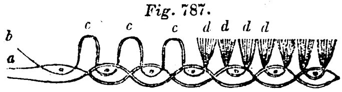
5711. *Paris cord* is a thick rich silk with fine small ribs running across. This was first brought from France, and the genuine has the cord all silk. An imitation is made here, and some of this has the cord of cotton. It is much used in making waistcoats and stocks.

5712. *Armozeen* is a thick plain silk, seldom any other colour than black: it is not much used; sometimes clergymen's gowns are made of it, and it is employed in hatbands, and scarfs at funerals.

5713. *Florentine* is made for waistcoats, and is plain, striped, or ribbed, and figured; when plain it is twilled. It is to be observed that there is another substance called also Florentine, made of worsted for common waistcoats.

5714. *Silk Velvet.*—This is certainly one of the richest of the silken fabrics, and was formerly much more used in dress than at present. Its origin is not known, but it has been made in Europe for centuries; at first, its manufacture was confined to Italy, where, and also at Genoa, it was carried to great perfection. The manufacture then reached France, and afterward Spitalfields. The name comes from the French *vellour*, which is derived from *velu*, covered with hair. Velvet is distinguished from every other kind of cloth by the soft *pile* on its surface, from which its great beauty results. It has this pile in addition to the usual warp and weft which it has in common with plain fabrics. The pile is occasioned by the insertion of short pieces of silk thread doubled under the weft, and which stand upright on its upper surface in such a multitude, and so crowded together, as entirely to conceal the interlacings of the warp and weft. The wood-cut, *fig.* 787, represents on a large scale the disposition of the threads in velvet, which are produced in the loom by means which cannot be explained without going into a detailed description of that machine, and the mode of weaving it, which would be foreign to our present object. The lines *a a* represent the threads of the warp, and the black dots are the threads of the weft crossing them. The line *b* passing into the web, and under the weft, forming loops at top, *c*, *c*, *c*, represents the thread intended to form the pile. As the weaving goes on, these loops, *c*, *c*, *c*, are cut through with a sharp instrument, and, when divided, their cut ends stand out each in the form of a little brush, *d*, *d*, *d*, and, being extremely close, the fibres of the threads separating produce the required pile. The surface of this pile is at first very irregular, but it is made perfectly even by subsequent processes, being cut by machinery, &c. The warp and pile of good velvet are both composed of organzine silk, and its richness depends upon the relative number of its pile threads. The manufacturers are accordingly accustomed to designate velvets of different degrees of richness as velvet of two four, or six threads, according to the number of pile threads which are inserted between each of the dents of the reed. The Spitalfields velvets are so much improved of late, both in fineness and durability of their colours, that they may vie with any foreign velvets. Velvet is sometimes imported from Germany, having the pile of an inferior silk that has been gummed; but, on wearing, this soon looks very ill. The Chinese also manufacture velvets, but they are inferior to the European. Velvet is either *plain*, that is, smooth and uniform, without either stripes or figures, or it is *figured*, or ornamented with various figures, though the ground be the same as the figures; or the velvety figures may be on a satin ground. *Cut velvet* has a ground of a kind of taffeta, or gros de Tours, and the figures velvet. The best manufactures of velvet have been in France, Italy, and Holland; but it is now made in great perfection at Manchester and other parts of England. Velvets that are the worse for wear may be greatly restored by passing a hot iron over the wrong side, while another person holds the velvet tight; this

Fig. 787.



raises the pile; and then the garment should be brushed, or whisked with a fine whisk, such as is sold by the Dutch women.

5715. *Barcelona kerchiefs* are named from Barcelona, in Spain, from which they were originally brought, though now all made in England; they are of four kinds, black, of plain colours, turban checks, and fancy. The black are more for use than show, and measure from twenty-six inches square to seven quarters. The turban checks were originally made for headdresses, and are about twenty inches square.

5716. *Bandana handkerchiefs* are properly Indian, though those made in England in imitation of them are likewise termed Bandana. The black are generally English, though a few come from India. India handkerchiefs not only wear much longer than British, but have the advantage of keeping the colour to the last; but as the patterns are not so elegant as ours, India silk is sometimes imported plain, and printed here. They are twilled and plain.

5717. *Ribands* are a very ancient part of the silk manufacture, and are known to have been used as an ornamental part of dress previous to 1332. They were made in France long before their manufacture was introduced into England; at Lyons it is carried to the greatest perfection. Coventry is the principal seat of the riband manufacture in England, which there gives employment to 10,000 persons; of the looms, about one third are what are called single looms, of a peculiar construction, which weave only one breadth at a time, and are mostly employed in the manufacture of figured ribands; but looms are also constructed, called engine looms, which weave several ribands, from eight to twenty-eight at once. Steam is extensively employed as a moving power. At one time the French ribands excelled ours; but the Coventry weavers have made so marked an improvement in their art since the legalized importation of foreign manufactured silks, that their ribands are, perhaps, nearly equal to those of the French looms; and, notwithstanding this improvement, they are 20 per cent. cheaper than formerly. Ribands are frequently ornamented with what is called a *pearl edge*, which is formed by some of the threads of the weft projecting beyond the rest. The inferior ribands are made of Bengal silk, but the best are made of silk from Italy. Riband is woven in pieces of thirty-six yards each.

Ribands are of various denominations, as satin, sarsenet, lutestring, gauze, taffeta, and pads, all belonging to the plain kind. Figured ribands are classed under the same heads. In some of the French ribands groups and wreaths of flowers are executed with the richness and variety of hand-embroidery. *Clouding* in ribands is produced by a peculiar management in the dyeing. *Galloons* and *doubles* are strong, thick ribands, principally black, used for bindings, shoe-strings, &c. *Ferrets* are coarse, narrow ribands shot with cotton.

5718. *Silk gauze* is an extremely light and transparent fabric, the threads of which are all at some distance from each other. Common gauze is plain, striped, or figured. In the best kind the figure is formed of silk, and a sort with flowers of gold is imported from China; but an inferior sort has the figure composed of magnesia, stuck on with gum. *Lisse gauze* is a plain but superior kind. *Crape lisse gauze* is crimped or craped. *Gossamer* is a very rich gauze used for veils; it is four times as thick and strong as common gauze, though nearly as open in its texture. It may be had four and five quarters wide.

5719. *Italian net* is a strong gauze composed of silk and worsted, and used for dresses; it is of various colours.

5720. *Mousseline de Soie* is a delicate silk fabric about as open as muslin, with a fringe, used for ladies' handkerchiefs, worn round the neck.

5721. *Crape* is a light, transparent stuff, in the manner of gauze, made of raw silk, gummed and twisted in the mill, and woven without dressing; when dyed black, it is much used for mourning. Crapes are either crisped or smooth; the former, being double, expresses the deepest mourning. White crape is used in various dresses. The invention came originally from Bologna; but Lyons has been long celebrated for this manufacture. It is likewise well made at Norwich; and lately a power-loom manufactory has been established at Yarmouth. The peculiar appearance of crisped crape is owing to the operations of dyeing and dressing after it is woven. An additional quantity of gum being added to the silk, the threads are disposed to undo the twist they had received in the mill; and hence the crisped and peculiar appearance. Washing it in hot water shows this; for then the crisping comes out, and it looks like gauze. The warp, and frequently the woof of crape, is usually made of singles; a better kind is made of two-thread tram; this is of a closer texture, and the crisping is superior.

5722. *China crape* is a beautiful variety, remarkably fine in texture and weighty in substance, which is usually dyed in various shades of pink and other gay colours, used in rich dresses.

CHAPTER VI.

FABRICS OF MIXED MATERIALS.

5723. There is a class of fabrics of mixed materials which cannot properly come into those which we have described; these mixtures consist of silk and other materials, or cotton and wool together, or where linen forms a part.

5724. *Bombazin* is a twilled fabric, the warp being silk and the woof worsted. It was first invented in 1575, by the Flemings, who settled in Norwich, and introduced the weaving of fine worsted stuffs. Being gray and black, it was chiefly used for mourning dresses; and it used to be largely exported to Spain and the Spanish Colonies for the dresses of the religious orders. When its manufacture was improved by the worsted yarn being spun by machinery instead of the hand, and dyed of various colours, a great deal of coloured bombazin was made in Norwich, Spitalfields, and other places; but this is not at present much used, the manufacture being almost confined to black.

5725. *Norwich Crape.*—It is difficult to say how this came to be designated a crape, as it is a very different fabric from the usual crapes. It is composed of a silk warp and worsted woof, generally of different colours, or, at least, of different shades. It is of all colours, and is distinguished from bombazin chiefly in not being twilled.

5726. *Poplin* is composed of a warp of silk and weft of worsted, but having more silk in its composition than bombazin. Irish poplins have long been celebrated, and are used for dress in the highest circles. Dublin is the place where they are made of the first quality. Superb patterns have been manufactured for court dresses, in gold and silver, on white, pink, and azure grounds, with flowers, and of every variety of colour; yard, and yard and a half wide.

5727. *Lustre* is a variety of poplin, but less substantial.

5728. *Gros des Indes* is a silk formed by using different shuttles with threads of various substances for the weft, by which a stripe is formed across the web.

5729. *Valentia* has a cotton warp, or a cotton and silk warp for the silk pattern, and the weft is worsted of British wool. There are often imitations of silk patterns from Spitalfields, and form a very showy manufacture: used for waistcoats.

5730. *Toilinette* has a weft of woollen yarn, and the warp of cotton and silk: used for waistcoats.

5731. *Cassinette* is made of a cotton warp, and the woof of very fine wool, or of wool and silk; it differs from valentia and toilinette, having its twill thrown diagonally.

5732. *Swansdown* is made of wool, with a small quantity of silk, for waistcoats; an inferior kind has cotton instead of silk.

5733. *Woollen cord* resembles corduroy, and is cut in the same manner as cotton cord, which is one of the varieties of fustian; but the face is wholly woollen. It has a warp of cotton and weft of woollen. It is strong and warm, and is well adapted for riding.

5734. *Linsey-woolsey* is a homely fabric, formerly much used by women among the working classes, made of thread for warp, and its woof worsted, generally one blue and the other white, or mixed with red.

5735. *Merinoes* are sometimes made of superior wool and silk.

On a few other Materials used occasionally in making Cloth.

The following substances, either actually employed, or proposed, for making cloth, are more interesting as objects of curiosity than as deriving any great importance from their actual value. They are, however, proper to be noticed, since, in this age of invention and speculation, hints of this kind may possibly suggest new and useful applications.

5736. *Several other caterpillars besides the silk-worm spin a kind of silk*, but it does not appear that any successful experiments have been made on them with the view of employing their threads in cloth.

5737. *The short-legged spiders*, also, form balls of silk to enclose their eggs. Some trials have been made with these; but they have all proved inferior in quality to the true silk, or cannot be procured in sufficient quantity to render them an object of attention. Indeed, from the ferocious disposition of these insects, they cannot be kept together in any number, as they fight and destroy each other.

5738. *The pinna marina*, a species of large muscle abundant on the coast of Italy, has the faculty of spinning from its body certain fine, brown threads, resembling silk, by which it fastens its shell firmly to the rocks. These threads, collected, form a remarkably fine kind of silk, of which stockings, gloves, and other articles, in small quantities, are manufactured by the people on those shores. The pinna fastens itself so strongly to the rocks, that the men who are employed in fishing it are obliged to use considerable force to break the tuft of threads by which it is secured, fifteen, twenty, and sometimes thirty feet below the surface of the sea. The threads of this shell have, from very ancient times, been employed in the manufacture of certain fabrics; it was well known to the ancients under the name of *byssus*, and was wrought, in very early times, into gloves and other articles of dress and ornament. It appears that robes were sometimes made of it, since we learn from Procopius that a robe, composed of byssus of the pinna, was presented to the satraps of Armenia by the Roman emperor.

Several beautiful manufactures are wrought with these threads at Palermo. They are, in many places, the chief object of the fishery; and the silk is found to be excellent. The produce of a considerable number of pinnæ is required to make one pair of stockings. The delicacy of the thread is such, that a pair of stockings made of it can be easily contained in a snuffbox of ordinary size, and, notwithstanding their extreme fineness, are found to protect the legs alike from cold and heat. Indeed, stockings of this kind are found too warm for common wear, but are esteemed useful in gouty and rheumatic cases. This great warmth of the byssus, like the similar quality in silk, results, probably, from both being imperfect conductors of heat as well as of electricity. It is not probable that this material will ever be obtained in great abundance, or that it will cease to be a rarity, except in the places of its production. It is never seen in England except in the cabinets of the curious.

5739. *A species of vegetable silk* may be procured, according to M. la Rouverie, from the young branches of the paper mulberry, from the bark of which the Japanese prepare a paper. Cutting the bark while the tree was in sap, and then beating it with mallets and steeping it in water, he obtained a thread from the fibres almost equal to silk in quality; and this was woven into a cloth, whose texture appeared as if formed of that material. The women of Louisiana prepare nets and fringes from fibres obtained, in the same manner, from the mulberry; and the finest of the Otaheitian native cloth is made of the bark of this tree.

5740. *The leaves of the pineapple plant* have been long known to afford a fibre which may be applicable to the purpose of making a species of cloth. The leaves are, in fact, composed of a bundle of these fibres, lying parallel, and extending from the base to the point of the leaf. To prepare these fibres for use, it is only necessary to pass the leaves through a very strong press, or under a heavy hammer, by which they are crushed, and all the juicy matter forced out; this leaves the fibres dry, and resembling a large skein, which, after being rinsed in water and dried, becomes easily separable into a white, glossy material, of considerable strength, resembling flax. This plant grows abundantly in tropical countries with very little cultivation; and it has lately been proposed to employ it in this way.

5741. *Cloth has been manufactured from the wool of the cotton grasses*, by Mr. Helliwel, of Greenhurst Hay, near Todmorden, in Yorkshire. The cloth is russet, very firm, and beautiful; he has also made yarn, for stockings, of the same material. There are two kinds of cotton grass plants; the common or single-headed cotton grass, *Eriophorum vaginatum;* and the narrow-leaved or many-headed cotton grass, *Eriophorum angustifolium*, both perennial plants; but it was from the latter that the cloth and yarn were made. This plant grows wild principally in the highest and most useless land in the kingdom; and it is thought that on Stansfield Common, near Todmorden, there might be from two to three hundred weight produced upon an acre, and that the cost would not exceed 2*d*. to 3*d*. a pound.—*Leeds Mercury.*

5742. *The stalks of nettles* have been used in France for making cloth.

5743. *Hop stalks* have been used in Sweden for making a strong kind of cloth, by a process very similar to that of preparing flax.

5744. *Glass* is a substance that must once have appeared to be one of the most unfit for this purpose; yet the art of spinning this brittle substance into very fine filaments while in a semi-fluid state has suggested the idea of making the threads fine enough to be employed as a material for cloth. Glass is known to be one of the most elastic substances; and so great is the elasticity of its filaments, which can be made thinner than hair, that they bend easily in any direction without breaking. A manufacture has lately been established in which spun glass is employed, together with silk, in forming a splendid kind of brocade, in which the glass threads form the figured pattern. This glass may be made of any colour: when yellow, the threads imitate gold; and when white, they look like silver; and they possess one great advantage, that they can never tarnish nor change colour in any way. Nothing can exceed the beauty and richness of this new kind of cloth, which has already been employed for dress and furniture. Specimens of this beautiful manufacture may be seen at the shop of Williams and Sowerby, Oxford-street, London, who are the patentees.

CHAPTER VII.

LACE.

SECT. I.—HISTORICAL REMARKS.

5745. This delicate and beautiful fabric, which has always been esteemed one of the most ornamental parts of dress, may lay claim to high antiquity, as it appears, from paintings, to have been used for the borders on dresses of Grecian ladies. It has been long made in Italy, and was brought from thence into France and the Netherlands: from the latter country the manufacture came to England, it is supposed, by some refugees, who settled in Bedfordshire and Buckinghamshire, where, in 1640, this art was in a flourishing condition. It had arrived at great perfection in the Netherlands, particularly in Antwerp, Brussels, Mechlin, Louvaine, and other places. Brussels and Mechlin laces were worn by the nobility and persons of high rank in the time of Charles I., Queen Anne, and George I., as is evident from the portraits by Vandyke, Sir Peter Lily, and Sir Godfrey Kneller. These laces were rich and durable, and were worked by hand on the cushion or pillow. In some places in England, lace was also made with great skill, particularly at Honiton in Devonshire, some of which nearly, if not quite, equalled the best Brussels point lace; and, during the war, veils of it were sold for from twenty to one hundred guineas. A very rich dress of lace, worn by her present majesty, has been made lately at Honiton.

Sect. II.—Manufacture of Lace.

5746. *Lace is a delicate net-work, formed of thread, cotton, or silk*, the meshes of which are varied in their figure, being eight sided, six sided, &c. The lace is sometimes ornamented by a thread, called the gimp, much thicker than that of the net, which is worked in among the meshes in the figure of flowers or of various elegant curves; and upon the taste exhibited in these much of the value depends. The various kinds of lace are denominated either from the places where they are manufactured, or from the particular manner of working: such as point net, Brussels or Flanders lace, made in the Netherlands; blond, made in France; pillow or bone lace, and bobbin net, made in this country.

5747. *Not many years ago, all lace was made by hand of flax thread;* and as the process was extremely tedious, particularly when of great width, with complicated patterns worked by the needle, it was very expensive: at present, machinery is also employed to produce it from cotton thread; and the consequence is, that the price of lace has fallen in a degree of which we have scarcely any other example in manufactures.

Lace made by hand, or, as it is called, *pillow lace* and *bone lace*, is worked upon a pillow or cushion, upon which a piece of stiff parchment is stretched, having a number of holes pricked through it to form a pattern of the intended lace. Through these holes pins are stuck into the pillow; and the fine threads, wound upon small bobbins made of ivory or bone, are woven around the pins, and twisted round each other in various ways, to form the required pattern. Bedfordshire, Buckinghamshire, and Northamptonshire were the chief places in England where this kind of lace was made, and it once gave occupation to multitudes of women in their own houses, till the machines deprived them of this occupation; at present still some earn a miserable subsistence by lace-making.

5748. *The imitation of this manufacture by machinery* was first attempted, at the close of the last century, at Nottingham. In 1809, Mr. John Heathcote invented and patented a machine for weaving the real twisted lace, like that made on the pillow: this was called the bobbin machine, and hence the lace produced by it is termed bobbin net. A considerable quantity of lace was made under this patent, which expired in 1824. Immediately a multitude of persons became desirous of embarking in a trade which had so lately yielded a very large profit.

"A temporary prosperity," says Mr. M'Culloch, "shone upon the trade, and numerous individuals, clergymen, lawyers, doctors, and others, readily embarked capital in so tempting a speculation. Prices fell in proportion as production increased; but the demand was immense; and the Nottingham lace-frame became the organ of general supply, rivalling and supplanting, in plain nets, the most finished productions of France and the Netherlands." The inhabitants of Nottingham look back to that period as to a sort of golden age, never equalled before or since. Dr. Ure remarks that "it was no uncommon thing for an artisan to leave his usual calling, and, betaking himself to a lace-frame of which he was part proprietor, realize, by working upon it, 20*s*., 30*s*., nay, even 40*s*. per day. In consequence of such wonderful gains, Nottingham, the birth-place of this new art, with Loughborough and the adjoining villages, became the scene of one epidemic mania." The lace machines are of complicated and difficult construction; but, to execute them, journeymen clock-makers were brought from Birmingham, and afterward master clock-makers set about their manufacture, in consequence of which a great many improvements have been made, and some of them are among the most ingenious pieces of mechanism known. Competition and superabundant supply gradually caused this fever to subside; but the manufacture has now taken its place among those of national importance. From this invention, the most extraordinary changes have taken place in the prices of lace. It has been stated that lace which was sold by Mr. Heathcote for five guineas a yard soon after the taking out of his patent, can now be equalled at 1*s*. 6*d*. a yard; that quillings, a narrow kind of lace, as made by a newly-constructed machine in 1810, and sold at 4*s*. 6*d*. a yard, can now be not only equalled, but excelled, for 1½*d*. a yard; and that a certain width of net, which brought £17 per piece twenty years ago, is now sold for 7*s*. It is calculated that at present above 200,000 persons are employed in the manufacture; one frame can produce 21,490 square yards of bobbin net annually, and about half of what is made in England is exported, in the unembroidered state, chiefly to the Continent; but it appears that, owing to smuggling lace machines out of this country, manufactures are establishing there which bid fair to rival us, if not surpass us, on account of their lower prices of labour from cheaper living. It is remarkable, also, that, as lace machines are now worked by steam power, they do so much more work than the first-invented machines, that the possessors of the latter suffer as much as did the hand lace makers when machines were first invented. There are in this country at present upward of 4000 lace machines, and Messrs. Boden and Morley, of Derby, make 40,000 square yards of lace per week, a quantity that would cover eight acres of land; and it is calculated that the value of the lace manufactured in England in a year exceeds two millions sterling. After the lace comes from the machine, it has to go through the operation of having the loose filaments burned off by singeing in a gas flame.

5749. *The embroidering of lace*, or working figured patterns on it, was at first all done by hand, in the tambour; and many females still earn a miserable pittance by their labour at this work, particularly at Nottingham; but even of this a great deal is now done by machinery that drive a multitude of needles.

When the net is to be embroidered by hand, a pattern is first drawn on paper; if the quantity to be embroidered is considerable, the design is cut on a wooden block, and printed on the net; after being embroidered, the net has next to be bleached, and dyed if required. It is afterward "dressed," or stiffened, by being dipped into a mixture of gum, paste, and water, and stretched on a frame by pins till it is dry.

Sect. III.—Description of the various kinds of lace.

5750. *The most celebrated foreign laces are*, according to Mr. Slater,

Brussels, the most valuable. There are two kinds: *Brussels ground*, having a hexagonal mesh formed by platting and twisting four threads of flax to a perpendicular line of mesh; *Brussels wire*, ground made of silk, meshes partly straight and partly arched. The pattern is worked separately, and set on by the needle.

Mechlin, an hexagonal mesh formed of three flax threads, twisted and platted to a perpendicular line or pillar. The pattern is worked in the net.

Valenciennes, an irregular hexagon, formed of two threads, partly twisted and platted at the top of the mesh. The pattern is worked in the net similar to Mechlin lace.

Lisle, a diamond mesh, formed of two threads platted to a pillar.

Alençon (called blond), hexagon of two threads, twisted similar to Buckingham lace, considered as inferior to any other made on the cushion.

Alençon point, formed of two threads to a pillar, with octagon and square meshes alternately.

5751. *The French nets* made by machinery are,

Single press point, called, when not ornamented, *tulle*, and when ornamented *dentelle*, made of silk, is an inferior net, but attractive from the beautiful manner in which it is stiffened.

Trico Berlin, so called from being invented at Berlin, and the stitch being removed three needles from its place of looping, is fanciful and ornamental in appearance, but not in demand in England.

Fleur de Tulle, made from the warp-lace machine; mesh of two descriptions, which gives a shaded appearance to the net.

Tulle Anglois is double-pressed point lace.

Thread lace of foreign manufacture must be imported in quantities of not less than twelve yards, unless of the value of £2 or upward per yard, or solely for private use; if lace so imported shall be joined or pieced, it is liable to forfeiture. Foreign lace can only be imported into the port of London. No gold or silver lace can be imported, under the penalty of £100. Licenses must be obtained annually for the sale of foreign and British lace.

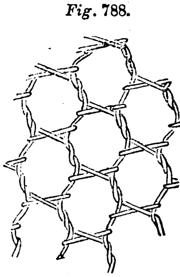
5752. *English laces are*,

A Silk Net in imitation of Blond.—A yard, three inches wide, machine-made, is now sold for 3½*d*., which formerly cost several shillings.

Quilling silk net, slightly stiffened with gum.

Pillow, or Cushion, or Thread Lace.—This is worked on the pillow or cushion, as above described; and, being made of linen thread, is the most durable. No lace will bear repeated washing without injury, except the thread lace; it is, therefore, still preferred by many persons.

Fig. 788.



Piece bobbin net is machine-made lace, of various widths, from 3-8 to 8-4. It resembles in its texture the plainer kinds of pillow-made lace. The threads are entwined together, so as to form perfectly regular six-sided meshes. The wood-cut, *fig.* 788, exhibits, on a magnified scale, the disposition of the threads, which results from the crossing and intertwisting of three, one of which proceeds from above, downward, in a winding direction, as the warp; the two others in a zigzag direction, crossing each other.

The beauty of bobbin net lace depends not only on the quality of the thread, but principally upon the perfectly hexagonal shape of the meshes. This elegant texture possesses all the beauty and regularity of the old Buckingham pillow lace. It is sometimes wrought with a thick thread among the meshes, in various patterns, representing sprigs, flowers, scrolls, wreaths, &c. Since the discovery of a new mode of finishing this lace, it has been made to resemble the most delicate specimens of Mechlin. It is used for veils, borders, edgings, trimmings, &c., and is sold at prices which appear excessively low when compared with its delicate fineness and seemingly elaborate workmanship.

Tatlings and pearls are narrow edging made to sew on to the piece net; the former from a quarter of an inch down to a sixteenth, and the latter from a sixteenth to the narrowest width possible.

Sect. IV.—Gold Lace.

5753. *Gold lace is formed of threads, made by covering yellow silk thread with flattened gold wire;* this thread is covered, being afterward woven into lace or cloth. The gold wire is seldom made entirely of gold, but is, in fact, only silver wire gilt, and the manufacture of it exhibits a striking instance of the ductility of gold, and the extreme thinness to which it can be reduced. To form it, a cylindrical ingot of silver is superficially gilt, and is afterward drawn into wire by passing it through a succession of holes in a steel plate, each one smaller than the other. The fine wire so produced is then flattened by a flatting-mill.

The gold with which the ingot is covered at first is not above the $\frac{1}{400}$ or $\frac{1}{500}$th of an inch, and sometimes not the $\frac{1}{1000}$th of an inch, being thin gold leaf burnished on to the silver. When the ingot has passed through the several holes required to form it into fine wire, Dr. Halley calculated that the thickness of the gold was only the $\frac{1}{134500}$th part of an inch; but by flatting, its surface is much increased, and consequently the gold is still thinner. Reaumur's calculation made its thickness still less, only $\frac{1}{350000}$th part of an inch and yet the gilding is entire; the best microscope does not show the least break.

The flattened gold wire so formed is twisted round a silk thread by means of a curious, complex machine, which causes several of the wires to go round the silk at once so that each wire shall just touch another, the whole forming a complete covering of gold.

CHAPTER VIII.

ELASTIC FABRICS AND WATER-PROOF CLOTH.

5754. *Elastic fabrics* being required for various purposes, such as braces, bandages, &c., several methods have been contrived to produce the quality of elasticity. Certain substances, as coils and springs of steel wire, are of themselves more or less elastic; and modes of weaving have been tried which have produced elasticity to a considerable degree, as may be observed in the stocking manufacture, and particularly the ribbed stockings.

5755. *The most perfectly elastic fabrics* are made by means of India rubber, or caoutchouc. The very great elasticity of this substance, with its other properties, suggested the idea that if it could be liquefied, and formed into threads possessing the same elasticity as at first, it would become a valuable material for elastic cloth; but, as we have stated, in the section on "Materials for Furniture," no means could be devised for some time for effecting this purpose. At length a method was discovered, by a major in the Austrian service, of producing threads from caoutchouc, and weaving them into cloth, without dissolving it. This material is softened by hot water, and pressed into thin laminæ, which are cut by a machine into very thin strips. These strips are then extended till they attain the required degree of slenderness; and they are kept stretched for some days in a cold apartment, till they lose their elasticity and become fixed. The threads are then put into a braiding machine, and covered with another thread of cotton, silk, or worsted, which is wound round them entirely, and afterward they are woven into cloth. When this cloth is finished, it is laid upon a table, and a hot smoothing-iron is passed over it, which restores the elasticity to the caoutchouc. It is necessary, by stretching the threads, to deprive them of their elasticity; for, if they were woven in their elastic state, the cloth would become puckered. When elastic bands, garters, or braces are made, the warp only is made of India rubber. These fabrics were first made at Vienna, whence the inventor removed to Paris, and erected a great factory for them at St. Denys. They are now also made in this country. Of the same material are made elastic belts, elastic stockings for varicose veins, knee-caps for weak knees, bands for sprained ankles or wrists, and other surgical bandages.

Water-proof Cloth.

5756. The inconveniences arising from our clothes being wetted by the rain are so universally felt, that numerous attempts have been made to render cloth impervious to water, or, as it is called, "water-proof." Some fabrics are made of such materials, or of such a texture, that they have this desirable quality, either entirely or to a considerable degree, without any preparation. Skins of most kinds are impermeable to wet, and the real camlets, and even good Scotch plaids, keep out the wet for a long time; but none of the artificial fabrics can be considered as completely water-proof, and skins are not sufficiently pliable nor elegant to be generally used as clothing. The first sort of fabric invented for the purpose of affording a completely water-proof covering appears to have been linen or silk varnished over, and familiarly known by the name of *oil skin;* of this great coats and cloaks have been made, coverings for hats, and other articles of dress. These are efficacious to a certain degree, and are still in use; they are, however, liable to several objections. *Varnished linen,* improperly termed *oiled linen,* soon cracks in folding when much used, and allows the wet to get through. *Oiled silk* is much better, being more pliable, but it is likewise more expensive; cloaks have been made of this so light and thin as to go into the pocket, but their shining appearance is too remarkable, and they were never much used.

5757. *A method employed in France for rendering leather, canvass, linen, &c., water-proof,* deserves insertion, as it may be useful on particular occasions. One hundred gallons of linseed oil are boiled over a gentle fire; to this are added a pound and a half of sugar of lead, and half a pound of very finely-powdered pumice stone. The liquid should be kept boiling until it becomes of such a consistence that, after being mixed with a third part of its weight of pipe-clay, it should be of the thickness of molasses; the whole is then passed through a lawn sieve. Next, ten pounds of pipe-clay are ground in thin glue to the consistence of lard; and to this the above varnish is added gradually, taking care to stir it well all the while with a strong wooden spatula, until it be thoroughly incorporated. A pound and a half of burned umber is now added, together with a pound and a half of white lead ground in oil. To apply this composition, the linen, or other cloth, is stretched over a wooden frame, and the varnish is spread by means of a broad spatula; the frame is now reversed, and the other side covered in the same manner. After remaining a week to dry, the article is taken off for use. This was not intended for ordinary clothing, but for boat cloaks, awnings, covers for carriages, &c. If a very glossy varnish be required, five pounds of the above composition are added to an equal quantity of clear resin, which is heated over the fire until it is dissolved; to this is added two pounds of oil of turpentine, with which some colour has been ground to give it a desirable tint; the whole is then passed through a lawn sieve. This varnish is then laid on with a brush, and, when quite hard, is rubbed over with pumice stone and water, and afterward well washed. Two or three coats of this are applied, letting one dry before another is laid on.

5758. *Cloth lined with oiled silk* has also been tried; but though this is impervious to the wet, yet, as the cloth outside holds much water, this, by evaporation, produces considerable cold, while the varnished lining prevents the insensible perspiration from escaping. Such contrivances may, however, be occasionally useful.

What is most desirable is to give the cloth the same property which we find in the fur of several animals, as the otter, beaver, &c. By this repelling property, water, when thrown upon the animal, rolls off again in drops, without wetting it. The cloth would thus be pervious to the air, or to the perspirable matter; but this degree of perfection does not appear to have been yet completely attained, although the idea has occurred to many persons, and several endeavours have been made to invent a cloth of this kind.

5759. *Cloth and stuffs have been made, in a considerable degree, water-proof* by a wash of the following composition: Dissolve an ounce of isinglass in a pound of soft water, one ounce of alum in two pounds of water, and a quarter of an ounce of soap in one pound of water. When the three solutions are made and strained, mix them together, and simmer them for some time. Brush this mixture over the cloth while hot; when dry, brush it well and give it another coat, all on the reverse side. In two or three days the cloth will be fit for use. Cloth prepared in this way does not prevent the air from penetrating, like India rubber; for lighter fabrics glue and gum arabic are added, and sometimes the stuff is dipped, instead of being brushed over.

5760. *The most complete water-proof cloths* are those made so by means of India rubber, which is extremely elastic, insoluble in water, and impervious to water or air. (See description of caoutchouc, in Book V., Chap. V., "Materials for Furniture.")

5761. *In South America* they take advantage of these properties to make water-proof *ponchos*, or cloaks. The cloth is stretched on a frame, and a layer of the liquid juice, fresh from the tree, is spread upon it, which becomes in a few minutes thick enough to have another cloth applied. Both these cloths are then pressed together, and are thus firmly united, the whole being perfectly impenetrable by water. But although this process is extremely easy in the native country of the caoutchouc plants, where only the juice can be procured in a liquid state, it is but of late that means have been discovered for rendering this material available here for the same purpose.

5762. In 1797, Mr. Johnson took out a patent for rendering cloth water-proof by covering one side with a varnish made by dissolving India rubber in equal quantities of oil of turpentine and spirits of wine. To conceal the varnish, which was laid on the wrong side of the cloth, some substance was sifted over it, such as silk, wool, or flock. The articles made in this manner were called *hydrolaines;* but they do not appear to have answered, as they never came much into use.

5763. *The water-proof cloth* which is most perfect in excluding the wet is that which is prepared according to the process for which Mr. Mackintosh had a patent, now expired, and which was mentioned when describing caoutchouc as a material used in manufactures. In this process the India rubber is dissolved by means of the liquid called naphtha, obtained from coal, and the solution is put between two folds of cloth, as in the ponchos of South America, just mentioned; the cloths are then pressed together, and hung up till this varnish becomes sufficiently solid. This method fully answers the intended purpose, and such cloth is not only used for cloaks and shooting jackets, but for a variety of other purposes, as Dr. Arnott's water beds, nursery aprons, and many other articles to be seen in the shops. Even boats, so light as to be easily carried over land, have been made by stretching this cloth over a wicker-frame; and, as the cloth is impervious to air as well as water, a cushion very convenient for travellers, from its elasticity, is made by blowing up a bag made of it, to which a stop-cock is attached. It may be observed that this cloth can be scoured with a brush and soap and water when it is soiled. Another method of using the India rubber for the same purpose has lately been tried, founded upon the pressing this material into very thin sheets. These are fixed between two thicknesses of cloth, or only on one side.

5764. *All water-proof cloth hitherto made* by varnishing over, or by any other process by which they are rendered impervious to the air as well as to the wet, have the disadvantage of confining the insensible perspiration, the consequence of which is that they soon feel intolerably hot to the wearer, and are, on that account, not only unpleasant, but unhealthy, except worn in such a way as to allow of the external air having free access to the rest of the dress. Such water-proof clothes, therefore, should not be made to fasten close round any part of the body, but be as loose and open as possible when it does not rain: that being attended to, they are found extremely useful in travelling.

5765. *Several cloths, said to be water-proof,* yet pervious to air, have been advertised of late; but as the processes are kept secret, we are not able to pass any opinion on them. One of them is said to be prepared with the powder of Lycopodium, which perhaps may be effectual.

CHAPTER IX.

FURS.

5766. *The term fur includes* the skins of all animals that are covered with an exceedingly soft and fine hair, except those which come under the class of wool. In the northern regions, furs have always been highly esteemed on account of the warmth which they afford as articles of dress; but the most valuable kinds have been chiefly employed to ornament the robes of persons of high rank, and vestiges of their application to this latter purpose are still visible in England, in the state robes of the king, the nobility, judges, &c., which are decorated with the fur of the ermine. This is also traceable in the bordering and other forms belonging to emblazonry in armorial bearings. The fur of the black fox is a princely ornament in the north. It does not appear, however, that furs constituted any part of the distinctive dress worn by the patrician orders of Greece and Rome, and the custom of wearing fur as an ornament is probably derived from the northern parts of Asia and Europe.

5767. *It is remarked in natural history* that the colder the country the finer and warmer are the furs of animals, it being wisely provided in the economy of nature that their clothing should be adapted to the rigours of their situations. The finest furs are, therefore, brought from the colder regions; those of high latitudes are better in quality than those of more temperate climates; thus, the produce of Siberia is superior to that of Russia, and the imports from Canada are preferable to those from the United States. Even during winter the furs of most animals improve both in quality and colour. The principal countries for furs are the solitary wilds of Siberia, and the immeasurable forests of North America: they form the riches of those dreary wastes, which produce nothing else for human use; and their value has tempted men to expose themselves to the utmost hardships of cold and hunger while pursuing the chase amid perpetual frost and snow.

5768. *At present furs are esteemed and worn,* not only in those countries where they are useful as a defence against the severity of the seasons, but as ornaments of dress, according to the caprice of fashion, by the inhabitants of milder climates, as the Southern Russians, Poles, Chinese, Persians, Turks, &c. All these nations, being of Tartar or Sclavonian descent, are said to inherit from their ancestors an attachment to fur clothing. Even under the burning suns of Syria and Egypt, and the mild climes of Bucharia and Independent Tartary, there is also a constant demand for furs, although there exists no physical necessity for them. With us they are used partly for the warmth they afford, as well as for ornament.

5769. Previously to the discovery of the New World, the furs in general demand throughout Europe were procured from the north and north-eastern parts of the Russian empire. The colonization of the countries bordering on Hudson's Bay gave a new turn to the trade in furs, and the cession of Canada by the French occasioned an immense importation of this article; in consequence of which, muffs, tippets, and furred garments, which formerly were only worn by people of quality, or the upper classes of gentry, now adorn the dress of females in a sphere of life which, at no remote period, usually displayed more homely attire.

5770. From the eagerness with which the fur trade has been pursued for many years, and the vast destruction of fur-bearing animals, this material has necessarily become more scarce. The advanced state of geographical science shows that few new countries remain to be explored; and from the indiscriminate slaughter practised by the hunters of Asia and America, and the appropriation to the uses of man of those forests and rivers which have afforded them food and protection, they must continue to decrease, although a supply may long remain in the mountains and uncultivated tracts.

5771. *When skins are merely dried*, being in other respects just as they were taken from the animal, they are denominated *peltries;* and they are properly called *furs* after they have undergone an aluminous process, by which the skin has been converted into a kind of leather. The principal animals from which fur is procured, are the ermine, sable, fox, bear, beaver, martin, otter, squirrel, cat, hare, and rabbit; but there are many other animals more rare which afford a fine fur. That of various amphibious animals, as the seal and beaver, is protected by a coating of long, coarse hair; and when this hair is removed, the short fur appears, which is shaved off for the purpose of covering hats.

5772. *The fur of the ermine* is the most valuable of any, and is well known as forming the lining to the state robes of royalty. This little animal is of the genus mustela (weasel), and resembles the common weasel in its form; it is in length from fourteen to sixteen inches, from the tip of the nose to the end of the tail; the body is from ten to twelve inches long. The change of colour which the ermine experiences in winter in northern climates is a matter of much interest to the physiologist, and of profit in a commercial point of view. In summer its fur is brown, and it is only in winter that this becomes of that softness and snowy whiteness which occasions so high a price to be set upon it. This is effected, not by the loss of the summer coat and the substitution of a new one for the winter, but by the actual change of colour in the existing fur. The extremity of the tail, however, undergoes no change, but remains permanently of a brilliant shining black, the under parts retaining a slight yellowish tinge. When the white fur is made up into dress, the tails are inserted, one to each skin, at regular distances, in *quicunx* order, and the pure white of the skin is thus relieved and set off by the rich black of the tail. The early employment of the fur for such uses occasioned its introduction among the colours of heraldry, where it appears either as the ground of the shield, or in the bearings. The fur is found of the best quality only in the cold regions of Europe and Asia, and the animal lives in hollow trees, river banks, and especially in beech forests; it preys on small birds, is very shy, sleeping during the day, and employing the night in search of food. It is taken by snares and traps, and sometimes shot with blunt arrows. The fur of the old animals is preferred to that of the younger. It is seen, though rarely, in Scotland and in the north of England, where it is called the *white stoat*, but its fur is very inferior to the foreign.

5773. *The fur of the sable* is also very highly prized; it is brownish black, and the darker the more desirable it is. It is finer, softer, and more glossy than that of any other quadruped, except the ermine. The sable is a native of Northern Europe and Siberia, and is also of the genus *mustela.* In the northern parts of Asiatic Russia it is found of the richest quality and darkest colour. In its habits it resembles the ermine, preying on small squirrels and birds, sleeping during the day, and prowling for food during the night. It varies in dimensions from eighteen to twenty inches. It is much used at present for making the well-known articles of dress called *boas.*

5774. *The fitchet weasel* yields a valuable fur, though inferior to the sable.

5775. *Fox-skins* furnish a considerable variety of furs. In the cold countries animals of this species are of all colours, white, gray, blue, iron gray, silver gray, red, variegated, and black. Of these the last is the most valuable, and the first the least; the hair of the white fox is apt to fall off. The blue fox-skins are sought for with avidity, owing to their scarcity, and the black fetch a high price, from their justly-acknowledged beauty, but the red fox of Asia is of a more brilliant colour, and its fur softer and finer, than any other; in China it is highly prized, and is variegated by adding spots of black fur. The silver fox is a rare animal, a native of the woody country below the falls of the Columbia River in North America. It has a long, deep, lead-coloured fur, interminged with long hairs, invariably white at the top, forming a bright, lustrous silver gray; by some it is considered as more beautiful than any other kind of fox.

5776. *A dog* is bred in Norway and Lapland for the sake of its skin, which is covered with a remarkably fine, soft, and glossy fur of a dark brown or black colour, and which is imported for muffs and tippets.

5777. *The martin* affords a valuable fur of various colours; but the part that extends along the spine, being of a deeper and richer brown than the rest, is most esteemed. The martins from Northern Asia and the mountains of Kamtschatka, are much superior to the American, although among the latter are some of great beauty. The fur is much employed in *boas*, and is often dyed for sables.

5778. *The sloth* has an extremely beautiful fur, possessing a high lustre.

5779. *The sea otter of North America* has a very fine, close, soft fur. It abounds in the rivers Columbia and Missouri, and also frequents, in great numbers, the Aleutian and Kurile Islands, between Asia and the northwest coast of America. This fur is jet black in winter, with a silken gloss, and that of the young animal is a beautiful brown. It bears a high price in China, where it was introduced in 1780, when furs had become so scarce in Siberia that the supply was insufficient for the demand in the Asiatic countries. It is not much employed in England, but chiefly exported to the north of Europe.

5780. *The fur seal* affords a skin for which the Chinese give great prices. Such numbers have been killed in the South Shetlands, that they have become almost extinct there.

5781. *The skin of the common seal* is made into leather by being tanned, or it is dressed with the fur on for caps and various articles of dress. Among the northern tribes, these skins afford excellent clothing and coverings for temporary habitations. Hundreds of thousands of these animals are killed every year for their skins and oil on the shores and ice-fields of Newfoundland.

5782. *Perhaps the softest and most delicate fur known* is that which clothes a little animal called the *chinchilla*, about the size of a small squirrel, which inhabits Peru and the northern parts of Chili. The fur was known as an article of commerce, and much prized, shortly after the conquest and occupation of Spanish America; and is mentioned by Father Acosta and Sir John Hawkins; but the habits and character of the animal have been known in this country only very lately. The chinchilla burrows in the ground; and Sir Francis Head, in his journey across the Pampas, found the numerous holes made by them dangerous in riding. Their flesh is remarkably fat, and is much relished by the people, who hunt them with dogs. There are two species; the *chinchilla lanigera*, the largest, is about nine inches in length, much resembling the rabbit; the fur is long, thick, close, woolly, somewhat crisped, grayish, or ash-coloured: the other species is described as smaller, only six inches long, and having the wool still softer. It feeds upon the roots of plants, is extremely gentle and docile, and may be easily tamed and kept in the house. Great numbers of these animals are caught in the countries adjoining the Andes, and sent to traders, who carry them to Buenos Ayres, or to Lima, whence they come to Europe. Captain Beechey lately presented a living specimen to the Zoological Society, and another has been added by Lady Knighton. An entire skin has been deposited in the British Museum.

5783. *The skins of several other animals* are employed as furs, and have various values; as those of the *wolverene*, *racoon*, *genet*, *wolf*, *badger*, *lynx*, *bear*, &c. The furs of the *beaver*, *otter*, *lynx*, and *racoon* are used principally for hats; and the *bear-skins*, among other uses, furnish an excellent material for cavalry caps and other military equipments. The skins of the *buffalo*, of the *Rocky Mountain sheep*, of *various deer*, and of the *antelope* are included in the fur trade. The white furs of the *arctic fox* and *polar bear* are sometimes brought from Greenland, but are not particularly valuable.

Among furs may be classed the *Russian*, *Bucharian*, and *Persian lamb-skins*, the soft, compact, and elastic wool of which is formed naturally into elegant curls or waves, as if pressed close to the skin by art; but when killed immediately after birth, or taken from the mother, they are still more beautiful, and often elegantly marbled with feathered waves, like silk damask. The most prized of the former are the blue, the black, and the silver gray; but of the *unborn* lamb-skins, as they are called, the fine black is the dearest and most esteemed. These are very generally used as an essential part of the dress of thousands among the lower classes in Persia, Russia, Poland, E. Prussia, Hungary, and Bohemia.

5784. *The skins of the rabbit and hare* are likewise dressed as furs, and the hair is employed in hats, &c. The supply would not be equal to the demand were our furriers dependant upon our country for them. Hundreds of thousands of rabbit-skins are annually imported here from Germany and other parts of the northern and middle districts of Europe, where myriads of rabbits are bred for this purpose. The fur of the *Angora rabbit* is excessively long. The prepared skins of the rabbit and hare being as warm as some furs, they are used as bosom comforters by those who are subject to diseases of the lungs.

5785. *The skin of the squirrel* has a delicate fur, which, though small, is sometimes joined together in useful articles.

5786. *As furs are used only in winter dresses, and are necessarily laid up during the summer months*, it becomes of importance to know by what means they may be defended from the ravages of the moth, to which they are particularly liable. The most efficacious preventive, it may be presumed, is that which is adopted by the traders and dealers in furs; and on inquiry being made of several, the answer obtained is, that no dependance is had on any of the strongly-scented substances, as camphor, commonly recommended for effecting the purpose in question. The precaution generally practised is daily to take out and open the furs; and while they are extended to beat the back part or skin very gently with a slender cane or stick; after which the fibres are carefully combed out with a comb adapted to this use. Thus the moths that may have obtained access to the furs are expelled, together with any eggs or larvæ that may have been deposited. The furs also, by this daily exposure to the air, are prevented from contracting any disagreeable musty smell, and are kept clean and sweet. To this we may add that, immediately on leaving them off as a wear, they should be put into boxes or drawers, so perfectly tight that no moths can have access to them, in which case they will be perfectly safe; for it is a vulgar error to suppose that moths or any other insects can come without being bred by others. The place where they are kept should be perfectly dry, and they should be aired frequently, to prevent mildew. Bags of brown paper, or strong linen, perfectly well closed, or even for valuable furs tin cases or boxes, will keep them from moths. Some recommend washing the skin with a solution of corrosive sublimate in spirits of wine; but as this is a strong poison, being a preparation of mercury, its use may be hazardous, although it is employed successfully to keep away insects in collections of butterflies and other objects of natural history.

CHAPTER X.

BLEACHING.

5787. *By bleaching, in general, is understood* the freeing cloths of their natural brown or otherwise coloured tinge, and rendering them perfectly white after coming out of the weaver's hands. Also linen, and other articles already in use, when they have lost much of their original whiteness, and become of a bad colour, are sometimes restored to their purity by bleaching.

SECT. I.—BLEACHING OF LINEN.

5788. The most ancient mode of performing this process, and, indeed, the only one formerly known, consisted in exposing the linen cloth on the grass, where it was subjected to the combined action of frequent wetting, of the air, and the rays of the sun.

5789. *Grass bleaching*, that is, bleaching by the influence of water, air, and sunshine, is now seldom practised in regular bleach-fields, having been superseded by an improved method, to be afterward described; but it is used in some parts, and, indeed, is the most common in many civilized countries. It is supposed to be the least injurious to the texture of cloth; and it is that which at present we are most interested in explaining. The details of the process vary in some respects, according to the nature of the cloth to be bleached; and we shall first describe the mode of bleaching linen.

5790. *Linen, as it comes from the loom,* is charged with the weaver's dressing, which is a paste of flour and water brushed into the yarn, to render the stretching of the warp more easy. To discharge this paste, the web must be steeped in cold water for forty-eight hours, till the paste is decomposed by fermentation, which does not extend to the linen itself. Boiling the linen in water will not answer, since paste is not soluble in boiling water. When the linen is well washed and rinsed after this, it is of a grayish-white colour, although the fibres of which it is composed are naturally very white. To separate the matter that discolours the linen is properly the business of bleaching. This colouring matter is of a resinous nature, insoluble in water, and, from its intimate union or dissemination through the very fibres of the flax, is difficult of separation, even by those substances which have a solvent power over it. *Alkaline lyes*, or solutions of alkali, rendered caustic, have the property of dissolving resins; hence they have been employed as menstrua for this purpose, but alone they are not sufficient. What appears to be a single ultimate fibre of flax in gray linen is composed of a bundle of minute filaments, closely cemented or agglutinated together by the resinous matter. By the application of the lye the potash first acts only upon the resin of the external coating of filaments, by which means they are loosened or separated, and exposed to the farther action of the air; a second boiling in the lye opens another layer, and thus successively, layer after layer, until the whole is divided or opened to the centre. Were the alkaline solution sufficiently strong to force its way at once to the centre, it would act upon the filaments themselves, and destroy the texture of the cloth. The lye, called the "bowking, or bucking," is prepared by dissolving potash in soft water, to which some soap is added. This liquor is heated to about 100°, and poured upon the linen. After the cloth is well down in the lye, it is drawn off, heated a little higher, and again poured upon the cloth. This operation is repeated at intervals, allowing the lye to remain longer each successive time, and moderately increasing the heat for five or six hours. The cloth is then left steeping for three or four hours, when it is taken out and well rinsed. But each filament, after the alkaline process, retains a certain impregnation of colouring matter so intimately united as to resist the farther action of it. This is removed by the slow and gradual influence of the atmosphere and the rays of the sun, which together decompose it.

It is necessary, therefore, to proceed in the following manner: The linen is carried to the field, where it is spread upon the grass, and secured by pins; water is sprinkled on it so as not to allow it to become dry for some hours. After it has lain about half a day, the watering is less frequent, and at night it is left to the full action of the air and dews. On the succeeding days it is watered three or four times a day, if the weather be dry, and it remains on the field till the air seems to have less effect in whitening. It is then brought back to the coppers, and bucked again with a lye somewhat stronger than the last, rinsed, and again spread out in the field, which is called *crofting*. It is thus bucked and watered ten or fifteen times, according to the weather, making the bucking stronger and stronger till about the middle, and then weaker and weaker till about the last.

It must now undergo the process of *souring*, or steeping in some acid liquor. The acid which had generally been used was formed by the fermentation of bran and water, or sometimes sour whey has been used. But sulphuric acid, very much diluted, has been found more convenient, shortening the process considerably, and being not more injurious. The cloths are kept in the souring for five or six days, and sometimes weeks, if it be formed of milk or bran; or only twenty-four hours if sulphuric acid has been used. The use of the acid liquor is to dissolve any earthy or metallic matter either inherent in the cloth, or accidentally communicated to it, or derived from the impurity of the alkaline salts in which it has been boiled. They are then rubbed with soap, more particularly the selvages, as these resist most the action of the air. The cloth is now again bucked, rinsed, watered, and exposed to the air, and these processes are repeated successively till the linen has acquired the necessary whiteness.

5791. The art of bleaching was formerly so little understood in Great Britain, that nearly all the linen manufactured in Scotland was sent to Holland to be bleached; but it has been since practised here with perfect success, and the whole operation of grass bleaching generally requires six months. In India, where bleaching was practised from the earliest time, citric acid, diluted, was used in some places instead of sour milk; but this old method of bleaching required considerable time as well as labour; and the risk of damage and robbery, from the cloth lying so long exposed, demanded much watching, and, consequently, great expense was incurred. By the modern discoveries in chemistry, these inconveniences have been in a great degree obviated, and a new bleaching agent has been introduced, unknown to our forefathers, but capable of giving astonishing rapidity and perfection to this important art. This new agent is called *chlorine*, formerly named oxygenated muriatic acid gas, which possesses the singular property of destroying all vegetable colours.

5792. *Bleaching by Chlorine.*—The gas called chlorine was first discovered by Scheele, a Swedish chemist, in 1774. Its property of destroying colours may be easily exhibited by putting into a vial containing it several slips of wet printed cottons; after remaining a short time they will become entirely white. When this gas is absorbed by water, a liquid is produced, formerly called oxygenated muriatic acid, which possesses the same remarkable property, and this was first noticed by Scheele from its whitening the cork of the vial containing it; but it was Berthollet who suggested its application to the bleaching of cloths, for which it is found so useful, that it brought down the time required for this operation from months to days, and even to hours. Profiting by the suggestions of Berthollet, several scientific persons in England, among whom were Professor Copland, Mr. Watt, and Mr. Henry, made experiments and improvements upon this new agent. Chlorine gas, by itself, was first found extremely difficult to use, from its volatility and the suffocating nature of its odour. This gas was then condensed in water, and afterward potash was mixed with this, which had the effect, in a considerable degree, of lessening its deleterious action upon the lungs. This diminution of action on the lungs does not depend on the chlorine itself being changed, but on the slow extrication of it permitting the gas to be greatly diluted with atmospheric air. The latter process having been invented at Javelle, the liquid obtained the name of *liqueur de Javelle.*

5793. But a discovery made by Mr. Henry, at Manchester, and by Mr. Tennant, of Glasgow, has entirely obviated the inconveniences occasioned by the smell of chlorine, and rendered the process of bleaching scarcely, if at all, injurious to the workmen. In this new process the chlorine is combined with lime, forming *chloride of lime, which possesses the bleaching qualities, with much less of the noxious smell;* and cloths put into a solution of this, diluted in a proper manner, can be bleached with such rapidity, that it is said a bleacher in Lancashire received 1400 pieces of gray muslin on a Tuesday, which, on the Thursday immediately following, were returned bleached to the manufacturers, at the distance of sixteen miles, and they were packed up and sent off on that very day to a foreign market. It may be easily conceived what a saving of time and capital this must occasion. So greatly has bleaching been benefited by the discoveries of modern science, that all the processes are commonly performed in a few days, and at the trivial cost of a half penny per yard on the cloth bleached and finished. The chloride of lime, or *bleaching powder*, is now made for three pence a pound. In using it, the powder is mixed with a sufficient quantity of water, and immersion in a solution of it answers the same purpose as exposing the cloths on the grass and watering. The dry chloride is less liable to decomposition than the liquid, besides being more portable.

In this new process, therefore, the steeping in bleaching liquor is substituted for exposure on the grass, and the bowking in alkaline lye and steeping in a solution of chloride of lime are repeated several times, until the whiteness is sufficient; afterward the cloth is well washed, passed through sulphuric acid diluted, and washed again with soap; and, lastly, is finished by starching, blueing, and calendering.

5794. *The chloride of lime is made on a great scale*, in the north of England, in the following manner: Lime is spread upon the stone floor, or stone shelves, in a closed room, and the chlorine, in the state of gas, is conveyed into the room by a pipe, when a combination takes place between the chlorine and the lime. The chlorine gas is formed in a leaden vessel by mixing equal parts of black oxyde of manganese and salt, and pouring on an equal quantity of sulphuric acid with as much water; the chlorine gas disengages, and from the vessel a leaden pipe leads it to the lime room. In this case, the salt and the black oxyde of manganese are decomposed; the sodium is converted into soda by attracting oxygen from the oxyde of manganese, and that salt, combining with the sulphuric acid, forms sulphate of soda, while the chlorine passes off in the form of a gas.

5795. *Bleaching liquid* is then made by adding one pound of fresh chloride of lime to two gallons and a half of cold water, which probably does not cost the manufacturer above a farthing a gallon.

5796. *The mode in which this bleaching liquor acts* is the following: When water is added to it, this effects its partial decomposition, by lessening the affinity of the chlorine for the lime; hence one half the chlorine leaves the lime, and dissolves in the water; it is therefore ready to act upon the colouring matter of the stuff exposed to it; and, as we have shown that the effect of chlorine is to destroy colour, this is, accordingly, what happens when coloured cloth is immersed in the liquid.

To increase the bleaching power of this fluid, a little acid is sometimes added, which, uniting to the lime, detaches still more chlorine.

Sect. II.—Bleaching wool.

5797. *In the bleaching of wool*, it is necessary first to free it from the natural grease, called yolk, which it contains; and this is done by scouring it with water mixed with stale urine, the ammonia which this contains being sufficient to remove the grease. In the employment of alkaline lyes for this purpose, great caution must be used; for, though wool is insoluble in water, it is capable of being dissolved by a strong alkali. When the expense is not an objection, scouring with soap is practised as preferable. Sulphureous acid, or the vapour produced by burning sulphur, is likewise employed for whitening wool as well as exposure on the grass.

Sect. III.—Bleaching cotton.

5798. *The bleaching of cotton*, in the first instance, being always performed by the manufacturer, does not come within the scope of domestic economy, and therefore need not be treated of here much in detail. When the cotton cloth comes from the loom it is covered with light, hairy filaments, which are singed off by passing the web over a heated copper cylinder. The fibres of cotton are covered with a resinous matter, and with a very small quantity of colouring matter, which are removed by an alkaline lye, or by exposure several times to steam and rinsing in water, previous to bleaching and dyeing. The weaver's dressing has also to be removed; and the bleaching is now generally performed by chloride of lime.

5799. After the bleaching of cotton cloth is completed, to improve its appearance it is usually passed through starch made of wheaten flour, mixed with porcelain clay and calcined gypsum or whiting, by which the cloth is made stiffer, and to exhibit greater substance, apparently, than it proves to have after being washed. The process was originally contrived for the purposes of fraud; and though now too generally understood to deceive many persons, yet the practice ought to be laid aside. The cloth is then dried on cylinders heated by steam, and afterward calendered, folded, and pressed. Dyeing and printing are subsequent processes.

Sect. IV.—Bleaching silk.

5800. *Silk, to be bleached*, must first be deprived of the natural varnish with which the filaments are coated, and to which is ascribed much of its stiffness and elasticity. This varnish is of a resinous nature, and is soluble in alkaline lyes. Soap generally removes it; but, as the matter separated is very fetid, putrid fermentation will take place and injure the silk, if it be not well rinsed in water. Steam is employed in France for this purpose; and, to give silk its complete splendid whiteness, it is necessary also to expose it to the fumes of burning sulphur, to destroy a substance of a yellowish colour with which the European silk is impregnated. The silk intended to be white requires to be more completely scoured than that which is to be dyed.

Sect. V.—Various facts respecting bleaching.

5801. *When linen or calico is discoloured by town washing, by age, or lying out of use*, the best method of restoring the whiteness is by bleaching it in the open air, and exposure on the grass to the dews and winds. There may occur cases, however, where this may be difficult to accomplish, and where a quicker process may be desirable. Here the art of chemistry may assist, and the following directions have been given by an eminent practical chemist. The linen must first be laid for twelve hours in a lye formed of one pound of soda to a gallon of boiling hot soft water; it must then be boiled for half an hour in the same liquid. A mixture must now be made of chloride of lime with eight times its quantity of water, which must be well shaken in a stone jar for three days; then allowed to settle, and, being drawn off clear, the linen must be steeped in it for six and thirty hours, and then washed out in the ordinary manner. This will remove all discoloration.

5802. *To expedite the whitening of linen in ordinary cases*, a little of the same solution of chloride of lime may be put into the water in which the clothes are steeped; but it must be evident that so powerful an agent must be employed with great caution, otherwise it may injure the linen.

5803. *Steam has been employed in bleaching* linen with great success in France. The process was brought from the Levant, and Chaptal first made it known to the public. In the old processes the close texture of linen resists the action of the heat of a common lye, and hence a long succession of lyes, and exposure on the grass, and considerable time were necessary to penetrate the fibres of the linen from stratum to stratum, as we have already shown. In the process of bleaching by steam these difficulties are removed. The high temperature of the steam swells up the fibres of the cloth, and then the alkali used with it penetrates into the cloth and seizes on the colouring matter. But steam alone does not bleach. After the cloth has been some time exposed to its action, it is to be taken out and immersed in chloride of lime, and afterward exposed a few days on the grass, by which the oxygen of the atmosphere rapidly carries off the colouring matter. If a yellow tint still remain, a second vapour bath and a second immersion in the chloride of lime will be sufficient to give the necessary whiteness.

5804. *The horse-chestnut* has been employed in France and Switzerland for the purpose of bleaching yarn; and it is recommended in the Mem. of the Soc. of Berne, vol. ii., p. 2, as capable of extensive use in whitening not only flax and hemp, but silk and wool. It contains an astringent saponaceous juice, which is obtained by peeling the nuts, and grinding or rasping them. They are then mixed with hot rain or running water, in the proportion of twenty nuts to ten or twelve quarts of water. Wove caps and stockings were milled in this water, and took the dip extremely well. It is supposed that if the meal of the chestnuts could be made into cakes or balls, it would answer the purpose of soap in washing and fulling. The sediment, after infusion, loses its bitter taste, and becomes good food for fowls, mixed with bran.

CHAPTER XI.

DYEING.

SECT. I.—GENERAL AND HISTORICAL REMARKS.

5805. The art of dyeing, though now seldom much practised in domestic economy, is too intimately connected with clothing and dress to be omitted. We shall, therefore, explain its general principles, and give directions for what is likely to be attempted by individuals not professed dyers; at the same time, we may observe that, in London and other places where there are professed dyers, it is better to employ them for valuable articles of dress or furniture, as it is not worth while to risk spoiling them. Their charge depends partly upon the colour, some colours being more expensive than others.

5806. *In all ages brilliant colours have excited admiration*; and even the uncultivated savage has evinced a passion for the beautiful and bright hues to be found in the feathers of birds and other natural objects. The origin of dyeing, or producing colours by artificial means, is of great antiquity; for Moses speaks of stuffs dyed blue, and purple, and scarlet, and of sheep-skins dyed red. Among the Greeks, dyeing appears not to have been much practised; the woollen clothes usually worn by them were of the natural colour of the sheep; but the wealthy preferred coloured dresses, of which scarlet was much esteemed; still more highly valued was purple, which was the distinguishing mark of the greatest dignities, being reserved for princes only. The most famous of their purple dyes was that called Tyrian, which is said to have been drawn from a certain shell-fish, a species of murex, common on the shores of the Mediterranean; but the quantity of purple juice afforded by this animal is exceedingly small, and, consequently, garments stained with it were of great price. The Romans were equally severe in restricting the use of purple to the highest rank; and it does not appear that the number of their dyes and dyed colours was considerable, although coloured dresses were not rare among them.

5807. The art of dyeing slowly improved in modern times, until the application of chemistry, by throwing on it peculiar light, has of late advanced it to a degree of perfection formerly unknown.

SECT. II.—THEORY OF DYEING.

5808. *Among the various substances capable of communicating colours to cloths of different kinds, very few have so strong an affinity for them as to answer of themselves the purposes of dyeing.* When we except indigo, the dyer is scarcely possessed of a dye-stuff that yields of itself a good colour sufficiently permanent to deserve the name of a dye, as they are almost all capable of being discharged by washing the cloth in water. This difficulty, which at first sight might appear insurmountable, has been obviated by a very ingenious contrivance. It has been found that, by first immersing the material to be dyed in certain substances, dyes, that without this preparation would be fugitive, become permanent, and cannot be discharged by washing. These substances, therefore, become a bond of union between the cloth and the dye-stuff, and have received the name of *mordants.* The principle appears not to be altogether of modern invention, but to have been known to the Egyptians and other nations of antiquity.

5809. *The nature of mordants is thus explained* by Dr. Thomson of Glasgow:

"The term mordant is applied by dyers to certain substances with which the cloth to be dyed must be impregnated, otherwise the colouring matters would not adhere to the cloth, but would be removed by washing. Thus, the red colour given to cotton by madder would not be fixed, unless the cloth was previously steeped in a solution of salt of alumina. It has been ascertained that the cloth has the property of decomposing the salt of alumina, and of combining with, and retaining, a portion of alumina. The red colouring principle of the madder has an affinity for this alumina, and combines with it; the consequence is, that the alumina, being firmly retained by the cloth, and the colouring matter by the alumina, the dye becomes fast, or cannot be removed by washing the cloth with water, even by the assistance of soap, though simple water is sufficient to remove the red colouring matter from the cloth, unless the alum mordant has been previously applied. The term *mordant* (from the Latin word *mordere*, 'to bite') was applied to these substances by the old French writers on dyeing, from a notion entertained by them that the action of the mordants was mechanical; that they were of a corrosive or biting nature, and served merely to open pores in the fibres of the cloth, into which the colouring matter might insinuate itself; and after the inaccuracy of this notion was discovered, and the real use of mordants ascertained, the term was still continued, as sufficiently appropriate, or, rather, as a proper name, without any allusion to its original signification."

5810. *Mordants not only render the dye permanent, but they have also a considerable influence on the colour.* The same colouring matter produces very different dyes, according as the mordant is changed. Suppose, for instance, that the colouring matter is cochineal; if we use the aluminous mordant, the cloth will acquire a crimson colour; but the oxyde of iron produces with it a black. In dyeing, it is not only necessary to procure a mordant that has a sufficiently strong affinity for the colouring matter and the cloth, and a dyeing substance which possesses the wished-for colour in perfection, but we must procure a mordant and a colouring matter of such natures that, when combined together, they shall form the desired colour. It is therefore evident that we can produce several colours with one dye-stuff, provided we can have a sufficient number of mordants; hence the selection and management of mordants are the chief arts of the dyer.

5811. *Mordants are generally composed of* earths, metallic oxydes, tannic acid, or all of these. Of earthy mordants, the most important and generally used is alumina, either in the state of common alum, or of acetate of alumina. Alum is a triple salt, composed of sulphuric acid, alumina, and potash; acetate of alumina consists of the acetic acid and alumina, and answers better than alum for a mordant. Almost all the metallic oxydes have an affinity for cloth, but only two of them are much used as mordants, viz., the oxydes of tin and of iron. The oxyde of tin is employed in the state of nitro-muriate (now called proto-chloride) and acetate of tin; it is a very valuable mordant, which enables the moderns greatly to surpass the ancients in the lustre of their colours; by its means alone, scarlet, the brightest of all colours, is produced. Tannic acid has also a strong affinity for cloth, and is principally obtained from nut galls and sumach. Oil is sometimes used as a mordant in dyeing cotton and linen.

5812. *Acetate of alumina is made* by a double decomposition of alum and sugar of lead (acetate of lead), but the proportions of each vary much, according to circumstances, and probably to the fancy of the colour mixer.

It is more particularly important that cloth of any kind that is to be dyed should first be rendered white, otherwise the colour of the fabric will interfere with that of the dyeing materials, and the result will be uncertain.

Sect. III.—PRACTICE OF DYEING.

Subsect. 1.—*General Observations.*

5813. *Colours may be divided into simple and compound.* The simple colours are blue, red, and yellow, and cannot be produced by the mixing together of different colours. Compound colours may be produced by the mixing together various colours, in different proportions. Thus, purple is formed by mixing red and blue; green, by mixing blue and yellow; orange, by mixing red and yellow; and the various shades of these depend upon the proportions of the colours so mixed. Some of the compound colours are produced most conveniently by the use of a single dye, yet most of them may likewise be formed by mixing several.

5814. *What is termed giving a ground in dyeing*, is communicating one colour to a stuff, with the intention of applying another upon it, and thus producing a compound colour. When it is found necessary to pass stuffs several times through the same liquor, each particular operation is called a *dip.*

It is important in dyeing that the water should be pure. The earthy salts existing in some water, and rendering it hard, are very liable to affect the colours, and prevent them from combining with the cloth. Water that is muddy, or that contains putrid substances, is also unfit: in short, water that possesses any qualities that can be distinguished by the taste should not be used.

5815. *The substances commonly dyed* are either animal, as wool, silk, hair, leather, and skins; or vegetable, as cotton, flax, or hemp. Great differences exist between the affinities for colouring matter possessed by these different substances, so that a process which succeeds perfectly in dyeing wool may fail when applied to cotton. Wool has generally the strongest affinity for colour; silk and other animal substances come next, cotton next, and hemp and flax last.

SUBSECT. 2.—*Dyeing Wool.*

5816. *Wool, previous to being dyed,* requires to be cleansed by scouring; it is dyed either in the fleece, or after it is spun into thread or worsted, or when it is manufactured into cloth. For forming cloths of mixed colours the wool is dyed before it is spun. It takes up more colouring matter in the state of the fleece than when made into thread, and less when woven into cloth; but the latter varies in this respect, according to its quality.

SUBSECT. 3.—*Dyeing Silk.*

5817. The raw silk of Europe is found to combine more readily with the colouring matter, and to receive a more permanent colour, when dyed in its natural state with its resinous varnish on, than after it has been deprived of it by scouring and whitening: the white China silk has a lustre superior to the European, and is therefore preferred for dyeing. The preparation by aluming, as a mordant, is very important in dyeing silk: the solution of alum must be cold; if the liquor is employed hot, the lustre is apt to be impaired. The colours used in dyeing silk are very delicate; they must therefore be dried quickly, and not be long exposed to the action of the air, that there may be no risk of change; on this account, drying stoves are used.

SUBSECT. 4.—*Dyeing Cotton.*

5818. *Cotton, before it is dyed,* requires to be well scoured by an alkaline lye, and afterward washed in a stream of water, and dried; but in some cases, as in dyeing Turkey red, the unbleached cotton is preferred, as producing a more permanent colour. Aluming and galling are the next preliminary processes in the dyeing of cotton stuffs; after which it is dipped in the dye.

SUBSECT. 5.—*Dyeing Blue Colours.*

5819. The only colouring matters employed in dyeing blue are woad and indigo. *Woad* is a plant cultivated in this kingdom, and even grows wild in some parts of England. *Indigo* is a blue powder extracted from a species of plant which is cultivated for that purpose in the East and West Indies. The indigo plant contains a green fecula, which, while in the green state, is soluble in water; but it attracts oxygen greedily from the atmosphere, in consequence of which it assumes a blue colour, and then becomes insoluble. The use of indigo as a dye appears to have been long known in India, from whence it was first brought to Europe by the Dutch. It is an extremely valuable material for this art, as it has a strong affinity for wool, silk, cotton, and linen; and every kind of cloth may be dyed with it without the assistance of any mordant whatever, the colour thus induced being, at the same time, very permanent. There are two methods of applying indigo in dyeing; one is in a state of solution in sulphuric acid, or sulphate of indigo. With this wool and silk are often dyed blue, but it can scarcely be applied to cotton and linen, because the affinity of these substances for it is not great enough to enable them readily to decompose the sulphate. The colour given by sulphate of indigo is exceedingly beautiful, and is known by the name of *Saxon blue.* One part of indigo is dissolved in four parts of concentrated sulphuric acid; to the solution is added one part of dry carbonate of potash, and then this is diluted with eight times its weight of water. The cloth must be boiled in a solution containing five parts of alum and three of tartar for every thirty-two parts of cloth. It is then thrown into a water bath containing a greater or smaller portion of the diluted sulphate of indigo, according to the shade which the cloth is intended to receive. In this bath it must boil till it has acquired the desired colour. The alum and tartar do not act as mordants, but facilitate the decomposition of the sulphate of indigo.

5820. *The other method of using indigo* is to deprive it of oxygen, to which it owes its blue colour, and thus reduce it to the state of green fecula, and then to dissolve it in water by means of alkalies or alkaline earths, which, in that state, act upon it very readily. If, therefore, indigo, lime, and green sulphate of iron be mixed together in water, the indigo gradually loses its blue colour, becomes green, and is dissolved. This solution is used for dyeing cotton and linen. Another method is to mix the indigo in water, with certain vegetable substances, which readily undergo fermentation; during which the indigo is deprived of its oxygen, and dissolved by means of quicklime or alkali. This process is employed in dyeing wool and silk.

5821. *In dyeing wool blue,* woad and bran are used as vegetable ferments, and lime as the solvent of the green base of the indigo. Woad contains a colouring matter precisely similar to that of indigo, only in smaller quantity. When the cloth is taken out of the vat it is of a green colour; but it soon becomes blue by absorbing oxygen. It is then carefully washed.

5822. *Silk is dyed light blue* by a ferment of six parts of indigo, six of potash, and one of madder. To dye it dark blue, it must previously receive a ground colour; *archil* is used for this purpose.

Cotton and linen are dyed blue by a solution of one part indigo, one part green sulphate of iron, and two parts of quicklime.

Subsect. 6.—*Dyeing Yellow Colours.*

5823. *The principal colouring matters for dyeing yellow* are weld, fustic, quercitron bark, and anatto. *Weld* (*Resiola luteola*) is a plant that grows commonly in this country. *Fustic* is the wood of a large tree that grows in the West Indies. *Quercitron* is a tree of North America, the bark of which contains colouring matter. *Anatto* is a kind of paste made from the berries of a plant that grows in America. Yellow colouring matters have too weak an affinity for cloth to produce permanent colours without the use of mordants. The mordant most usually employed for this purpose is alum, or acetate of alumina. Where very fine yellows are wanted, oxyde of tin is used. The yellow dyed by fustic is more permanent, but not so beautiful as that given by weld or quercitron. A good drab colour is given by fustic, when the mordant is oxyde of iron. Weld and quercitron bark give nearly the same colour, and the latter is the cheapest.

5824. *Wool may be dyed yellow* as follows: Boil it for an hour or more with about one sixth its weight of alum; then, without rinsing it, plunge it into a bath of warm water containing as much quercitron bark as equals the weight of alum employed as a mordant. The cloth is to be repeatedly turned in the boiling liquid, till it has acquired the intended colour. To deepen the colour, a quantity of clean, powdered chalk, equal to the hundredth part of the weight of the cloth, is to be stirred in, and the boiling to be continued for eight or ten minutes longer. For very bright golden yellows the oxyde of tin must be used as a mordant. If a greenish yellow is wished for, some tartar may be added to the dye. The addition of a little cochineal will give an orange.

5825. *Silk may be dyed yellow* by weld or quercitron bark. The proportion should be from one to two parts of bark to twelve parts of silk, according to the shade wanted. The bark, tied up in a bag, should be put into the water cold, and the temperature then raised to 100°, when the silk, previously alumed, should be dipped in, and continued till it has acquired the proper colour. Chalk or pearlash will deepen the tint.

5826. *Cotton and linen are dyed yellow* by a mordant of acetate of alumina, prepared by dissolving one part of acetate of lead and three parts alum in a sufficient quantity of water. The cloth is to be soaked for two hours in this solution, heated to 100°, wrung out and dried, and the soaking and drying may be repeated; it is then barely wetted with lime-water, and dried. If the colour is wished to be very bright and durable, the soaking and wetting with lime-water should be repeated several times; the lime makes the dye more permanent. The dyeing bath is prepared by putting quercitron bark into cold water with the cloth, then bringing this gradually to a boiling heat; but after this the cloth must only remain a few minutes, lest the colour should acquire a shade of brown.

5827. *Nankeen yellow* is dyed by a solution of red sulphate of iron, which is combined with the cloth by carbonate of potash.

Subsect. 7.—*Dyeing Red Colours.*

5828. The colouring matters employed for dyeing red are, kermes, cochineal, archil, madder, carthamus, Brazil wood, lac, and logwood. *Kermes* is a species of insect, but it does not afford so fine a colour as cochineal, another insect: both are from America *Cochineal* is the most precious of all our dyeing drugs, affording the scarlet crimson, and from it the finest carmine is obtained. It was found in use among the Mexicans, on the discovery of America; and it was the beauty of its colour, as displayed in their furniture, ornaments, and cotton cloth, which attracted attention. At first it was supposed to be the seed of a plant, appearing in the form of small shrivelled grains; but it was afterward ascertained to be a species of insect, called *Coccus cacti*, from its feeding on the *Cactus opientia*, or prickly pear. The best cochineal is still produced in Mexico, though it is now also brought from India and other tropical countries. There are varieties of the insect, affording dyes of different qualities; the dye from the wild insect is inferior to what is produced from those kept in gardens. Lately it has been introduced into Cadiz, where it is reared in a botanic garden, and promises to succeed in that climate. *Archil* is a paste made by pounding a species of lichen (*Rocella tinctoria*) with stale urine. *Madder* is the root of a well-known plant. *Carthamus* is a flower cultivated in Spain and the Levant. It contains two colouring matters; one yellow, which is soluble in water; the other red, which is insoluble in water, but soluble in alkaline carbonates, as carbonate of soda. *Brazil wood* is the wood of a tree growing in America and the West Indies: its decoction is a fine red colour. *Lac* is the production of an Indian insect. The decoction of it gives a fine deep crimson. *Logwood*, called also Campeachy wood, grows in the Bay of Campeachy and Jamaica. It gives out a colour to alcohol, but sparingly to water. None of the red colouring matters have so strong an affinity for cloth as to form a dye without a mordant.

5829. *Wool may be dyed red* by any of these, according to the shade required. Cochineal gives the brightest crimson; the best mordant is nitro-muriate of tin (chloride of tin). Scarlet is a compound of crimson and yellow; and, to produce a bright scarlet, the cloth must first be dyed yellow by means of any of the yellow dyes, and then plunged into a bath of cochineal with tartar and nitro-muriate of tin (chloride of tin). For common crimsons, alum is used as a mordant, and the dye cochineal; or, if pale crimson, a little madder may be added to some cochineal.

5830. *Silk is dyed red* with cochineal, carthamus, or Brazil wood; madder is not bright enough. Archil is used when the colour is to be lilac. Silk cannot be dyed a full scarlet; but a colour approaching to it may be given by first impregnating the silk with murio-sulphate of tin, and afterward dyeing it in a bath composed of four parts cochineal and four of quercitron. Crimson may be given by cochineal alone; and poppy and rose by an alkaline solution of carthamus, to which lemon juice has been added.

5831. *Cotton and linen are dyed red* with madder. The colour is called Turkey red, because first brought from the Levant. It was introduced into Glasgow in 1810, by a Frenchman, M. Papillon, and that city has ever since been famous for dyeing that colour. The cloth is first impregnated with oil, then with galls, and, lastly, with alum; it is then boiled for an hour in a decoction of madder, and plunged into a lye of soda to heighten the colour. The application of the mordant is difficult, but the colour produced is permanent. Cotton may be dyed scarlet by means of murio-sulphate of tin, cochineal, and quercitron bark, but the colour is fading.

SUBSECT. 8.—*Dyeing Black Colours.*

5832. *The substances employed to give a black colour to cloth* are red oxyde of iron and tan, which have a strong affinity for each other. Logwood is used as an auxiliary, as it adds to the fulness of the black. Cloth, before it receives a black colour, is usually dyed blue, to render the black more agreeable. If the cloth be coarse, sometimes a brown from walnut peels is substituted.

5833. *Wool is dyed black* as follows: It is boiled for two hours in a decoction of nut galls, and afterward kept for two hours in a bath of logwood and sulphate of iron, at a scalding, but not a boiling heat. During the operation it must be frequently exposed to the air, because the protoxyde of iron, of which the sulphate is composed, must be converted into sesqui-oxyde, by absorbing oxygen, before the cloth can acquire a proper colour. The common proportions are five parts of galls, five of sulphate of iron, and thirty of logwood, for every hundred of cloth.

5834. *Silk is dyed black* in the same manner.

5835. *Cotton and linen* are not easily dyed a full black. The cloth dyed blue is steeped for twenty-four hours in a decoction of nut galls, and then put into a bath prepared of acetate of iron, wrung out and dried, and the process is continued till the colour is deep enough.

SUBSECT. 9.—*Dyeing Brown Colours.*

5836. *Brown is, in fact, a compound colour*, although it may be given by a single process, by means of several dye-stuffs, as walnut peels, the root of the walnut tree, birch bark, sumach, &c. These substances, containing tannin, which is a mordant as well as colouring matter, produce a permanent dye by simply boiling the cloth with them.

SUBSECT. 10.—*Dyeing Compound Colours.*

5837. *Compound colours, as green, purple, orange*, and an infinity of shades and mixtures of these, some of which have received particular names, are produced by dyeing the cloth first one colour, and then another, to produce the required tint.

5838. *Green*, being composed of blue and yellow, the wool, silk, or linen is first dyed blue, and then yellow, by any of the processes described above. When sulphate of indigo is used, all the ingredients are mixed together, which produces *Saxon green*. Other shades, as *pea green, grass green, sea green*, &c., are produced by employing various proportions of yellow and blue dyes, according to the experience and taste of the dyer.

5839. *Purple* is blue and red, and comprises lilac and violet, which are different shades of it. Wool is first dyed blue, and then scarlet, in the usual manner. By mixing cochineal with sulphate of indigo, the process may be performed at once. Silk is dyed first crimson by means of cochineal, and then dipped into the indigo bath. Cotton and linen are first dyed blue, then galled, and dyed by oxyde of iron.

5840. *Orange*, consisting of red and yellow, is produced by a scarlet or a crimson, and then dyeing yellow. Carthamus gives to silk an orange.

5841. *Olive* is obtained by adding blue to the above, or by a blue, yellow, and madder bath.

5842. *Cinnamon colour* is given by dyeing with slight madder colour before the orange. Silk receives this colour by logwood, Brazil wood, and fustic, mixed; cotton and linen by weld and madder.

5843. *Grays, drabs*, and *browns*, of various shades, are produced by dyeing with oxyde of iron, and then yellow with quercitron or sumach.

CHAPTER XII.

CALICO PRINTING.

5844. *Historical Remarks.*—Cotton cloths are seldom dyed of one uniform colour, except for linings; but when used in dresses for the female sex, drapery of beds and windows, the coverings of furniture, and similar purposes, they are ornamented with figures of various kinds printed in colours; and the endless variety of patterns which are printed on white cotton and muslin give to these fabrics a rich and elegant effect. The natives of India, as they were the first manufacturers of cotton cloth, so they were the first who stained or painted them with various ornaments. Herodotus speaks of a nation on the borders of the Caspian who painted figures of animals on their linen garments with a vegetable dye, which were so durable that they would not wash out; and Strabo speaks in praise of the beautiful flowered cottons of India, which, from the stationary condition of the people of that country for thousands of years, were probably nearly the same as what are made use of there at present. From Pliny's description of the mode in which the Egyptians practised the art of staining their linen cloths by the use of mordants, it is evident that an art analogous to calico printing was well known to the ancients, although less perfect than it has become since by the application of modern chemistry.

5845. Calico printing by means of blocks has long been practised in Asia Minor, Turkey, and all over the East. It is said to have commenced in London in 1676, and was much encouraged and improved in consequence of the government having prohibited, in 1700, the importation of the cheap and beautiful prints of India, Persia, and China, with the view of protecting the woollen and silk manufactures. In order to procure an imitation of the Indian chintses, plain calico was brought over, and printed in England. Parliament then passed a law, in 1701, prohibiting the wear of any printed or dyed calicoes; this confined the printers to the printing of linen, and put a stop to calico printing for ten years. Afterward the printing of cloths made of cotton and linen together was permitted, on paying a duty of sixpence a yard; and subsequently these prohibitions were entirely removed. Calico printing has since been moved from the vicinity of London to Lancashire, where the greatest improvements have been made.

5846. *As the art of calico printing depends, in a great measure, upon that of dyeing*, we must refer the reader to our chapter on that subject; but we shall at present say a few words that may assist in connecting these sister arts. We stated that certain substances will of themselves, when applied to cloth of any kind, produce a permanent colour, or dye, such as will bear washing without being removed; but these substances are few in number. The majority of dyeing materials require, to render them fixed, that the cloth shall first be imbued with some other material that has an affinity both for the cloth and for the dye-stuff. This is called the *mordant*, which acts as a bond of union between the cloth and the dye. The first kind of colours is sometimes termed *substantive* colours, and the latter *adjective*.

5847. *Calico printing consists* in impregnating those parts only of the cloth which are to receive the colour with a mordant, and then dyeing it as usual with some dye-stuff. The dye attaches itself firmly only to that part of the cloth which has received the mordant. The whole surface of the cotton is, indeed, more or less tinged, but by washing and bleaching it, all the unmordanted parts lose their colour, while those which have received the mordant retain it. Let us suppose that a piece of white cotton is to receive red stripes; all the parts where the stripes are to appear are pencilled, or otherwise marked with a solution of acetate of alumina; after that the cloth is dyed in the usual manner with madder. When taken out of the dyeing vessel it is all of a red colour, but by washing and bleaching the madder disappears, leaving every part of the cloth white, except where the stripes were impregnated with the acetate of alumina, which remains red. In the same manner may yellow stripes be given to cloth, by substituting quercitron bark, weld, &c., for madder.

5848. *A few examples of the manner in which various colours are given to calicoes* may be mentioned. 1. One of the most common colours on cotton prints is a kind of nankeen yellow, of various shades, down to a deep yellowish brown, or drab: to produce it, the pattern is printed with acetate of iron, the cloth is then plunged into the potash lye. 2. For yellow, the block is covered with acetate of alumina, and the cloth dyed with quercitron bark. 3. Red is communicated by the same mordant, the dye being madder. 4. Lilac brown and blackish brown have a mordant of acetate of iron, and a dye of madder. 5. Dove colour and drab are done with acetate of iron and quercitron bark. When several colours are to appear in the same print, methods like the following are used: If cloth is dyed with quercitron bark, and then printed with several blocks, that which has acetate of alumina will give a yellow, the block which has acetate of iron will give olive or drab, and that which has a mixture of these two mordants will give olive green.

If the cloth be dyed with madder, the block with acetate of alumina will give red, acetate of iron will give brown or black, and the mixture of these will give purple. Indigo, as in dyeing, is the only colour that can be applied at present, so as to be permanent, without a mordant.

5849. *The mordants are applied to the cloth* either by a pencil, or more frequently by means of wooden blocks, on which the pattern is cut in such a manner as to project in relief. When these blocks are applied, care must be taken that no part of the mordant with which they are covered spread to that part of the cloth which is to be left white, otherwise all the distinctness and elegance of the print will be destroyed. It is necessary, therefore, that the mordants should be of such a degree of consistence that they will not spread to those parts of the cloth beyond the intended pattern on the surface of the block; this is effected by thickening them with starch or gum before they are put upon the block. It is usual to mix some colouring matter with the mordant, in order to render the impression visible; but it must be some substance that may be removed by the same process as the mordant itself. Sometimes two mordants are mixed together, and much of the science and skill of the calico printer depends upon his knowledge of the properties of the various mordants and their action upon colouring matters, so as to render the latter fixed and beautiful.

5850. *Few dye-stuffs are used by calico printers,* and they are chiefly indigo, madder, and quercitron bark, or weld; various tints being produced by the mixture of these and the use of the various mordants.

5851. *Previous to the printing, the cloth as it comes from the loom is prepared* by dressing, which consists in passing the cloth very rapidly over a cylinder of copper heated intensely, or over a broad flame of gas. It is next steeped for twenty-four hours in a weak alkaline lye, and then boiled in a solution of potash, which is termed *ashing*, and afterward well washed. It is next subjected to the process called *souring*, which consists in immersing the cloth in water containing a twenty-fifth part of sulphuric acid. Singeing and calendering are rendered particularly necessary where the printing is by blocks, in order to render the surface smooth to receive a good impression.

5852. *Inventing and drawing patterns for calico printing* employ artists of a peculiar class, who are continually engaged in this business, and the variety produced is immense, to satisfy the perpetual changes produced by fashion. Hitherto our artists have been inferior to those of France and Germany, where the arts of ornamental design have been paid more attention to; but now that there is a national establishment for teaching design as applied to manufactures, it is to be hoped that we will no longer be reproached with inferiority. The designs, when finished, are cut on wooden blocks, or engraved on copper, according to the kind of printing.

5853. *The blocks by which the mordants are applied* are usually made of wood, but sometimes the pattern is cut out of thick plates of brass or copper, fixed firmly to the wood. The printer takes the block into his hand, and presses it down firmly upon the cloth, taking care to be very accurate, applying it regularly, and to keep the pattern uniform and properly joined. Sometimes, instead of printing from the wooden blocks, stereotype casts are made from the blocks, and these are used for printing. When several colours are required, so many blocks are prepared, each to print the separate colours; when a small quantity of one colour is introduced, that is often added by a hair pencil.

5854. *What is called resist work* is another mode of conducting the process, the reverse of what has been described. The pattern is then printed on the cloth with a paste which *resists* the dye colour, when the goods are immersed in the dye vat, so that the grounds only are dyed, the pattern remaining white. This process is practised in cases where the ground is intended to be blue.

5855. *Discharge work* is another variety of calico printing. Here the cloth is first dyed uniformly with some vegetable colour, as Brazil wood; it is next dyed black with an iron colour. The cloth is then washed and calendered, when it will appear uniformly black; but, in order to produce a pattern, this is printed with a peculiar solution of tin, which has the effect of discharging the iron black dye, and rendering the crimson colour of the Brazil wood visible.

5856. *Another method consists* in printing upon Turkey red, or any dyed colour, some powerful acid, and then immersing the cloth in a solution of chloride of lime. Neither of these agents, singly, affects the colour; but those parts which have received the acid, on being plunged in chloride of lime, are speedily deprived of their dye, and made white by the acid of the liberated chlorine. An addition to this invention was made by Mr. James Thomson, near Clitheroe: the acid was combined with some mordant, or metallic oxyde, capable, after the dyed colour was removed, of having imparted to it some other colour. This laid the foundation of that series of processes in which the chromic acid and its combinations have since been employed with such great success.

We have mentioned the original method of printing calicoes by means of blocks, which is still practised to a certain extent; but of late many great improvements have been made in all parts of the processes, and particularly in that of printing.

5857. *To produce more delicate patterns than could be produced by wooden blocks,* copper plates were engraved, and calicoes printed by the usual process of copper-plate printing; but the mode of printing by these was tedious, as well as that by block; in each the patterns had to be applied 448 times in a single piece of calico that was twenty-eight yards in length.

5858. *The grand improvement in the art was the invention of cylinder printing*, in 1785. In this the pattern is engraved upon the surface of cylinder, which is covered with the proper colours, is rolled over the cloth, producing an impression in a rapid manner, and much more accurately than by blocks or plates. The detailed description of this process we extract from Mr. Baines's excellent work "On the Cotton Manufacture." A polished copper cylinder, several feet in length (according to the width of the piece to be printed), is engraved with a pattern round its whole circumference, and from end to end. It is then placed horizontally in a press, and, as it revolves, the lower part of the circumference passes through the colouring matter, which is again removed from the surface of the cylinder, except the engraved pattern, by an elastic steel blade, placed in contact with the cylinder, and reduced to so fine and straight an edge as to take off the colour without scratching the copper. The colour being thus left only in the engraved pattern, the piece of calico or muslin is drawn tightly over the cylinder, which revolves in the same direction, and prints the cloth. After the piece is printed, it passes over several metallic boxes, heated by steam, which dry it. A piece of cloth may thus be printed and dried in one or two minutes, which, by the old method, would have required the application of the blocks 448 times: nor is this all; two, three, four, and even five cylinders may be used at the same time in one press, each cylinder having engraved upon it a different portion of the pattern, and being supplied with a different colour. The piece passes over them successively, and receives the entire pattern almost in the same moment. To produce the same effect by hand-block printing would have required 896, 1344, 1792, and 2240 applications of the blocks, according as two, three, four, or five cylinders may have been employed. The saving of labour, therefore, is immense; one of the cylinder printing machines, attended by a man and a boy, is actually capable of producing as much work as could be turned out by one hundred block printers and as many boys. In consequence of the wonderful facility given to the operation, three fourths of all the prints executed in this country are printed by the cylinder machine. But the course of improvement did not stop here. These cylinders can be multiplied to an extraordinary degree by the process for multiplying copper plates for printing, an invention usually ascribed to Mr. Perkins, but which, Mr. Baines states, had been practised in Manchester some years before he came from America.

5859. *Another kind of cylinders for calico printing consists of* cylinders of wood, which have pieces of brass let into the wood, and projecting above the surface an eighth of an inch.

5860. *Calico printing requires* that the conductors should be acquainted with chemistry, since many of the processes depend essentially upon chemical laws, and the knowledge of these leads to improvements in this complicated art. In large establishments, therefore, there are always some persons who have studied this branch of science.

5861. *The large print-works of Lancashire* are among the most interesting manufactories that can be visited. The bleaching, the block printing, the cylinder printing, the dyeing, the designs of patterns, the engraving of blocks and cylinders, and the preparation of colours frequently all go on within the same enclosure, and form a splendid exhibition of the application of science and mechanics to the arts. Some of these print-works employ some thousands of work-people, while the order and cleanliness of the works impress the visiters with agreeable surprise.

5862. *Linen is seldom printed like calico*, because the latter is cheaper, and printed linens are not so beautiful, the material possessing less affinity for colouring matters.

5863. *The printing of silks, fine woollen stuffs*, such as merinoes, mousseline de laine, &c., or stuffs of silk and wool, is conducted upon the same general principles as the printing of cottons; but all the former require very different and complicated processes.

CHAPTER XIII.

CALENDERING.

5864. Calendering is a process by which all accidental wrinkles and creases are removed from various kinds of silks, stuffs, calicoes, and linens, and their surfaces rendered smooth and uniform. Calicoes are always calendered previous to printing, to make the threads flat. The high polish which certain goods require was formerly effected by rubbing the cloth with a smooth flint stone, but it is now performed by calendering, or passing the cloth between two rollers, one of which is made to move slower than the other. Some of these rollers are made of cast iron, and hollow, so that heaters can be introduced, which are useful in some kinds of goods. Calendering is also used for pressing certain stuffs previous to packing. It is likewise used by the scourers and dyers after their several operations; but calendering is a particular branch of business, and this process is seldom, if ever, performed in private families.

5865. *A glazing* upon some articles is sometimes produced by the old process of rubbing a smooth, hard substance on them, as a polished flint, and, to render the gloss more complete, a little bleached wax is rubbed on the cloth previously.

BOOK XVIII.

DETAILS RESPECTING VARIOUS ARTICLES OF DRESS.

CHAPTER I.

TAILOR, MANTUA-MAKER, AND MILLINER.

5866. These are the persons to whose taste and judgment the fashion or cut of most dresses are intrusted, and, therefore, of whose importance it would be absurd to entertain any doubt. But we have already stated that we do not intend to touch upon the subject of costume, or the forms of dress, which, indeed, among us, are continually varying; and the few observations we have to make upon the details of dress will be confined to those which concern convenience or economy.

5867. Less than a century ago, it was a usual custom for gentlemen to purchase their cloths and velvets, and to employ a tailor to make them into clothes; and at that time much more practical knowledge of the material must have been necessary than at present, when a partial union has taken place between the trades of the tailor and the woollen draper. The present usual practice is to place confidence in the former, that he will employ only good materials. Putting the whole into his hands has, however, the bad effect that it has become extremely difficult to judge of the correctness of his charges, or the extent of his profits. Without proposing to alter the system of executing this business, we may observe that some acquaintance with the manufacturer's qualities and prices of materials may form some check on exorbitant charges, and serve at once the cause of economy and morality. The same remarks may be applied to the dresses of ladies; but ladies have some advantage over men, in being more generally familiar with the details of dress; nevertheless, where fashionable dress-makers are employed, there is likewise some reason for looking into the details of their accounts, and the qualities of the materials. The subject of dress, therefore, with respect to economy, though not considered as of a high class, is deserving of attention, and ought not to be altogether neglected in our work.

5868. *With respect to the tailor*, the principal difficulty is to find out those who can cause their clothes to fit well; and the cutting out of the cloth is one of the great secrets of their trade. Their frequent failure is chiefly owing to the unscientific manner in which their measures are taken, and their not knowing how to make the necessary allowances for the peculiar make of each individual. We would suggest, as an improvement, that they should learn to take measures upon various plaster casts or models of the human figure; and although many may wonder of what use practical geometry can be to a tailor, yet we could easily point out the way in which he would be benefited by some knowledge of that, as well as of drawing and sculpture. We believe the superiority frequently perceived in France among those who are concerned in dress is owing to the general taste for the fine arts, which has descended to a lower grade in the population than in this country.

For those to whom the ordinary expense of clothes is not felt as an object worth much consideration, the most convenient way is that which is most usual, namely, to order them of a respectable tailor, leaving him to state the price, and having one agreed upon. This will generally ensure the best materials and the most fashionable cut. But there are some other modes of proceeding where great economy in dress is aimed at. The cloth may be purchased of a respectable woollen draper, who will generally recommend a tailor to make it up; the difficulty in this case is to get a tailor who can make it fashionable and a good fit, for the tailors who work in this manner are generally persons of inferior skill.

A still cheaper way is to purchase clothes ready made in the shops; but this is one of the worst modes, as there is often some kind of imposition practised, besides the great uncertainty of finding clothes that fit well. Some tailors advertise to make a complete suit of clothes at a very low price, even for three guineas and a half, scarcely the price which others charge for a coat; and although it can scarcely be expected that these can be of the best quality, yet, by a little caution in choosing the cloth, and attending to the tailor's fitting, this is worth attending to where great economy is required in clothes for ordinary wear.

CHAPTER II.

HATS, CAPS, AND OTHER COVERINGS FOR THE HEAD.

5869. Almost infinitely diversified have been the contrivances for protecting the head from the violent effects of the sun, from wet, and from cold; and most nations in the least removed from barbarism have adopted some dress for this purpose. This custom, however, has not been universal. It is said that the ancient Egyptians, in general, went without any covering on their heads. Many of the celebrated warriors of antiquity appear to have followed the same practice. The negroes of Africa, and other savage tribes, go bareheaded; and this was an old Saxon fashion, the remains of which, perhaps, may still be seen in Christ's Hospital boys, who do not suffer from it. It was an ancient maxim to "keep the head cool and the feet warm;" and in dry and temperate climes there probably would be no danger in young people going bareheaded, even if they were much in the open air; but with our artificial habits this could not be generally practised by adults.

The turban is the general covering used by several Asiatic nations, and by the Turks, who came originally from Asia. It is generally composed of a number of folds of cotton or muslin cloth, and is well calculated for defence against the rays of the sun, which are often so violent there as to occasion death. It is the custom, however, in those countries to wear turbans without intermission, in the house as well as out of doors, which makes the head tender, and is unfavourable to strength.

5870. *The woollen bonnet, or cap,* in some form or other, was the most usual covering for the head among the European nations before the invention of hats; and they are still much worn. One of the most simple, and, perhaps, oldest forms, is the common bonnet of the Scotch Highland peasants; but it has a mean look, and its chief recommendation is its cheapness. The Highland military bonnet, sometimes ornamented with feathers, is a degree smarter.

5871. *Various caps of fur* are worn in Holland, Poland, and Germany, and in other countries of Europe. Caps are also made of the skins of young lambs, the wool of which is curled by a peculiar process.

5872. *Caps of leather, sometimes varnished,* are in a great variety of forms, and of late years have been much worn in England by mechanics and young people.

5873. *Travelling caps* are made in a similar way, and are either to keep off the wet entirely, or for sleeping in, where hats would be inconvenient. These are too well known to require enumeration.

5874. *Hats* are not modern, as they were used by some of the ancient Greeks. They are now, and have been for many years, by far the most general article for covering the head in Europe and America, and are probably the best contrivance; they are made of various materials, as felt, straw, chip, willow, whalebone, silk, &c. When the felting of wool and hair for hats was first invented does not appear. The Tartars employ this process of felting in making a kind of covering for their tents; and, although we do not find it mentioned among the arts of the Greeks and Romans, it was known to our Saxon ancestors, though felted hats were not common among them. They seem to have been made in Flanders earlier than in Britain, for in Chaucer's "Canterbury Tales" the merchant wears "on his head a Flaundrish beaver hat."

5875. *A late paper in the "Archæologia" supplies us with the following curious information respecting hats in this country:* The Chronicles of Froissart mention the hats of the time of Edward III. and Richard II., and white hats seem then to have been worn at Ghent as the badge of a political party. But they were by no means common, and were confined to the wealthy till the reign of Henry VIII. Stowe informs us that "the English used to ride, and go in winter and summer in knit caps, cloth hoods, and the better sort in silk-thrummed" hats. In the time of Queen Elizabeth, high crowns came in fashion, and they were often pointed and conical. At that time hats were restricted by act of Parliament to the upper classes of society; the middle and lower being confined, under a penalty, to the use of knit caps. This act, however, was soon repealed, and felt hats came into general use. In 1638, King Charles prohibited the importation of beaver hats, and from this period may be dated the increase in the value of beaver fur.

During the Commonwealth, and subsequently, broad brims were much used, and the Quaker's hat is a diminished remnant of that period. These being often inconvenient, it was the custom occasionally to turn up one or two sides, which led to the three-cocked hat in the time of Queen Anne. About 1750, round hats became very prevalent among the lower orders, and the cocked hat was the distinction of a gentleman. About 1790, cocked hats were laid aside, and ever since round hats have been the universal wear. The various forms of these are too well known to require enumeration; the chief varieties are the high and low crowned. The former are to keep the head cool by the air in the upper part; the low crowned are generally broad brimmed, the better to shade the face in summer.

5876. Plumes of feathers, and the single feather of the peacock, or common fowl, have been worn in the hat in very ancient times. In China, they are a mark of dignity. In modern times feathers have been confined to military men. Particular vegetables have been worn in the hat as badges of party or family; thus, the Welsh wear leeks, and the Irish the shamrock, in certain festivals; and oak leaves have been worn in memory of Charles II. sheltering himself in an oak Cockades have been also used as ornaments. White was the colour of the Stuarts and Bourbons; a black cockade is the family badge of the Elector of Hanover. Large white cockades, called *favours*, are now worn by servants at weddings. It was the fashion to wear large jewels in the hat as ornaments, and hat-bands, with loops and bindings of gold and silver lace, were esteemed as the marks of wealth and dignity; all these have given place to a taste for greater simplicity in dress; and for many years we have had no ornament in the hat beyond a simple narrow black band.

Uncovering the head, or taking off the hat, is a mark of respect almost peculiar to Europeans; in Persia it is considered indecorous.

5877. *Felted hats are made*, in the first place, of a thick close felt of wool mixed with some kind of hair; this is called the foundation; and on the outside of the hat a finer kind of hair is worked in, which, in the best hats, consists of the fur of the beaver, whence the term beaver hats. Some hats appear formerly to have been made entirely of beaver; but this is never done now, on account of the scarcity of the material. There are a great many qualities of hats, from the various kinds of hair made use of either in the foundation or in the covering. Our object is not to go into all the minutiæ of hat-making as a trade, which would extend far beyond our limits, but only to convey a general idea of the mode in which these articles are formed.

5878. *The process of hat-making* begins with felting, which consists in a method of working up wool or hair into a species of cloth, independently of either spinning or weaving, and the mechanism of the process depends in a great measure upon the conformation of all animal hairs and wool, which disposes them to unite by pressure and heat, so as to produce a compact and firm substance. The first process in hat felting is to obtain the most complete separation of the fibres, and to dispose a layer of them in every possible direction with regard to each other. For this purpose, a quantity of the hair or wool is laid upon a platform of wood about four feet wide, and struck repeatedly by means of a bow and string. The workman, holding the bow in his left hand, and placing the bow-string near to the material, plucks it towards him by a pin; the string, in flying back, is made to strike into the wool or other material, and scatters a portion of it to a considerable distance, occasioning it to fall down in a regular layer. By repeated strokes of the bow-string, the whole heap is at last thoroughly loosened, and spread over a part of the platform in an even layer; this is then brought together by the hand into some regular form, according to the kind of hat to be made, and folded up in a wet cloth; it is then laid upon a warm iron plate, and the process of felting is carried on by pressing it by the hands in various directions, and sprinkling with water, by which the mass acquires a certain degree of consistency from the fibres of the hair or wool entangling together. Before the felting is completed, a quantity of fine fur, either of the beaver, or some other animal, as the rabbit, camel, &c., is laid on the outside of the felt, in such a manner as that the ends of the hairs point one way, as on the animal; these are worked in so as to be fixed in the felt, and completely to cover it; and upon the goodness of this fur will, in a great measure, be the quality of the hat. The hats are at first made into a conical form; and, to render them still firmer, they are now boiled with some alkali, and felted again with hot water, and the conical cap is by various processes put upon a block of the desired shape, and worked on till it fits. The edge or rim is now worked out, and cut into the proper shape. The hat is next dried; and its nap is raised or loosened by rubbing it with a brush of wire, and sometimes it is pumiced, to take off the coarser hairs, and afterward smoothed with seal-skin. It is then tied securely upon its block, and dyed black in the usual manner. After being dyed, it is stiffened; this is done by various substances. The most common hats are stiffened with glue, or with gum Senegal; but beer grounds are first applied to the inside as a cheap mucilage, to prevent the glue from coming through to the surface. If the hats are to be water-proof, some substance is used that will not be softened by rain. For this purpose, a varnish is used composed of shell-lac, sanderach, mastic, and other resins dissolved in alcohol or naphtha; some use a solution of India rubber. The finishing of the hats is produced by softening them a little by exposure to steam, and brushing and ironing them till the required gloss is produced. Lining and binding complete the process.

5879. *The materials made use of for felted hats* are chiefly the fur of the beaver, rabbit, and hare, sheep's wool, camel's and goat's hair, cotton, and silk; the first is by far the most esteemed, on account of its silky softness. The furs of the hare, the rabbit, and the beaver, being naturally straight, cannot be felted by themselves till they have acquired a curling property at their points; this is given by the application of nitrate of mercury, an artifice called *secretage*. *Neustria* is an article lately introduced into the manufacture of hats; it is the fur of an animal of that name, a species of water-rat, resembling the otter, and is as fine as the fur of the beaver. Within these fifteen or twenty years, it has been largely imported from South America, to the amount of 800,000 skins annually.

5880. *The colours of felted hats* are black, white, and drab; the first are, of course, dyed. White hats are worn only by ladies, and have a nap of rabbits' fur, selected from the white skins. Drab hats for men are made of stuff of the natural colour, assorted on purpose; they are used for summer wear, absorbing the sun's rays less than black, and being consequently cooler; they are likewise proper for the seaside, the spray of the salt water injuring the colour of black hats.

5881. *Silk hats* are made by fixing a kind of plush with a long nap of silk upon a body of felt, chip, straw plat, or some other material; they have lately come much into use, from their cheapness, and keeping their colour. Several improvements have lately been made in silk hats. When they were first manufactured, they were liable to two objections: the body was hard, consisting of pasteboard, and was apt to hurt the head, from want of elasticity; and the edge of the crown, being much exposed to wear, the silk nap soon got abraded, so as to lay bare the cotton foundation, whence the hat assumed a shabby appearance. Afterward the body was made of felted wool, and the joining of the side with the crown was not made at the edge, but in the crown itself. The plush or velvet employed in covering these hats was, at first, made upon a cotton foundation, which cannot receive the same brilliant black dye as the silk; the best silk hats are now covered with a plush made wholly of silk. It is said that the French make a better silk material for covering hats than we can, and their material is imported by us and put on beaver bodies, which are then called *Paris hats;* this material has a shorter nap, and looks smoother and more glossy than ours. Silk hats are also frequently made upon a very light body, as willow, covered with a plush of floss silk, and sold under the name of *gossamer hats*, which serve very well for summer wear, but which are not calculated for bad weather; some of these are sold so low as five or six shillings, and really, while in good condition, look very well. A fabric has also been woven from threads cut from whalebone, which is extremely elastic and durable; this serves for the body of the hat, and, being stiffened with resinous varnish, the silk is applied on the outside.

5882. *Water-proof hats*, made so by a stiffening applied within of shell-lac, or India rubber, have the inconvenience of preventing the perspiration of the head from escaping, and are, therefore, disagreeably hot, particularly in summer.

5883. *When a beaver or silk hat has been wetted with rain*, on coming into the house it should be wiped dry and brushed, to lay the nap smooth. If put away and suffered to dry without that precaution, the nap will be rough, and brushing will not lay it smooth and restore its gloss.

5884. *Much more attention and care are bestowed upon the hat in England than on the Continent;* here every person of any respectability takes care to appear in public in a good hat. Foreigners are less solicitous about this part of dress.

5885. *Travelling cases are made for hats;* those who wish to preserve this article perfect make use of a travelling cap, and send the hat in its case as part of the luggage.

5886. *Straw hats* are in very general wear for women, and also occasionally for men; they are not a modern invention, the neighbourhood of Dunstable having been celebrated for a century and a half as the principal seat of the manufacture, which employs a great many persons.

5887. *Dunstable hats* are made of whole straw platted in long, narrow strips, or ribands, which are afterward sewed together in the form of a hat or bonnet. The weight and clumsy appearance of these bonnets first suggested the idea of dividing the straw into strips; but it was a considerable time before a method was invented of performing this in a perfect manner.

5888. *Split straw* is an elegant manufacture, brought into use about forty years ago, and has now become very general for women's bonnets. The straw of wheat or of rye is cut at the joints, and the outer skin being removed, it is sorted into small bundles, and is next split by means of a very simple instrument, and delivered to be platted. The plat is sold by the score yards, and about three score and a half will make an ordinary sized bonnet. It is sewed by the bonnet-makers, and then blocked, which is a laborious process; and, after being pressed, wired, and lined, it is ready for sale. There are markets in the plat districts for the sale of straw, plat, and bonnets; the best market for the latter is at St. Alban's. The various forms of bonnets into which the straw plat is worked up, varying continually with fashion, baffles all description, and is a subject well understood.

5889. *Straw is bleached and straw hats cleaned* by putting them into a cask into which a few brimstone matches are placed, lighted. The fumes of the sulphur have the effect of destroying the colour, or whitening the straw. The same effect may be produced by dipping the straw into the chloride of lime dissolved in water, an article which may now be procured at any large chemist's. Of the straw hats, the *Leghorn* are the most highly prized, as the finest in the world; these are made in the neighbourhood of Florence, Pisa, the district of Sienna, and the upper part of the Vale of the Arno, and are exported from Leghorn. The straw is produced from a small kind of wheat cultivated on a poor soil, and bleached like flax; it is remarkable for its strength and whiteness; the plat is extremely regular, and the straw is not split. Attempts have been made to grow this kind of wheat in England, but they have not succeeded.

5890. *White linings to hats or bonnets*, particularly when they are glazed or shining, as some silks, are hurtful to the eyes, in consequence of their reflecting a great deal of light, and are somewhat similar in their effects to snow, which is known to be extremely injurious to the sight. These linings ought to be of dark colours, gray or green, and should not be of glossy materials.

5891. *Various other materials besides straw are used for making light hats.* Several grasses have been tried, but none have been found to equal wheat straw. *Chip*, which is the thin strips of wood made by a plane, is employed; the *willow* is found to answer well, and these strips are woven by a loom into a kind of twill, or diamond tissue, and afterward bleached like straw. A hat made of two folds of this has a considerable resemblance to Leghorn.

CHAPTER III.

SHOES AND BOOTS.

5892. *Historical Remarks.*—The antiquity of these articles of dress is, no doubt, as early as the civilization of mankind. We find that they were worn by the ancient Egyptians; several of their actual shoes, having been preserved to the present day, may be seen in the British Museum; they are formed of matting, the bark of the papyrus, leather, and other materials. Shoes were also used by the Greeks and Romans, though they generally wore sandals, which were merely soles tied on the feet with thongs. It would be endless to mention the variety of shoes that have been in use at different times, and among various nations. The most simple kind of shoes appears to have been merely a piece of leather bound round the foot, and such are still used in remote places in the Highlands of Scotland, where they are called *brogues.* In the reign of Edward IV., shoes were pointed at the toes, and had long beaks of four or five inches, turned up and fastened to the knee by a chain. Afterward we find them quite round at the toes, and ornamented with slashes. In the time of Charles I., the toes were made quite square; and the boots came only half up to the knee, with wide tops turned down. Neither these nor the shoes appear then to have been blacked. Blacking is a very late fashion.

5893. *The shoe consists of* the sole and the upper leather. The part which covers the upper part of the foot is called the *vamp*, and the part which surrounds the heel forms the two quarters; these last are sewed together at the heel, and to the vamp at about the middle of the foot. The sole is composed of the real or lower sole, and the welt, the heel, and the inner or upper sole. Boots and shoes, for comfort and durability, should have upper leathers of fine-grained, well-seasoned *calf leather*, and the soles of stout and well-hammered *neats' leather.* The seams should be wrought with well-waxed thread, in stitches as fine as the nature of the substance will permit.

5894. *Various other kinds of leather* are occasionally used for shoes, though none is equal to that of the calf for wear and keeping out the wet; these are from the skins of goats, horses, dogs, and seals; they are lighter leathers, and sometimes made into dress shoes. Doe-skin leather is extremely elastic, but does not keep out the wet unless prepared by some water-proof process. For the mode of preparing leather, see "Materials of Furniture," Book V., Chap. V.

5895. *There are few parts of our dress in which fashion is so mischievous as in our shoes;* instead of forming them, as they should be, to the shape of the human foot, it would seem as if the latter was to be regulated by the taste of the shoemaker. If we wish to know what is the natural form of the foot, we should observe those who have never been accustomed to wear shoes, and we shall find that all the toes, the little ones included, have their full play, and can be moved about, like fingers, in every direction. The Greeks, who seldom wore shoes, and, consequently, had their toes unfettered, conceived and executed their fine statues according to this perfect form; the little toes are never bent in under the rest, as is almost universally the case in this country, where the feet are often enclosed in tight shoes from infancy; and where shoes do occur in Greek and Roman sculpture, they are always round at the toes. Pointed shoes are not only extremely injurious to the feet, bringing on corns and other inconveniences, but they are really, however the contrary may be supposed, in bad taste, although all-powerful fashion has given them an imaginary elegance.

5896. *The best method of having boots and shoes well fitted* is, after having procured some to fit accurately, to get possession of the lasts on which they were made, and to have in future all new ones made upon them. Some take the trouble of having a plaster cast taken of their foot, and of having a last made from it. The erroneous idea that a very small foot is handsome has crippled many; whereas good taste demands that the foot should have a certain proportion to the rest of the body. The present custom of making shoes to fit each foot, right and left, is much to be commended, and is a great improvement.

5897. *Various leathers besides those of calves* are used in making thin shoes, particularly for dress, where appearance more than strength is the chief quality. Leathers for this purpose are made of the skins of the horse, dog, seal, &c. *Ladies' walking shoes* are also made of some of these thin leathers. The bright, shining varnish now common on dress shoes is called *enamelling.*

5898. *The best boots and shoes are town made,* and to order; but now a very great quantity of both are manufactured in the country, and sent up to London, and it is with these that the sale shops in London are filled. These are much cheaper than what are made in town; but they are likewise inferior in all good qualities, and cannot be depended on; but the convenience of getting them ready made is sometimes an object. Many of these sale shops take orders, but, instead of getting the articles made at home, send into the country for them.

5899 *On the subject of shoes, Dr. Arnott remarks:* "In a graceful human step the heel is always raised before the foot is lifted from the ground, as if the foot were part of a wheel rolling forward; and the weight of the body, supported by the muscles of the calf of the leg, rests for the time on the forepart of the foot and toes. There is at that time a bending of the foot in a certain degree; but where strong wooden shoes are used, or any shoe so stiff that it will not yield and allow this bending of the foot, the heel is not raised at all until the whole boot rises with it, so that the muscles of the calf are scarcely used, and, in consequence, soon dwindle in size, and almost disappear. Many of the English farm servants wear heavy, stiff shoes, and in London may be constantly seen as the drivers of country wagons, with fine, robust body and arms, but with legs which are fleshless and spindles, producing a gait most awkward and unmanly. The brothers of these men, otherwise employed, are not so misshapen; and even they themselves, when they choose to become soldiers, and are trained in military exercises, lose their peculiarity. What a pity that, for the sake of a trifling saving, graceful nature should be so deformed. An example of an opposite kind is seen in Paris, where, as the streets have no side pavements, and the ladies are obliged, consequently, to walk almost constantly on tiptoe, the great action of the muscles of the calf has given a conformation of the leg and foot, to match which the Parisian belles proudly challenge all the world—not aware, probably, that it is a defect of their city to which the boasted peculiarity is mainly due." It may be observed, also, that dancers have always large calves to their legs.

5900. *A machine was invented by Mr. Brunel* for making shoes by uniting the soles to the upper leathers by means of rivets instead of sewing. The leather is likewise cut out by stamps, and the whole of the process being effected by mechanism, very strong shoes are made with great expedition. The army is supplied from a manufactory in which the only workmen employed are the invalid soldiers of Chelsea Hospital.

5901. *The sedentary posture* in which shoemakers generally work being very unhealthy, several inventions have been made for enabling them to follow their trade in a standing position, and are described in the "Transactions of the Society of Arts."

5902. Among the varieties of shoes, we may enumerate

Gentlemen's dress shoes, made of Spanish leather.	Gentlemen's strong walking.	Ladies' double and single soled.
" pumps.	" light walking.	" kid, Spanish, and patent leather.
" dancing.	" shooting.	" satin.
	" Bluchers.	" prunella

5903. *Boots* are not modern. They were worn in the Roman army both by cavalry and infantry. They have undergone as much change of fashion as any other part of dress. The varieties at present in use are,

Top or jockey boots, used for riding.
Wellington boots, which come up nearly to the knee, without tops.
Half, or Hessian, now little used.
Military boots.
Fishing boots, water-proof, or of India rubber.
Hunting boots.
Bluchers, only coming over the ankle.
Oxonian, differ from the last in being tied at the side.
Dress boot shoe, for dinner, but not ball-room dress; useful for saving time in dressing.

5904. *Shoes and boots made completely water-proof* are useful for occasional shooting or fishing, but are unwholesome for common wear, from their confining the insensible perspiration. Leather, when made in the most perfect manner, is impermeable to water under ordinary circumstances, but does not prevent the passage of the perspirable matter. Various preparations have been made to brush over leather and render it water-proof; these are generally composed of mixtures of oil, turpentine, rosin, and wax; in short, any bituminous, resinous, or adhesive matter that will resist acids, alkalies, and water, and will unite with drying oils, provided, when mixed in proper proportions, they do not render the leather hard, or make it crack, or otherwise disagreeable. *A few receipts for this purpose* may be given.

1. Take six gallons of linseed oil, one pound and a half of resin, and four pounds and a half of red litharge, or any other substance known as dryers; boil them together till they acquire sufficient consistance to adhere to the fingers, and draw out into strings, when cooled, upon a piece of glass. It is then to be removed from the fire, and when sufficiently cool it is to be thinned to about the consistence of sweet oil by adding spirits of turpentine to it, which will generally require about six gallons. It is then left to settle for a day or two, after which it is to be carefully poured off from the grounds; about one pound and a half of ivory or lamp black, and some Prussian blue ground in linseed oil, is added and intimately mixed with it. To apply this varnish, lay it on with a brush until it lies upon the surface of the leather with an even gloss; then hang up the article operated upon until the next day, when the application may be repeated, and each successive day as often as is necessary.

2. In six ounces of oil of turpentine dissolve, by gentle heat, three drachms of India rubber, and mix this with eight ounces of linseed oil. Apply it as above.

3. Melt in an earthen vessel, over a slow fire, half a pint of drying oil (boiled linseed oil), one ounce of bees' wax, one ounce of oil of turpentine, and half an ounce of Burgundy pitch, or rosin. If new boots or shoes are saturated with this composition, and left to hang in a warm place for a week or ten days, they will be impervious to wet, and likewise soft and pliable. This composition is used by the fishermen of New-England.

Effectually to prevent the wet from coming through the soles of shoes, some have put a sheet of some impermeable substance between the two soles. Thin sheet copper has been employed, but that is not sufficiently pliable; oil-skin, or a thin sheet of India rubber, will answer. Cork soles put inside boots or shoes are very useful.

5905. *Goloshes* are a kind of wide shoe to put on over the foot of shoes or boots, and they are generally made water-proof. They are now made very perfect of India rubber.

5906. *Clogs* are easier to walk in than pattens, but they throw up more dirt. They consist of a thick sole of wood or leather, worn over the ordinary boots or shoes. Jointed French clogs combine both patten and clog, having the cleanness of the one and the firmness of the other, with flexibility.

CHAPTER IV.

GLOVES.

5907. Gloves are not a modern invention, although they are much more used at present than in former times. Xenophon describes the ancient Persians as wearing gloves, and Varro informs us that they were of long standing among the Romans. But they were often worn only as a protection of the hand in particular cases; in warm climates they were not thought very necessary, and it was only in cold countries that their use became general. Gloves were, in the early ages of Christianity, introduced as a part of monastic costume, and in later periods formed an essential part of the episcopal habit. The glove was employed by princes as a token of investiture; and to deprive a person of his gloves was a mark of divesting him of his office. Throwing down a glove constituted a challenge, which he accepted who took it up, a custom which was continued down to the reign of Queen Elizabeth; and this ceremony was performed, perhaps, for the last time, at the coronation of George IV., when his majesty's champion entered Westminster Hall, completely armed and mounted, and, throwing down his glove, challenged any one to dispute the right of his sovereign to the crown. Gloves were particularly used in hawking; and the custom of presenting them at weddings and funerals is still general. They were formerly considered as a valuable new-year's gift, when they were richly worked and embroidered.

5908. *Gloves are made of various materials*; leather, silk, linen thread, cotton thread, cotton cloths, and worsted. The good qualities of gloves are strength, warmth in winter, coolness in summer, elasticity in fitting well, and to be well sewed in the seams. There is a distinction, also, between those which will bear washing and such as will not; likewise in the manner of sewing.

Of leather gloves there are a great many kinds, according to the quality of the material, or the uses for which they are required. Of these the principal are:

Kid gloves, the most beautiful, from their softness, thinness, and elasticity, fitting the hand almost like a second skin. They are white, and dyed of all colours, but white kid is always worn in full dress. Those of French manufacture are certainly superior to ours in the neatness of the workmanship, and for elasticity they are highly prized. This superiority has occasioned many imitations in this country, and it is said that most of what are sold here for French are, in fact, home-made, from French or Italian skins. We have few goats in England; therefore our kid leather is chiefly imported from Switzerland and Tuscany, whence it comes by way of Leghorn. Most of the lower-priced gloves sold for kid are made of lamb-skin, which is thicker; a vast many are made in Worcestershire.

It used formerly to be the custom in the southwest of Ireland to slaughter many cows while in calf. The skins of these unborn calves were of extraordinary fineness and delicacy, and from such was prepared the leather of which the celebrated *Limeric gloves* were made. This practice, however, is now almost discontinued; and whatever merit the Limeric gloves may still possess is owing to the skill of the manufacturer, and not to the superiority of his raw material, which is generally kid leather. *Beaver gloves* are among the most common of the cheap leather gloves, manufactured chiefly at Hereford; they are dyed of many colours, but they do not wash. *Woodstock* gloves are a superior kind of soft leather, made of lamb-skins, which have the advantage of bearing washing; they are manufactured chiefly at Woodstock, in Oxfordshire, which has been celebrated for them ever since the time of Queen Elizabeth. *Buck-skin* is the strongest kind of leather gloves, and washes well. It may be had white, and of various colours. *Doe-skins* are of a thick, strong, and soft leather; bear washing. *Tan leather* is the name of a very serviceable, strong, and cheap glove for riding, driving, or gardening; its colour is that of bark or tan, and it is either common or York tan. *Sheep-skin* is not much used, except in the army; it is generally white. Leather gloves are likewise sometimes *lined* with fleecy hosiery or fur for winter, and are sometimes *cuffed*.

5909. *Machines have been lately invented for sewing* leather gloves, by which the process is performed more accurately, and which reduces the price. The principal leather glove manufactories in England are at Worcester, Woodstock, Yeovil, Leominster, Ludlow, and London.

5910. *Thread gloves* are either of linen or cotton thread; but it is the former only that are *properly* known in the shops by the name of thread gloves, though it is now a common practice to pass off cotton thread for linen thread. They are a remarkably cool wear in summer, and bear washing perfectly; they are sometimes of unbleached yarn.

5911. *Cotton gloves* are the cheapest of all, and are dyed of various colours; being warm, they are much in use for common wear. Many are imported from Germany of a very low price. *Berlin gloves* are strong, and of white cotton; they were originally imported from the Continent, but are now made in great numbers in Nottingham and Leicester. These, and the other cotton gloves, have almost driven away the common beaver.

5912. *Jean, satteen, and cambric* gloves are cut out of the cotton cloth of these names, and sewed together their use is confined to women. The first are strong, but the cambric gloves are bought merely for their cheapness, having nothing else to recommend them.

5913. *Mittens* are gloves made of various materials, of which the tips of the fingers are wanting, and are used in work that requires the points of the fingers to be uncovered.

5914. *Silk gloves*; these are of various qualities, determined by their weight and the neatness of workmanship. The French white are the best: they are also black, and coloured. A figured silk net glove has lately come much into use among ladies; it is extremely elegant, and cool in summer. Gloves are now also made remarkably cheap of spun silk.

5915. *Worsted gloves* are of many kinds. *Lambs' wool* and *Shetland* are extremely soft and warm. *Dutch knit*, plain and lined, are strong and warm: *German worsted* are the cheapest. Worsted gloves, though not so elegant as others, have a great advantage in their real warmth in cold weather.

The above gloves, of silk, cotton, and worsted, and thread, are now generally woven in the loom; knit gloves, formerly so common, being seldom to be met with. Several other names of gloves may be found in shop lists, and every winter produces something new: gloves of various kinds of *cloth* sewed are now introduced; they are warm, and fit well. Elastic wristbands to gloves are a late improvement.

CHAPTER V.

STOCKINGS.

5916. These, as now made, are comparatively a modern invention. The art of knitting them by hand, with long wire needles, is supposed by some to have come originally from Spain, although it is not ascertained that it was invented in that country. A company of stocking knitters was established in Paris in 1527.

5917. Previously to the time of Henry VII., knitted silk stockings were unknown in England; and Stowe observes, in his Chronicle, "for you shall understand that King Henry VIII. did wear only cloath hose, or hose cut out of ell broad taffata; or that by great chance there came a pair of Spanish silke stockings from Spaine." Thus, although silk stockings had been brought into England prior to the reign of Edward VI., yet we find Stowe commemorating as "a great present" a "payre of long Spanish silke stockings" that Sir Thomas Gresham presented to that king. Thus they were articles of great rarity and value in the time of Queen Elizabeth, for we are informed by Stowe, "in 1560 her silk woman, Mistris Mountague, presented her majestie with a payre of blacke knit silk stockings, for a new-year's gift; the which, after a few days' wearing, pleased her highnesse so well, that shee sent for Mistris Mountague and asked her where shee had them, and if shee could help her to any more; who answered, saying, 'I have made them very carefully on purpose, only for your majestie; and seeing those please you so well, I will presently set more in hand.' 'Do so,' quoth the queen, 'for indeed I like silke stockings so well, because they are pleasant, fine, and delicate, that henceforth I will weare no more cloth stockings.'"

5918. Stockings continued long to be knit by hand in the various countries of Europe, and the machine at present used for weaving them, called the stocking loom, was invented in 1589, by Mr. William Lee, a native of Woodborough, near Nottingham. This machine, to any one who attentively considers its complex operations, and the elegant sleight with which it forms its successive rows of loops or stitches, will appear to be one of the most remarkable strides ever made in mechanical invention. Notwithstanding, Lee met with no encouragement in England: Queen Elizabeth, the patroness of art, was then in her decline; and her successor, James, did not perceive the value of an important manufacture. The encouragement refused by King James was offered by Henry IV. of France, and his sagacious minister, Sully. Under their patronage, Lee settled at Rouen, where he established his manufacture; but being envied by the inhabitants of that place, whose genius he had eclipsed, he was proscribed as a Protestant; and, concealed in Paris, he ended his days in secret grief and disappointment. Some of his workmen made their escape to England, and restored the invention to its native country. It was in Leicestershire, and the neighbouring counties of Nottingham and Derby, that the first manufactories were established, and laid the foundation of the hosiery trade of that district.

5919. The invention of the stocking frame by Lee enabled the English manufacturers to export vast quantities of silk hose to Italy, where they retained their superiority for a long time; for Keysler, in his travels through Europe, so late as 1730, remarks that "at Naples, when a tradesman would highly recommend his silk stockings, he protests they are right English."

5920. In 1758, Jedidiah Strutt, of Becher, near Derby, invented a machine for making ribbed stockings; and the spinning machine of Arkwright was successfully applied to the manufacture of cotton stockings. The factory at Becher is at present the most extensive in the world for stocking making. It employs about 400 silk stocking frames, which produce 200 dozen pairs of hose weekly, and 2500 cotton hose frames, each turning off on an average nine pairs weekly, the whole amounting to little less than 100,000 dozen in the year. The stocking frame so multiplies the article, that stockings which could not be knit in a week are now sold at 9*d.* or 1*s.* the pair.

5921. The yarn for the stocking frame is required to be particularly smooth and equal, and it is therefore spun in a manner different from other yarn, two rows being united to form a thread; on this account, it is called double spun twist.

5922. *Stocking knitting or weaving is a distinct art* from cloth weaving, the manner of combining the thread being essentially different in the two. In the stocking fabric, instead of two threads, the warp and woof, as in cloth, the whole piece consists of one continuous thread, which is formed into a series of loops in successive rows, and the loops of each row are drawn through those of a former row.

Besides stockings, there are woven of the same manufacture a great variety of articles, as under waistcoats, nightcaps, drawers, petticoats, cuffs, gloves, &c., all of which belong to the branch of *hosiery*, a name which comes from the Saxon *hosa*, hose or stockings.

5923. Although the stocking loom has, in a great measure, superseded the use of the knitting needles, the latter are not entirely laid aside; and stockings knitted by hand, though generally less beautiful in appearance, can be more depended upon for durability as well as for accurate fitting. Knitting also furnishes a useful occupation to many persons in situations where it would be difficult to find other employment, and is even at present used as a resource. It is still a common employment among the German ladies.

The manufacture of knitted worsted stockings has existed for several centuries in the Pyrenees. In the valley of Carrol they make annually at present upward of 30,000 dozen pairs, which are exported to Bordeaux, Toulouse, and all parts of France. They are made of Spanish wool, and cost from ten to forty sous a pair. The French government does not permit machines for stocking weaving to be erected there, lest they should injure the employment of the inhabitants.

5924. *All hosiery is to be judged of* by the fineness of the thread and the closeness of the texture, which, in the case of stockings especially, may be partly appreciated by weighing, as it were, the articles in the hand. In ribbed stockings a deception is sometimes practised, against which it is necessary to guard. The spaces between the ribs, which ought to be formed by an inversion of the stitch, contains no stitch at all, but an open range of threads, pervious to weather, and utterly destitute of durability. As the ribs of stockings exposed to sale are necessarily almost in contact, the fault cannot be detected without introducing the hand and opening the tissue, when it will be instantly apparent, and, indeed, will exactly resemble the flaw caused by a dropped stitch in a stocking in wear. In cheap cotton stockings the feet are often cut out and sewed together; but these seams invariably hurt the foot.

5925. *The usual varieties of stockings* to be found at the hosiers' are,

Silk—white, black, coloured, both English and French.
Ditto, with cotton feet.
Spun silk, ditto.
Silk socks—black, gray, gray and white
Cotton—white, black, coloured.
Cotton socks, same colours, and unbleached.
Worsted—white, black, coloured, speckled.
Lambs' wool—white, black, coloured.
Shetland stockings—very fine and soft.
Lambs' wool and yarn mixed.
Angola and *Vignonia*—white, black, coloured.
Woollen socks of the same kinds as stockings.
Fleecy hosiery; an extremely warm fabric, having the outside smooth and the inside covered with a fleecy nap; highly valuable for invalids.
Gauze hose; remarkably thin, worn under silk stockings; they are of cotton and worsted.

5926. Stockings are kept only of a few fixed sizes, which causes some inconvenience in getting well fitted The usual sizes are called

Children's,	Women's full size,	Youths',	Men's out size,
Girls',	Ditto, large size,	Men's,	Gouty hose,
Maids',	Boys',	Slender men's,	Fishermen's hose.
Slender women's,			

Where stocking frames are at hand, stockings can be got made to any size.

CHAPTER VI.

SHIRTS.

5927. Shirts are made of linen of various qualities; of cotton cloth or calico of different kinds, and of checked and striped cloth. Their varieties are too well known to require any description; and they are either made up on purpose, or bought ready made of a great variety of prices. Breasts of finer materials, and false collars, are likewise conveniences universally known.

5928. *Stocks and handkerchiefs for the neck* are parts of dress respecting which we need not give any details, as every one is familiar with them.

CHAPTER VII.

POCKET HANDKERCHIEFS.

5929. These are made of silk, cotton, or linen. India silk is the most durable, and preferred for common wear. They are sometimes imported plain, and printed here, because our colours are brighter and better; still, the India pattern is preserved. *Bandanas* are a kind of silk handkerchiefs manufactured in the East Indies, the patterns of which generally consist of square or circular spots, variously arranged upon a red, blue, or yellow ground. They have been imitated here in cotton, by first dyeing fine calico a brilliant Turkey red, and afterward discharging the colour from those parts which in the pattern are white, by means of liquid chlorine, which is made by adding sulphuric acid to the solution of chloride of lime. An immense number of these are manufactured by Messrs. Monteith and Co., Glasgow, who have a patent for the method of producing the spots, which is done with extraordinary expedition. Twelve or fourteen webs of dyed calico are stretched over each other, and a leaden plate, perforated with holes of the form of the spots, is fixed upon them by a powerful press; the discharging liquor is then admitted into these holes and forced through all the thicknesses of calico. After the chlorine has performed its office, water is passed through to wash it quite away; and then the cloth is bleached, to produce a clear white in the spots. In this process only about en minutes are employed, in which time, by a sufficient number of perforated plates, 224 handkerchiefs are discharged; and 19,200 yards are converted into bandanas in the space of ten hours by the labour of four workmen.

The *Balasore* handkerchiefs, made about Preston and Chorley, and *Pullicats*, made at Glasgow, are other imitations of Indian manufactures. Besides these, cotton handkerchiefs of an infinite variety of English patterns are daily making their appearance.

5930. *White pocket handkerchiefs* are made of lawn or cambric. French cambric is considered the best; some of them have borders, and even fringes. Scotch cambric is not made of flax, but cotton. In this country these are usually worn plain; but in some countries, particularly in the East, they are elegantly embroidered, and are carried much in the hand by ladies.

CHAPTER VIII.

BUTTONS.

5931. Diversified as have been the forms and sizes of this useful article, they yet scarcely exceed the variety of the materials of which buttons have been made. Almost every substance capable of being used in their manufacture has been tried, under the influence of fashion or ingenuity. Among them are, gold, silver, plated copper, pinchbeck, steel, mother-of-pearl, ivory, bone, horn, tortoise-shell, jet, cannel coal, paper, leather, glass, &c.; besides these, there are buttons which consist of a wooden or bone mould covered with silk, mohair cloth, or some similar substance. It will be only possible for us to point out the most remarkable varieties.

5932. It would appear that the most ancient buttons were not circular, as at present, but simply short cylinders sewed on by the middle. The remains of these may be traced in the Hungarian coats, sometimes imitated among us in ornamental dresses.

5933. Buttons may be divided into two general classes: those with shanks, or loops, of metal, and those without. Buttons with shanks are chiefly made of metal. The blanks of the buttons are either cast or stamped out of a sheet of metal; in the former, the shanks are inserted while the metal is in fusion; in the second, they are soldered on. Metal buttons are turned round in a lathe, and the ornaments are executed in a variety of ways, either stamped or cut with various tools, among which are some of great ingenuity.

5934. *Gilt buttons* are made of a mixture of copper with a small portion of zinc, or brass mixed with copper common brass being unfit for gilding. They are cut out of sheets of this metal, and the shanks are affixed by solder. The gilding is performed by means of an amalgam of quicksilver and gold. An amalgam is made by putting leaf or grain gold in quicksilver, dissolving this in nitric acid, and applying the solution to the surface of the buttons, on which a deposition takes place of the metallic portion of the ingredients. The quicksilver being driven off by heat, the gold remains on the buttons, which derive their fine lustre from being afterward burnished. The quantity of gold on gilt buttons is fixed by act of Parliament to be five grains of gold to a gross of buttons, or ten grains of gold to the surface of a circle of twelve inches diameter. The better sort undergo the process twice, and are called *double gilt*.

5935. *Brass buttons* are simply stamped out of sheet brass, and ornaments are struck by a die.

5936. *Plated buttons* are made out of copper plated with silver, and are chiefly used in liveries. The figures or devices upon them are formed by stamping with dies.

5937. *The commonest kind of metal buttons* are those which are stamped in pewter, and chiefly used in the trimming of military jackets; they are of course very soft; but not being intended to bear any stress, but merely to exhibit the number of the regiment, or some such other figure, and to be stitched close to the cloth, they answer well enough.

5938. *White metal buttons* are cast of a composition consisting of brass with a portion of tin, so as to form a kind of bell metal; they afterward are turned in a lathe, then whitened by boiling with grain tin and crude tartar, and polished by a buff, and crocus martis. The shanks are let into the metal when casting.

5939. *Cup buttons* are made of two pieces, either plated or gilt; one is flat, like a common button with a shank; the other is a hemisphere fixed on, which has been punched by a fly press.

5940. *In mother-of-pearl buttons*, where the shanks cannot be soldered, they are inserted in a very ingenious manner. The hole is drilled in the mother-of-pearl, and undercut, so as to be larger at the bottom than at the top; and the shank being driven in by a steady stroke, the elasticity of the mother-of-pearl allows it to go in, but closes afterward, to prevent its coming out.

5941. *Buttons without shanks* are of two kinds. The first are simply disks of turned horn or bone, with four holes drilled through the face for the purpose of sewing them on the dress, and the surface is made concave, to preserve the thread by which they are sewed. The horn buttons are made of cow-hoofs softened in boiling water; and they acquire their form by being afterward pressed into heated moulds. The second kind are circular disks made of horn, bone, or wood, which are afterward covered with cloth or thread of some kind; and, though certainly gilt and other metal buttons have a rich appearance, yet taste has lately demanded that they should give way to those covered with some material.

5942. Formerly button moulds were usually covered with threads of gold, silver, silk, and other costly materials, wound over the mould in a peculiar and ornamental way; this employed a great many hands, and when the present method of covering them with cloth or mohair was introduced, a great outcry was raised, on account of the number of persons which it threw out of employment; and it is not generally known that a penalty of from 40*s*. to £5 per dozen attached to any person who shall cover button moulds with the same cloth as the coat.

5943. Custom alone has made us consider the number of buttons with which our coats are studded as ornamental; but they are on many accounts inconvenient, particularly in brushing the clothes. Formerly, when metal buttons were generally worn, their manufacture, particularly at Birmingham, was immense: of the various kinds in use, it is still very considerable, but extremely variable from the inconstancy of fashion.

CHAPTER IX.

VARIOUS OTHER ARTICLES CONNECTED WITH DRESS.

5944. *Sewing Needles.*—History is silent with respect to the invention of that useful implement, the needle; but it is said that those used at present, made of steel, at first called Spanish needles, were introduced in the reign of Queen Elizabeth. Whitechapel, in London, Redditch, in Gloucestershire, and Hatherage, in Derbyshire, are the places most noted for their manufacture; and, considering the excellence of their workmanship, the small price at which they are sold is truly surprising.

5945. *Needles are made* of steel wire: a coil of such wire, in its soft state, is cut by a large pair of shears into lengths of four or five inches. The bundles of lengths are first to be made quite straight; which is done by putting a ring over each end, laying the bundle on an iron table, and rolling it backward and forward by a flat piece of iron placed upon it. The pieces, cut into the proper lengths for needles, are next to be pointed: this operation is performed by the workman holding two or three dozen at a time upon a dry grinding stone, each wire revolving while in contact with the stone. In consequence of the minute particles of steel which are evolved in a cloud during this operation, and which are necessarily inhaled by the workmen, needle grinding is found to be an employment extremely prejudicial to health. Of late years, several contrivances have been resorted to in order to remedy this evil; but it is said that it is difficult to persuade the sufferers themselves to use them. The eye of the needle is generally perforated by women: the end of the wire is flattened by the blow of a hammer, and the perforation is made by a steel punch, the groove where the eye is placed being made by a particular file. The needles, now perforated, again require straightening by a process similar to what was described at the commencement. They are next to be hardened, as hitherto the steel has been in the soft state. For this purpose, several thousands of them are placed in a cast iron receptacle, in which they are covered with ashes to prevent oxydization, heated to a cherry red, and afterward tempered to a blue colour. Again they require straightening, and then are scoured bright; this is performed by collecting them in regular tiers in a strong cloth, each tier being separated by some fine emery, oil, and soft soap. The parcel, being then tied round with strings, is placed under a loaded box like a common mangle, by the motion of which backward and forward, for two or three days, the needles are rubbed against one another, and the whole come out clean and bright. Lastly, they are picked and sorted, the heads all one way, ready for sale.

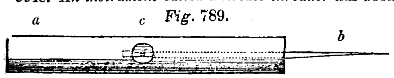
5946. Needles called gold-eyed, silver-eyed, and drilled-eyed, are recommended, as not being so liable to cut the thread. The first are gilt by dipping the heads and eyes in an ethereal solution of gold. The so-called silver-eyed have not a particle of silver, but have their peculiar appearance from a particular kind of polish. The drilled-eyed alone constitute a real improvement, as the sides of the eyes are smoothed after punching, and these are really less liable to cut the thread: the eye is circular, instead of being rectangular as in common needles. The exquisite polish and sharpness of points which the best needles possess is the consequence of a still more careful operation, by polishing them upon a fine stone.

The cheapness of the common sort of needles has often excited surprise, particularly when we consider the excellence of their workmanship; but this is a striking instance of the advantage of a subdivision of labour, every sewing needle passing through the hands of 120 different operatives, during its manufacture, before it is ready for sale; whereas if each needle was begun and finished by the same person, the price of these useful articles would be immensely greater.

5947. The principal varieties of needles are, *crown* or *common; Whitechapel; royal improved; best London; best Chapple; best sorted Chapple; blunts*, used by glovers and tailors; *yarn, looping*, and *knitting needles; Williams's, Davis's, Sheppard's*, and *Boulton's* (these are sold in papers containing 25 each); *worsted darners*, stouter and longer, and the eye larger than the cotton; *packing needles.*

5948. *An instrument called a needle threader* has been lately invented, which is found to be extremely useful to those whose sight is not very good. A small hole is bored longitudinally in a piece of wood or metal of the size of a thick black-lead pencil (*a, fig.* 789), into which the needle, *b*, to be threaded is placed with its eye downward; a hole, *c*, is made in the side of the threader just opposite the place where the eye of the needle will reach to; and this hole is made conical, spreading outward. Although it might be difficult to see the eye of the needle itself out of the threader, yet there can be no difficulty in seeing this conical aperture, and to direct the thread into it; but as soon as the point of the thread is pushed into it, it cannot fail to pass through the eye of the needle, which may then be drawn out threaded. It is obvious that a single threader can only suit one size of needle. This ingenious instrument is sold by Wilks, 186 Regent-street, London; price two shillings.

Fig. 789.



5949. *Pins, such as we now use*, seem to have been unknown in England till about the middle of the fifteenth century. Previous to that time pins were made of ivory, bone, box-wood, and a few of silver, and they were necessarily of large size; and brooches and hooks and eyes were much employed for holding together the parts of dress. In 1543 the manufacture of modern pins had become so considerable as to claim the atten tention of the Legislature; and in 1626 it was introduced into Gloucestershire, which is at present noted for it.

5950. *The process of pin-making*, as it has been usually practised, is the following: The brass wire of which pins are made is purchased by the manufacturer in coils of about 22 inches in diameter; and the first operation, after drawing it to the proper thickness, is to render the wire thoroughly straight, and it is then cut into lengths of five or six inches; and the operation of pointing is similar to what we have described in making needles. It used to be a very unhealthy employment, from inhaling the brass dust; but, by particular contrivances lately introduced, this evil is obviated. A lad twelve years of age will point 16,000 in an hour. When the pointing is finished, the pieces are put into gauges, and the pins cut off to the proper length; and the process is repeated upon the remainder of the pieces of wire. The next process is making and putting on the heads. The head of a pin is made of a piece of smaller wire, twisted about the end and riveted on. The first thing is to convert a piece of small wire into a spiral by wrapping it round another piece of wire the thickness of the pin; and that having been done, the workman divides this spiral with a pair of shears into pieces of two turns each with surprising dexterity, letting them fall into a basin. Fixing these on the pins is performed by women and children. Dipping the pointed end of the pin into the basin containing the prepared heads, they get one of them on, and move it along to the other end where it is to be fixed. Each operator sits before a steel stake having a small cavity, into which one half of the new head will fit; immediately above is a steel die, having a corresponding cavity for the other half of the head; this latter die can be raised by a pedal moved by the foot, and it falls through a very small space, perhaps from one to two inches, the weight being from seven to ten pounds. There is a cavity in the centre of these dies, to admit the body of the pin, and to prevent its being injured by the blow of the die, which is produced by raising it and letting it fall upon the head, for the purpose of tightening it. A single person will head from 10,000 to 15,000 pins in a day.

The pins are now ready to be whitened, or tinned. To remove any grease or dirt which may adhere to their surface, and also to make them a little rough, which facilitates the adherence of the tin with which they are to be covered, they are placed in a boiler with a pickle consisting of water and cream of tartar; after this they are kept for an hour in a boiling, strong solution of tartar, in which grain tin is put, an operation which is repeated once or twice. By an exchange of chemical affinities, the tin is transferred to the surface of the brass pins, which are then removed to a tub of water into which some bran has been put, in order to wash off the acid liquor. The pins, though tinned, are not yet bright; and they are next put into bowls, with hot, dry bran, and well shaken; by this they are thoroughly cleaned and dried, and also polished. The bran is separated by winnowing, and the pins remaining in the bowls are ready for papering. This last process is performed by women and children. The papers are channelled by a sort of crimping iron, and the pins, taken from the bowls by means of a comb which places all the heads in one direction, are pushed through the paper with great expedition, a little iron lever being used for that purpose.

All the processes employed in the art of pin-making, if added together for one pin, would occupy rather more than seven hours and a half of time; yet, by the division of labour, and by making so many at the same time, it is possible to manufacture them with profit for the small price at which they are sold.

The most ingenious machinery for the manufacture of pins is that patented by Mr. Wright, of Wellclose-square, London: by this the whole of the above processes are performed without the assistance of any manual labour; and it has been stated that, if all the establishment were at full work, it could supply the consumption of the whole kingdom, estimated at 16,000,000 pins per day.

5951. *The various sizes of common pins*, as they are found at the haberdashers', are, *Lillskins, short whites, gilt short whites, gilt middlings, gilt corkings*. These are made up in papers. *Pound pins* are sold by weight, in sorted sizes or not. *Lace pins* are very long and slender, for fixing anything on to lace. *Black pins*, and white pins with black heads, are of various sizes. *A new pin* has lately been patented by Taylor and Co., which has the head made out of the same wire as the body of the pin; not put on, as is the case with common pins. *The patent pins*, made by Durnford and Co., are much superior to the common pins, being of stiffer wire, and having the heads flat and better fixed on; their stiffness makes them much more agreeable to use: they are not retailed in less than sixpenny papers.

Thimbles are well-known guards for the tip of the finger in sewing, and to push the needle readily through; they have either a closed end, pitted, or they are without one, and called the *open thimble*, used by needle-men, as tailors and upholsterers. They are made of brass, silver, and steel, or gold and steel.

5952. *Thread.*—It is the usual custom with many haberdashers to describe by the term thread only that which is made of flax, or linen thread; and young shopmen have often no idea that anything else is entitled to this name; whereas it is proper to know that every small line made of fibres of any kind for the purpose of sewing with, or for the rudiments of cloth of any sort, is *a thread*, whatever may be the material; thus, properly, there is not only linen thread, but woollen or worsted thread, silk thread, cotton thread, and even gold and silver thread. In some countries thread is made of a great many other materials, as of the fibres of various plants, and the sinews of animals. Although we have observed that linen thread is the usual distinctive term for that which is made of flax, yet the term *flax thread* would be more appropriate, though this is not in use, since linen is the cloth made from flax, and not the material of thread. When thread is spun for weaving, it is termed *yarn;* when two of these are twisted together for sewing, it is called *sewing thread*, or *twist*, as it is twisted less or more.

5953. *Thread made of Flax, or Linen Thread.*—Much of this was formerly imported from the Netherlands, as Bruges thread, Lisle thread, &c., used for sewing cambric; but these are now superseded by our own manufactures. The greatest quantity of sewing thread is made in Scotland. *White* or *stitching thread* is used for sewing white articles where great strength is required; but, in general, sewing cotton is now so well made that it is very generally employed instead of thread of flax. *Wire thread* is a kind much twisted, used by bonnet-makers. *Patent* or *Shrewsbury thread* is of various colours, and sold in pound papers for sewing strong, coarse articles. *Scotch thread* is of all colours and thicknesses. *Lace thread* is for mending lace.

5954. *The different kinds of cotton thread* are chiefly divided into twist, yarn, and sewing thread. The first is either water twist or mule twist.

Water twist, which we have mentioned in describing the manufacture of cotton, is so named because chiefly made by water mills, and is used for weaving calicoes; it is spun hard with a great deal of twist.

Mule twist is made by steam-engines for weaving muslins and the finest cotton goods, and is somewhat softer than the former.

Stocking yarn, for stocking weaving, is spun softer than twist, and two threads are afterward doubled together, and then slightly twisted round each other.

5955. *Cotton sewing thread*, usually called *sewing cotton*, has of late been made so beautiful by machinery, and its utility and cheapness are so well known, that it has, in a measure, superseded the use of linen thread formerly used. It is used in every house, and in the making of almost every kind of clothing.

5956. *White ball cotton* is of various sizes, distinguished from each other by numbers, or by letters; there is also coloured ball cotton. *Reel cotton* is a superior kind. These are now extensively used for sewing instead of the linen thread employed before the cotton was brought to such perfection; but the latter is not nearly so strong, nor so durable for many purposes, as flax thread. To free cotton thread from its divergent fibres, it is passed rapidly through the flame of coal gas, by which it acquires a more smooth and even appearance. *Mending cotton*, or *darning cotton*, is chiefly used for repairing cotton hose; it is white, black, and coloured, and is composed of two threads but little twisted. *Trafalgar cotton* and *Moravian cotton* are used for working muslins, nets, cambrics, &c., and are quite soft. *Knitting cotton* is for knitting gloves, socks, fringes, &c.; it is twisted hard, but not so hard as sewing cotton. *Marking cotton* is in small balls, and is dyed previously to being twisted, so as to render the colour immoveable. *Lace thread* is also made of cotton, for mending lace or bobbin net. *Gimp thread* is a soft thread used for embroidering on muslin. *Glazed cotton* is another variety for the same purpose.

5957. *Worsted*, or *worsted thread*, is made of wool of various degrees of fineness, and dyed of all colours, chiefly for darning, embroidery, and tapestry.

5958. *Silk Thread, or Sewing Silk.*—In describing the silk manufacture we explained the manner of converting the labours of the silk-worm into thread. What is prepared for sewing is, *fine white, or China silk; common sewing silk, black, and dyed of all colours; tailors' sewing silk; twist, or mohair, for tailors; floss silk*, for darning hose, &c.

5959. *The thread of the Laplanders* is of a very different nature from ours; they know nothing of flax or hemp, nor of any other plant whose stalks might supply the place of these in making thread, but theirs is made of the sinews of the reindeer. They beat these sinews well, after having steeped them long in water, and then they spin them out. The thread is made of any fineness they please, but cannot be longer than the sinews admit. This thread requires much more labour to make than ours; but it is much stronger, and therefore superior on many occasions. In fact, it is very similar to our own catgut, only finer; and with this they sew their clothes, gloves, &c.

Miscellaneous Articles.

5960. *Bindings* are fabrics woven of very narrow widths for sewing on the edges of various cloths, and ties for various purposes. They are made of worsted, cotton, hemp, and flax. *Carpet binding* is of worsted, about two inches and a quarter wide, made very strong; and there is a kind of linen and worsted. Worsted binding is about one inch and a half wide, and is either *common London*, or *double London quality*. *Shoe binding*, narrow, for binding shoes. *Venetian binding* is a finer kind of worsted of various widths, proper for Venetian blinds. Chints binding is for white dimity and printed furniture. *Blue and white bindings* are for mattresses and bed-ticks. *Flannel bindings* of silk and cotton.

5961. *Ferrets* are narrower than bindings; they are of worsted, cotton, or silk.

5962. *Tapes* are the narrowest fabrics of this kind, and are either plain or twilled. *Holland tape* is a white tape of linen, of various widths, described by numbers, as Nos. 13, 14, &c. *Dutch tape* is a finer kind of the same. *Dutch diaper*, or herring-bone tape, is white, of linen, soft and strong. *Pink, red, or lawyers' tape*, of linen. Blue and black tape. There are also cotton tapes of various kinds.

5963. *Webs* are strong fabrics from two to three inches wide, for supporting the seats of sofas, and similar uses. They are made of hemp.

5964. *Fringes* are for furniture or for ladies' dresses. The first are from two inches and a half to four inches deep, and are of three varieties; *plain head, plain head and bullion, gimp head.* Those for dresses are called *fancy fringes*, and are made of worsted or silk, from half an inch in width to two or three inches.

5965. *Laces* are of silk, cotton, or linen; and are made flat, oval, and round. *Stay laces* and *upholsterers' cord* are made of a number of threads from three to twenty, knitted together in a braiding machine.

5966. *Combs* are well-known instruments for disentangling and adjusting hair. They are made of various forms and materials, according to the uses to which they are applied; but we shall confine ourselves at present to those which are employed in dress. Combs are manufactured of all prices, from a few pence to any sum, and sometimes they are set with brilliant stones, pearls, and even diamonds; but those which are most in use are of tortoise-shell and horn, these substances uniting the qualities of strength, elasticity, lightness, and an agreeable colour, suitable to that of the hair. The pieces of tortoise-shell in its natural state are never quite flat; but they are steeped in boiling water for a considerable time to soften them, and are then pressed into the desired forms between iron plates; the teeth are cut with saws, and they are finished with rasps, files, and polishing powders. Horn combs are made of bullocks' horns: after the solid tips are sawn off, the horn is heated over a fire, by which it becomes nearly as soft as leather, and the horns are slit open on one side and pressed flat; they are then plunged into cold water to harden them. The mode of finishing is the same as for tortoise-shell. Lately combs have appeared made of iron japanned.

5967. *The fan* is a very ancient apparatus, having been used by the ladies of Egypt and India, as well as those of modern times, for cooling the face by agitating the air: they were originally made of feathers bound together, like the tail of a peacock when spread out, whence the French name *éventail.* The present usual form is Chinese, and consists of a semicircular piece of paper double, and enclosing slender slips of wood, ivory, or tortoise-shell, susceptible of folding in or expanding at pleasure. Fans, about fifty or sixty years ago, were in high fashion here; at present they are seldom used. Great elegance is displayed in the carved work of some fans, and particularly the Chinese ivory fan-sticks. Those now used are small.

5968. *Braces* are a useful modern invention for suspending the pantaloons or trousers, superseding the necessity of girding the body, as was the case in former times, and which was an injurious practice. They are made of leather, cotton girth, or elastic fabric, by means of India rubber woven in the cloth. The last are the most pleasant wear.

5969. *Veils worn by ladies* are considered prejudicial to the eyes by some oculists; on account of their continually interrupting the view of objects, they render their images upon the retina confused, distracting and weakening that organ. White is the most prejudicial colour.

5970. *Umbrellas.*—The Chinese have used them from time immemorial; and they may be seen sculptured on the ruined buildings of Persepolis, the capital of ancient Persia.

Our umbrellas used formerly to be covered with oiled cotton or linen, or oiled silk; but it is found that these materials, when stretched as the umbrella is opened, keep out the rain sufficiently without varnish. The best sticks are of whalebone; some are of cane, which are very inferior. The lightness of an umbrella is a good quality, and for this purpose the stem or handle is best of bamboo or other cane, which unites strength with lightness. It is very important that the circular wire by which the sticks are connected with the stem should be strong, since it is apt to give way, a circumstance very annoying, as it generally happens when the umbrella is in use. Indeed, we would recommend all travellers to have an umbrella extra strong, and the wire is best of stout copper. *Parasols* are on the same principle as umbrellas, only smaller and made more elegant.

5971. *Artificial Flowers.*—These are beautiful ornaments, and sometimes made with a degree of perfection, as imitations of nature, that is truly surprising. The Italians appear to have been the first people in Europe who excelled in this art, but of late years the French have borne away the palm. Silk was the first substance used; feathers had been employed by the natives of South America with great success, but there is great difficulty in dyeing them. The finest cambric is employed at present in France, taffeta also, and very thin shavings of whalebone. We employ here the same materials, and also stiffened muslin. For the leaves of ordinary flowers there are metal stamps sold in the shops; unusual or fancy flowers are cut out with the scissors; the muslin is generally dyed by the florist. The petals, or leaves, when formed, are fixed on to stems of wire covered with silk, by means of a paste composed of gum Arabic and flour, and made secure by tying. After separate flowers have been thus made, they are formed into groups, and tied together. Much taste is required in arranging the flowers into groups, and fixing them together so as to have a natural play. Artificial flowers are made of various degrees of excellence and price, according to whether they are intended merely to decorate apartments, or to wear in the dresses of ladies. Some are made of an inferior kind, and sold extremely cheap. A great many are made in this country, but it is admitted that we do not equal the French in their best flowers.

Flowers made of thin leaves of coloured wax excel, perhaps, all others in appearance; but they are only fit for ornaments to be kept under glass, and cannot be worn in articles of dress.

5972. *Walking-canes* are made of a great variety of substances. The proper cane is a species of calamus, or reed, which grows in India, and is remarkable for its glossy smoothness; the external thin covering being actual siliceous matter.

Beads.

5973. These well-known ornamental articles have been in general estimation at all times, and in all countries, and are made of a great number of substances.

5974. *Those of glass* are by far the most general, and are of great antiquity, being found not uncommonly in the ruins of ancient Egypt. The principal manufacture of glass beads of all colours and sizes is at Murano, near Venice, and is thus described: Tubes of coloured glass are drawn out into lengths in the glass-houses, in the same way as our thermometer tubes; these are cut into very short lengths, each sufficient for a single bead, by laying them upon the edge of a fixed chisel, and striking them with a blow; the pieces so formed are then put into a vessel containing fine sand and wood ashes, and shaken about until their bores get filled with wood ashes; they are in that state transferred to an iron pan suspended over a fire, and stirred about as before, by which their sharp angles get fused, and each piece assumes the form of a round bead. When this process is perfected, the whole is taken out, and the ashes cleaned from the bores by washing, when they are ready for use. Prodigious quantities are manufactured in this place, at a cheap rate, and are packed up in casks to be sent all over the world.

5975. Beads made of *coral, jet*, and other substances not fusible, are made by turning. Those of *satin spar* are extremely beautiful; and it is proper to know that beads are also made of *fibrous gypsum* that are so like those of satin spar as often to deceive purchasers, but which are extremely soft, and very easily scratched. Beads of *pearl* are well known; good imitations of these are made by filling hollow glass balls with scales of a fresh-water fish ground up with gum. Some of the gems are occasionally employed as beads.

BOOK XIX.

THE TOILET, AND SUBJECTS CONNECTED WITH IT.

5976. *The ordinary business of the toilet is too well known* to require that we should go into all the details respecting it; nor shall we attempt to unveil all the profound mysteries of the cosmetic art, by which almost miraculous effects are daily promised, but seldom performed. Our object is chiefly to point out some circumstances that concern the preservation of health or convenience.

5977. *The term toilet* is originally French (*toilette*), and is derived from *toile*, any thin stuff. It appears to have been first applied to a fine covering of linen, silk, or tapestry spread over a table in a bed-chamber, or dressing-room, to place the dressing things upon, such as dressing-boxes, mirrors, perfumes, combs, pincushions, brushes, razors, &c. Several dressing or toilet tables are described under "Furniture," Book V.

5978. *Dressing-cases* are so infinitely varied, that any description of them, or even enumeration of their varieties, would be an arduous task; and they can only be judged of by inspection and trial, according to the wants of each individual.

5979. *One of the chief objects of attraction in the affairs of the toilet is the care of the skin*, the keeping of which in a condition to perform its important functions has been shown to be essential to health by numerous medical writers. The principal means by which it is effected are the use of the bath, and frequent ablution; but as these will be treated of at length in Book XXVI., on "Health and Sickness," we shall refer to that portion of the work. We propose here to give a few hints respecting some subjects usually included under the head of toilet, such as the hair, the teeth, the ear, the eyes, the fingers and toes, cosmetics and perfumes.

CHAPTER I.

MANAGEMENT OF THE HAIR.

5980. Fine hair has been, in all ages, considered as a beautiful ornament, and the proper management of it is well deserving of attention: as this will be assisted somewhat by a knowledge of its structure and mode of growth, we shall first describe these.

5981. *Each hair* is a hollow tube attached to a root or bulb, which grows in the skin. The shaft of the hair is of a horny substance, but the bulb is furnished with vessels and nerves, as is evident from the pain which is felt in pulling the hair by the roots. When the roots are pulled out, the hair does not grow again. Although the hair is tubular, if it has never been cut it is closed at the points, which are sharp, as may be seen in the large hairs that form the whiskers of animals, and from the hair of which camel's hair pencils are made, which becomes useless if the points are cut off. There is probably a circulation of some fluids in hair, although, from its minute structure, this cannot be ascertained; but it may be inferred from the change that takes place in its colour. It is well known that the hair of the human head is almost always lighter, and sometimes of a different tint, in childhood than it becomes afterward; and as old age advances, it experiences, in most people who do not become bald, the remarkable change into gray. The time at which hair turns gray varies remarkably in different persons; and it is frequently accelerated by great anxiety of mind, of which singular instances have been recorded. The turning gray is very different from falling off; the latter appears the consequence of some decay at the roots, whereas they are only the most permanent hairs that ever become gray; the strongest and darkest coloured are the most liable to the change, and are longer in being shed than those which have preserved their colour. Hair, when gray, appears to be in some degree transparent, and has a remarkable silvery or glistening appearance.

The colour of hair is various, but limited within certain boundaries. It varies from very light flaxen to a deep raven black, and goes through the shades of yellow or golden, to reddish and red, auburn or light brown, and dark brown, and blackish brown.

5982. *The proper management of hair* is very simple. It should be kept as clean as possible, by daily brushing and removal of the scurf that forms upon the skin, and occasional washing with pure water, which will have no injurious effect on the health, providing the hair is not very long, so as to make drying it difficult. To assist in drying it thoroughly, souce the brush in a very little hair powder, and brush it out again; after that a little good perfumed pomatum may be brushed in; too much not only makes the hair greasy, but injures it. There is a natural oil secreted by the hair, which serves to keep it in good order; sometimes this is defective, and the hair becomes dry and harsh; it is then proper to supply the deficiency by a little pomatum or oil. The use of these gives to hair a fine gloss, just in the same way as a mahogany table is made to shine by rubbing it with wax, which fills up all the minute cavities with a smooth substance. A multitude of hair oils are sold by the perfumers under specious names, their compositions being kept secret; and each of them is said to have extraordinary qualities. Most of those which are advertised are expensive, and persons who have tried them agree that their pretended virtues are extravagantly overrated. The oil of *behn* is that which is best adapted for the purpose, having no odour of its own, and not being liable to become rancid.

5983. The oil of behn is used in perfumery as the basis for receiving the fragrant scents of various flowers, which yield little or no essential oil by distillation, but impart their fragrance to expressed oils. This oil is prepared in Egypt, Syria, and Italy, from the nut of *Guilandia moringa*. On standing some time, it separates into two parts; one forms the basis of the fragrant oils, and the other is valuable for the clock-maker, as it does not freeze in the severest cold. It is merely a very pure oil, and, when a little perfume of some kind is added, it forms the oils which are sold under the title of *huiles antiques*, scented with orange flowers, violets, jessamine, roses, bergamot, citron, rosemary, lavender, &c. Those who wish to be economical may substitute purified hogs' lard, in which a few drops of some essence, such as that of bergamot, has been added. Olive oil becomes rancid, and is improper. When hair is allowed to grow very long without cutting, it is observed that it splits at the points, which injures its growth; an inch or two should then be cut off. Curling is best effected in the usual way, by papering. Using hot irons is apt to injure the hair, and the *curling fluids* so confidently advertised have but a very temporary effect, and are injurious.

5984. When hair has become greasy from the too free use of oil or pomatum, it is proper to remove the unctuous matter by good brushing. Occasionally soap is resorted to, or even a weak alkaline lye; but these must be employed with caution, and sparingly; for soap used too often will change the colour of the hair; and as it is a well-known fact that a strong alkaline lye will actually dissolve hair and wool, the incautious use of it, therefore, must be very liable to produce some injurious effects. A little white soap dissolved in spirits of wine is most effectual, and less injurious than soap alone. After this the hair must be well washed with water.

5985. The plentiful growth and agreeable appearance of hair is usually promoted by general health and simple management; and more dependance may be placed on them than on any arts which the perfumer may pretend to.

5986. *The loss of hair which occasions baldness* is a usual effect of old age; but it takes place not unfrequently at earlier periods of life. Premature loss of hair is indicative of some derangement of the bodily system, by which the ordinary functions of the skin are in a defective state. The causes of this may be various, and are not easily investigated. It is a very common result of acute fevers, and even of strong mental excitement. Though the hair has begun to come off, this effect will sometimes cease with the return of perfect health; and whatever can restore the proper action of the skin will contribute most effectually to preserve the hair. But when baldness has actually taken place for some time, it may well be doubted whether any application can reproduce hair upon the part from which it has disappeared, particularly after the person has advanced to a certain time of life. This defect is almost peculiar to men; women at an advanced age, though their hair becomes white, are seldom affected with this disease. When the hair is observed beginning to come off, the defect is frequently owing to a dryness of the skin and some want of nourishment at the roots; in that case a little good pomatum or purified hogs' lard may check the evil, and prevent its extending.

5987. In the daily papers are seen numerous advertisements of preparations for restoring the hair which has fallen off; and we are confidently assured that, through their virtues, thousands of persons who had been bald are now adorned with luxuriant tresses. It is really amusing to observe how far impudence can go, and credulity can lead to being duped; and one would imagine that the extravagant style and gross ignorance displayed in these puffs would be sufficient to expose them. The best of these nostrums, that is, those which contain nothing deleterious, are little more than some of the ordinary fats or oils we have mentioned, coloured and perfumed, and which any persons may prepare for themselves at one twentieth of what they cost in the shops, to say nothing of the latter being totally useless as to the purpose for which they are recommended.

5988. Although there is a very general idea that the fat of the bear, or *bear's grease*, promotes the growth of hair more than any other material, in consequence of the extravagant puffs by which its sale is announced, yet it is, in fact, no more efficacious than common pomatum, which it much resembles. Indeed, it is more than probable that the greatest part of that which is sold for bear's grease never came from that animal. Rea' bear's grease has a very disagreeable smell; and this is imitated, it is said, by usin the fat of an old goat, or rancid hog's lard. The least evil is, that the weak and cre ulous will throw away their money; but there is the greater danger that they may b seriously injured by compounds made up by persons ignorant of the nature of the ingredients they put together, and totally unfit to be trusted when health is so much concerned. Among the substances said to make hair grow, we find also enumerated bees burned and pounded in oil of roses, decoction of box-wood, juice of cresses, onions, nettles, and sage; oil of chamomile and of Palma Christi, fox and goose grease, burned butter, honey water, ashes of rats, moles, hedgehogs, &c.! the efficacy of which we may be permitted to consider as extremely problematical.

Among the advertisements we have alluded to are sometimes the most absurd names, as *oil of talc*, talc being a substance from which no oil whatever can be extracted. *Blistering the bald part* has been lately announced as a sure method of making hair grow upon it; but until this has been confirmed by competent medical practitioners, we would not advise any one to make the experiment.

5989. *For dyeing the hair* various nostrums are sold. In most of these the composition is kept secret, and therefore they are not safe to use; but the basis of the black dyes formerly employed consisted of *nitrate of silver*, or lunar caustic, which, although it does turn the hair black, is at the same time injurious to it if used frequently, and, besides which, stains also the skin and the fingers. A dye is now used which is said to be free from these defects: it is composed of litharge, or vitrified oxyde of lead, with lime well powdered in a mortar, and mixed in water in the proportion of 85 parts by weight of the former to 15 parts of the latter. The manner of using it is the following: After the hair has been washed with warm water and soap to free it from grease, and afterward dried, it is to be well covered over with this mixture, of the consistence of cream, beginning with the roots. Four folds of soft brown paper are then to be placed over the whole, and secured by an oil-skin cap. The hair must remain in this condition from three to six or eight hours, according to the depth of shade required, and the cap may then be removed. Some of the dye will fall out, and the rest must be combed and brushed out when the hair is dry. Washing the hair with water should be avoided for three or four days, as that renders it brittle and irritates the skin; otherwise this dye does not injure the hair. But the safest mode is to purchase the dye of some chemist on whom dependance can be placed, as Mr. Garden, of Oxford-street, London. It is to be observed that, as the hair grows, the parts next the roots will be undyed; but, from the usual mode of wearing the hair, this is not seen immediately; but the dyeing, on this account, requires renewal every two or three months.

Powdered crude antimony (sulphuret of antimony) is employed by women in the East to stain their eyebrows black. The Persians are said to be very skilful in dyeing their hair a glossy black, and frequently practise it. A black-lead pencil is also often employed to colour the eyebrows; but this comes off by washing.

5990. *Depilatories are substances for removing superfluous hair;* but they are mostly unsafe to use, the general basis of them being either yellow orpiment, which is a preparation of arsenic, or caustic alkalies, and sulphate of barytes; all of which, in removing the hairs, injure the skin, and their absorption may be dangerous. The *Oriental rusma* is one of the most celebrated of these: it is composed of two ounces of quicklime, half an ounce of orpiment, and strong alkaline lye, of course extremely caustic. It is sometimes tempered by the addition of a little starch or soft soap, so as to form a pomade. By its use the hair is removed in a few minutes; but we cannot recommend it. Plucking out the hair by the roots, though more painful, is less dangerous.

5991. *False hair* is well known, and is useful. It is made up of every shade and quality. Hair which does not curl or buckle naturally is brought to this state by art, in the following manner: After having picked and sorted the hair, and disposed it in parcels, according to its lengths, they roll these up and tie them tight down upon little cylindrical instruments called pipes, of wood or earthen-ware; in this state they are put into a pot with water, over a fire, to boil for two hours. When taken out, they are dried and enclosed in brown paper, and baked in an oven.

5992. *Hair powder*, at one time universally worn, is now scarcely used, except for occasionally drying or cleaning the hair, and similar purposes. It is merely wheat starch powdered very fine. It was formerly made of various colours, and perfumed.

CHAPTER II.

THE TEETH.

5993. Without going into the description of the anatomical structure of the teeth, we may observe that they are composed of an internal part of *bone*, and an external coating of a harder substance, called *enamel*, which consists of phosphate and a little carbonate of lime, in a very dense form, without any gelatin. Each tooth has a root or fang, an artery, a vein, and a nerve; and it is the exposure of the latter to the air that frequently causes the toothache, when this is owing to what is termed a hollow tooth; in other words, when part of the substance of the tooth has been destroyed by caries.

Teeth are of three kinds: front teeth, or incisors, for cutting the food; eye teeth, for tearing; and molar, or double teeth, for masticating or grinding. When the teeth decay and are lost, the digestion suffers from the deficient mastication of our food; hence health, as well as comfort, depends much upon their preservation. When any are lost, it is advisable to have them replaced by artificial ones, which, if done well, will serve the purpose of mastication. If the caries is discovered at any time by observing a small hole in one of the teeth, it may be filled up or plugged, which generally prevents the decay from spreading farther. The good colour of the teeth gives an idea, not only of good health, but of a proper attention to cleanliness and good habits. They should be washed every morning and evening; but merely washing the mouth with water is not sufficient; it is necessary to use a brush, with or without tooth-powder.

If the teeth are neglected, they are apt to be covered partially by an incrustation of a hard, stony substance, called *tartar*, which tends to destroy them by injuring the gums. The formation of this substance is prevented by frequent cleaning and brushing: if it has taken place, it should be removed by the dentist, and not by acids, as some improperly recommend. Too frequent brushing, also, with rough tooth-powder will wear off the enamel, and produce the evil it was intended to avoid. Some receipts for proper tooth-powders will be given. Many of those advertised for sale are pernicious, as well as the tinctures.

5994. *Safe tooth-powders* may be had of respectable dentists; but the following is recommended by Mr. Brande: "Finely powdered charcoal forms an excellent powder; it cleans the mouth mechanically and chemically; but as alone it is dusty, and not easily miscible with water, it may, for this purpose, be mixed with an equal weight of prepared chalk; and, if requisite, scented with a drop or two of oil of cloves." Another tooth-powder consists of prepared chalk, with a little Peruvian bark, bole ammoniac, cream of tartar, and orris root; or charcoal made of burned bread pounded and sifted, a little salt, and orris root. It is to be observed that the cream of tartar is hurtful, owing to the excess of its acid.

5995. *The Breath.*—When this is of an unpleasant kind, the cause generally lies in the lungs or the teeth. The treatment of the former does not come within our limits; it is only for us to say that health must be sought for; no specific remedy will be of any avail as a permanent cure. When it is owing to the teeth, what we have already said may be sufficient. For other details respecting the teeth, the reader is referred to Book XXVI., on "Health and Sickness."

CHAPTER III.

THE EAR.

5996. This is a delicate organ, and must be treated with great caution. Almost the only thing that is safe is to wash it daily, externally and internally, with simple water as far as a towel with the finger can reach. The practice of using ear-pickers is scarcely safe, and has been known to produce deafness by injuring the ear. In case of incipient deafness of some duration, an experienced surgeon should be consulted: some of those persons who assume the title of *aurists* are not to be depended upon.

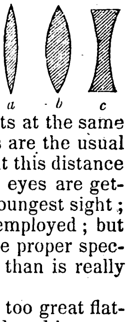
CHAPTER IV.

THE EYES.

5997. Every one must be aware of the value of preserving these unimpaired as long as possible, and also of knowing what remedy to apply when they become defective. For weak sight at an early age, being usually dependant on the state of health, a skilful physician is the best adviser; but there are defects of vision which can, fortunately, be corrected by spectacles, and it is the choice of these we wish to explain.

5998. As old age draws on, every one finds a difficulty in reading a book held at the usual distance, and feels the necessity of holding it farther off to see distinctly; this evil increases until distinct vision cannot be had but at a much greater distance, and, at last, this distance becomes so great that the apparent size of the letters is too much diminished to discern them. This defect, the natural consequence of old age, is owing to the convexity of the eye having diminished; and it is to be remedied by using spectacles, the glasses of which are what are termed by opticians *double convex*, of which *a* and *b*, *fig.* 790, are sections, showing that they are ground thicker in the middle than at the edges. When the defect is first perceived, glasses with a slight degree of convexity will do, as *a*, which opticians call the *first sight;* but after a few years, the eyes becoming still flatter, glasses more convex, as *b*, are necessary to enable one to see to read distinctly at the usual distance; and on every increase of a few years it will be required to have them more and more convex, or what are termed older sight. The more convex the glasses, the more they magnify, or the larger they make objects at the same distance appear. In general, when the eye is perfect, six or eight inches are the usual distance at which we hold small objects to view them, such as a book; but this distance is not exactly the same for all persons. To choose spectacles when the eyes are getting old, begin by trying glasses that magnify least, or what is called the youngest sight; if these enable one to read at the usual distance, they are the kind to be employed; but if vision is still indistinct, try a higher magnifying power, and so on until the proper spectacles are found; but be careful not to use a higher magnifying power than is really necessary, otherwise the evil of age will be brought on prematurely.

Fig. 790.



5999. *Persons are said to be long-sighted* when the defect is owing to the too great flatness of the eye, which is occasionally, but rarely, natural, as well as produced by age; the defect relates only to near objects, for they generally see objects at a distance as well as ever. It is proper to begin to use spectacles as soon as the eyes are discovered to be defective through age, and some injure their sight by avoiding to use glasses longer than is prudent. The first sight, or lowest magnifiers, are often called *preservers*.

Short-sighted persons are those whose eyes are naturally too convex, a defect which has existed from their childhood. The consequence of this defect, is, that objects at a distance cannot be perceived distinctly, although they see near objects perfectly well, and, indeed, better than other persons, for eyes of this kind are, in fact, of themselves magnifiers; but so deficient is their sight with respect to distant objects, that sometimes they can scarcely discern any thing clearly across a street, and some have been known never to have observed the horizon until they saw it through glasses. As we have observed that all eyes get naturally flatter by age, time will correct this defect, wholly or in part, by rendering the eyes less convex; but, in the mean time, to do the same by means of spectacles, their lenses must be ground very differently from magnifiers: they must be *concave glasses*, ground thinner in the middle than at the edges, as at *c*, and such glasses diminish objects instead of magnifying them. Short-sighted persons require these glasses most out of doors, for, without them, they can scarcely recognise their friends. Ordinary spectacles with two glasses are by much the most convenient and best for the eyes, whether convex or concave; but single lenses of either kind are occasionally useful, as they may be worn fastened to a riband, and may often be used more expeditiously than spectacles that require to be kept in a case; but the habit of using them in reading is said to injure the sight. Common cheap spectacles sometimes appear to answer as well as those which cost three or four times the money but very cheap glasses are not to be depended upon: they are sometimes ground irregularly and imperfectly, and then they injure the eyes. It is better, therefore, to have spectacles from a respectable optician, who has a character to maintain. Spectacles having lenses called *pebbles*, made of rock crystal, are not liable to be scratched like glass; but they are not in any degree better than those of glass for vision; and, if care be taken of the latter, they do just as well.

CHAPTER V.

HANDS AND FEET.

6000. So much care is now bestowed upon the hands by some persons, that it would seem as if it was not supposed they were made to be used; nevertheless, it is essential in good society to have them in the proper condition. When any sort of work is to be done that will injure them, it is best to wear gloves. Farther than that, and washing them frequently with soap and water, and a soft brush, much attention is, perhaps, not requisite. When they are chapped in winter, they may be covered with one of the pastes mentioned among the receipts for pomades, and cold cream is often an agreeable remedy. The nails require particular care, otherwise they are apt to become coarse and split. The skin at the root is disposed to grow too far down, and when it does it should be removed. Nails, when in their best state, have so much transparency that the colour of the flesh beneath is seen through, and they have a fine polish. Nothing is more unseemly than not to clean out below the nails regularly every morning, and they should be kept properly pared, neither too long nor too short.

The feet require equal care. They should be frequently washed, and, above all things, tight shoes should be avoided, if it be wished to keep away corns. When these or chilblains occur, the directions should be followed that are given in Book XXVI. The toe nails are best cut with scissors or nail-nippers: in paring them with a penknife elderly persons are apt to wound the flesh, which to them is sometimes dangerous, the circulation in the extremities being so feeble that mortification is occasionally the consequence of a slight wound.

CHAPTER VI.

SHAVING.

6001. Various have been, and still are, the customs respecting *the beard* among different nations. Ancient writers have made honourable mention of the fine beards of antiquity. Homer describes the white and flowing beards of Nestor and of Priam, and Strabo relates that the gymnosophists of India were solicitous to make the length of their beards an object of popular veneration. The Romans did not begin to shave till the year of Rome 454, when a number of barbers were brought into Italy. The custom, however, never became universal, and we find some of the Roman emperors with, and others without, this ornament. The ancient Germans and Franks generally wore only mustaches; but the Normans had a great aversion to any part of the beard, and William the Conqueror found some difficulty in compelling the English to follow their example in removing the whole of the beard. In the fourteenth century beards were again in fashion; but towards the close of the sixteenth they were reduced to mustaches, and, by degrees, afterward shaving the whole face became general. The Russians were long extremely tenacious of their beards, and among the Turks it is considered infamous to have it cut off. The Jews wear a beard on the chin, but not on the upper lip; and they, as well as the Turks, have been in the habit of anointing and perfuming it. Notwithstanding, however, the great fondness for, and respect very generally paid to, the beard, there are certainly numerous inconveniences in this male appendage, and modern cleanliness had banished it from the British Islands, though it seems inclined to reappear among us.

6002. Every one knows how desirable it is to shave with comfort, and, to do this, proper apparatus is essential. Previously to the operation of using the razor, the face should be washed with *tepid*, not warm, water, and a good lather laid on with a proper brush; some prefer cold water. The soap is to be rubbed to a lather in a soap-dish, or shaving-box; others prefer first wetting the beard, and rubbing the cake of soap on the face, and making the lather with the brush on the skin, which is the most effectual way when the beard is very strong. Instead of soap some use *shaving paste*, which may be made by melting together one drachm each of almond oil, white wax, and spermaceti; beat them up with rose water and a square of Windsor soap. *A liquid for shaving* may be made by dissolving eight ounces of Castile soap in a pint of spirits of wine.

After the operation the face ought to be washed with *cold* water, and the razor wiped dry either with a cloth or piece of wash leather: it is usually dipped into hot water prior to using it; a practice, however, not always necessary.

6003. *A good pair or set of razors* is essential, and the safest method is to procure them of a respectable cutler; not but that many common and cheap razors turn out very good, for the value of the material is little, and the steel made in the way of ordinary manufacture sometimes happens to be of very good quality, but this is an uncertainty.

6004. *A keen edge may be kept on the razor for some time by the use of the strop*, and some recommend stropping it every time after it has been use, and before it is put by. The reddish material with which one side of razor strops are covered is a preparation called *crocus martis*, an oxyde of iron, made into a paste with hogs' lard or spermaceti ointment; the other side of the strop is covered with fine black-lead and lard. There is some art in stropping a razor well; if done badly, the edge is apt to be rounded. It is convenient to keep some of the paste in a box, and to put occasionally a little upon the strop by spreading it with a knife before the fire. A cylindrical strop has lately come into use, and appears to be an improvement, as there are no edges. There is also a proper mode of using the razor, which is not intended to cut as a direct cutting instrument by a movement similar to scraping, but by the same movement as a mower uses in cutting hay with the scythe.

6005. *Setting a razor*, or giving it a keen edge, after having been dulled by use, and when the strop is found insufficient, is generally performed on a stone called a *hone;* but the exquisite edge given by cutlers can rarely be produced by those persons who are not in the habit of setting, from a want of skill and sleight of hand, which long and constant practice only can give in perfection. Various contrivances have been made to assist the inexperienced operator.

6006. *A hone has been invented by Mr. Fayrer, of Pentonville*, which is of a novel kind. It consists of a plate of brass about an inch wide, on which is put oil and some fine powder of oil-stone, or of water of Ayrstone. The hone is swung on pivots, in consequence of which the surface always applies itself evenly along the edge of the razor, in whatever direction the pressure of the hand is made that holds the tool.

6007. *The following contrivance for sharpening razors* is given in the Journal of the Royal Institution by Mr Knight, president of the Horticultural Society: "The instrument consists of a cylindrical bar of cast steel, three inches long without its handle, and about one third of an inch in diameter. It is rendered as smooth as it can readily be made with sand, or, more properly, glass paper, applied longitudinally, and it is then made perfectly hard. Before it is used, it must be well cleaned, but not brightly polished, and its surface must be smeared over with a mixture of oil and the charcoal of wheat straw, which necessarily contains much siliceous earth in a very finely-reduced state. In setting a razor (observes Mr. K.), it is my practice to bring its edge (which must not have been previously rounded by the operation of a strop) into contact with the surface of the bar at a greater or less, but always at a very acute, angle, by raising the back of the razor more or less, proportionate to the strength which I wish to give to the edge; and I move the razor in a succession of small circles from heel to point, and back again, without any more pressure than the weight of the blade gives, till my object is attained. If the razor has been properly ground and prepared, a very fine edge will be given in a few seconds; and it may be renewed again, during a very long period, wholly by the same means. I have had the same razor, by way of experiment, in constant use during more than two years and a half, and no visible portion of its metal has within that period been worn away, though the edge has remained as fine as I conceive possible, and I have never at any one time spent a quarter of a minute in setting it. The excessive smoothness of the edge of razors thus set led me to fear that it would be indolent, comparatively with the serrated edge given by the strop; but this has not in any degree occurred, and therefore I conceive it to be of a kind admirably adapted for surgical purposes, particularly as any degree of strength may be given with great precision. Before using a razor after it has been set, I simply clean it on the palm of my hand, and warm it by dipping it into salt water; but I think the instrument recommended operates best when the temperature of the blade has been previously raised by the aid of warm water." The handles of the best razors are made of ivory. The greatest number of common razors have their handles of horn, dyed black and pressed; others are mottled, to imitate tortoise-shell.

CHAPTER VII.

SOAPS FOR THE SKIN.

6008. For the general theory of the action of soap, and of the manufacture of the common kinds, we refer the reader to Book XXII., on "The Laundry." But it will be necessary here, in describing those kinds that are used for cleansing the skin, to point out the way in which that effect is produced; and for this purpose we cannot avoid repeating some facts that we have already mentioned. The union of alkali and oil forms soap; and though oil is not soluble in, or miscible with, water, soap is perfectly so. The skin is covered with an infinity of very minute pores, through which exudes constantly a perspirable matter, partly of an oily nature, and which keeps it in a soft state. To this matter the dusty particles with which we are constantly coming in contact adhere, and fill up the pores of the skin, or cover it partly with a coat of dirt. To remove this oily or greasy matter, we require only to add to it alkali, which would form a soap; and as we stated soap to be soluble, this newly-formed soap on the skin might be easily removed with the dirt adhering to it by washing with water alone. But alkali by itself, such as pearlash or soda, would, by its causticity, injure the texture of the skin, and, if employed frequently, would produce disease, such as red excoriations blotches, and eruptions. But in common soap the greater part of the alkali is already combined with oil, and therefore the only portion of it that can act upon the skin in the way we have described is that which the soap may possess more than is sufficient to neutralize the oil in it. From this it is evident that the more alkali soap has the stronger it will be, or the more detergent, but then, also, it will be the most apt to injure the skin.

It is of some importance, therefore, with a view to keep the hands in good order, that the proper sort of soap should be used. The hands of some persons are apt to be too dry, and require softening by the use of ointments or pastes, while others have their hands too moist. For these it is requisite to use soaps of different qualities. For the toilet soaps, some perfume is generally added; they are also frequently coloured in various ways.

6009. *The most beautiful soap* is the fine white soap prepared from olive oil and soda, extracted from the best barilla, which is manufactured largely in the countries where the olive grows, particularly the south of France, for which Marseilles is the most celebrated; also some parts of Italy and Tripoli. This soap is sometimes artificially marbled, or streaked with red and blue veins; and the marbled soap is harder than the white, requiring to be drier to take the marbling.

6010. *Windsor soap* is the kind most generally used by men for the toilet. The best is made of one part olive oil to every nine parts tallow, and the more common of tallow only; these are united to barilla, and scented by oil of caraway, oil of anise, or some other perfume. It is made white and brown.

Curd soap consists, according to Dr. Ure's analysis, of 52 parts fat, 6 soda, and 42 water, in 100 parts; nine tenths of the fat is tallow.

6011. An almost infinite variety of soaps have been made by perfumers, every one recommending his own; but the basis of them all is good soap of the ordinary kinds, either soft or hard, which they remelt and mix with various perfumes. The soaps are reduced to thin shavings, and these are put into a copper pan in a water-bath. If the soaps are new, they will melt on the application of heat; but if they are old, a little water is added. When the fusion is complete, some perfume, and, if required, some colour, is added, and the soap is poured into moulds. Formerly many foreign soaps were imported, and many counterfeit soaps were sold under their names, as Joppa soap, Smyrna, Jerusalem, Genoa, Venice, Marseilles, Gallipoli soaps. At present these have mostly given way to our English soaps. The following is the composition of some of the perfumed soaps:

Cinnamon Soap.—30 pounds of good tallow soap, 20 ditto of palm oil soap; perfumed with 7 ounces of essence of cinnamon, 1¼ ditto of sassafras, 1¼ ditto bergamot; colour, 1 pound yellow ochre.

Orange-flower Soap.—30 pounds good tallow soap, 20 ditto palm oil soap; perfumed with 7½ ounces essence of Portugal, 7½ ditto amber; colour, 9½ ounces of some yellow green pigment and red-lead.

Musk Soap.—30 pounds good tallow soap, 20 ditto palm oil soap; perfumed with 4½ ounces powder of cloves, pale roses, gilliflower, essence of bergamot, and essence of musk, each 3½ ounces; colour, Spanish brown.

Bitter Almond Soap.—50 pounds of best white soap, 10 ounces essence of bitter almonds.

Soap à la Rose.—30 pounds olive oil soap, 20 of good tallow soap; perfumed with 3 ounces essence of roses, 1 ditto cloves, 1 ditto cinnamon, 2½ ditto bergamot.

Soap au Bouquet.—30 pounds good tallow soap; perfumed with 4 ounces bergamot, 1 ounce each of oil of cloves, sassafras, thyme, and neroli; colour, brown ochre.

Naples soap is a strong soft soap, scented; it comes to us in pots.

The best Castile soap comes from Spain, and sometimes it is imported from Marseilles. It is used medicinally; but a great deal is made in this country by pouring the best white soap into moulds, and giving the marbled appearance by some solution of sulphate of iron in water.

Transparent soap is considered by some as an elegant variety: it is made by dissolving Windsor soap in spirits of wine, cutting the soap in slices, putting them into a large vial with a sufficient quantity of the spirit, and letting it remain before the fire till the whole is dissolved, using no more spirit than is just necessary. When this solution is poured into a mould, it becomes solid in cooling, and retains its transparency. There is no particular advantage in using it; on the contrary, it is seldom so good as ordinary soap, and is apt to spoil.

Palm soap is made with palm oil and soda: it has a smell peculiar to itself, which is not liked by every one.

Soap balls, or *wash balls*, for washing the hands, are made of various colours, by simply cutting white soap into small pieces, rolling them in vermilion, blue, or other colour, and squeezing them together into balls. They are scented with various perfumes; but they are at present little used.

Soft toilet soaps are generally made of hogs' lard and alkali, and are in great request for shaving.

Pearl soft soap is an elegant soap of this kind; it is also called *almond cream.*

6012. *Milk of roses* is a saponaceous liquid, formed by mixing the liquid obtained by exposing potash to the air with rose water, and then adding to this oil of almonds, till the mixture becomes milky without being greasy. It may be doubted whether any perfume or other addition to soap can improve it in its most important use. If there is too much alkali in the soap, that is, if it be too strong, it will make the skin rough. Perhaps nothing exceeds good Windsor soap.

Some prefer oatmeal to soap for washing the hands; it is certainly less likely to injure the skin.

6013. *Freckles and Pimples.*—We abstain from giving any of the very numerous receipts for removing these, although they are common in books that treat of cosmetics, because we consider many of the applications useless and absurd, and some highly dangerous. Freckles are the result when certain persons have been much exposed to the sun; there is generally a constitutional liability to this defect, for which the only safe and sure remedy is to guard the face by a veil or parasol: with respect to pimples, we consider that no applications should be made without medical advice, since incalculable mischief may be done by employing the nostrums that are usually recommended, some of which are dangerous, being repellents which drive inwardly what nature is endeavouring to throw out. We refer the reader to the medical part of this work, in Book XXVI., for advice on this subject.

CHAPTER VIII.

COSMETICS.

6014. *General Observations.*—The desire of being agreeable has, no doubt, led to the invention of cosmetics. Under this term are usually comprehended all the expedients invented to soften the skin, to maintain its transparency, lustre, and freshness, to give colour to the complexion, to prevent or efface wrinkles, to whiten and clean the teeth, to stain the hair and eyebrows, and, in short, to improve the appearance of the face and hands.

6015. The term is derived from the Greek *κοσμειν*, to adorn: the Greek ladies, we are told, studied much the use of cosmetics, as the women of the East do at the present day; hence, we see frequently advertised various nostrums under the title of *Circassian bloom*, &c. When we consider the anatomical structure of the skin, and how easily it absorbs substances applied to it, it is evident how careful we should be not to use any deleterious materials for the face and hands, and that we should know accurately the nature and composition of all substances recommended by perfumers. The intimate connexion between the functions of the skin and those of the stomach were not so well understood formerly as they are in the present day; and hence many practices were resorted to in the use of cosmetics that are now known to be very improper. Nevertheless, all cosmetics are not to be condemned equally; some are, perhaps, harmless, and others are occasionally useful. We shall illustrate this by a few general remarks. Of paints for the face, which are occasionally employed, some, as we shall show, are highly dangerous; and those which are not so have an injurious effect, if used constantly, in stopping up or clogging the pores of the skin. Those cosmetics which owe their efficacy to vinegar and alum, or any other acids and astringents, are often for a time efficacious, giving a firmness and lustre to the skin; but this effect is merely temporary, for they in time alter its texture, dry it, and produce premature wrinkles; they are, therefore, better avoided. Mucilaginous cosmetics, such as barley water, oatmeal, &c., have not this inconvenience; they render the skin more supple, softer, and more polished. Pastes and ointments sometimes produce good effects in certain states of the skin. They are generally laid on the face and hands, and remain on all night, contributing to restore the suppleness and elasticity of the skin; but the fatty substances that form their bases ought to be well purified. Some consider the wax that sometimes enters into the composition as too drying and irritating, and recommend fresh cream as better. As a general rule, it is prudent to avoid the use of all cosmetics the composition of which is a secret or unknown, which will, of course, exclude all those which are advertised with high-sounding names. Some of these produce astonishing effects at first, but ultimately ruin the skin, destroying its natural functions, and, consequently, seriously injuring health.

6016. *All medical men teach that the best way of improving the skin is to improve the health generally by temperate living and moderate exercise*, and this will be evident by considering its structure. It is well known that the skin consists of the *outer* or *scarf skin*, called by anatomists the *cuticle* or *epidermis*, and the *inner* or *true skin*, named *dermis*. *The first* is a very thin membrane, transparent, and without blood-vessels; it has no nerves, consequently no sensation, and may be pared or cut with a knife without any pain; it is that which rises in blisters. *The true skin* beneath is much thicker, and is entirely filled with nerves, and the extremities of an infinity of minute blood-vessels, by which the blood which comes from the heart to the skin returns back again, the turn in the circulation being at the surface. That these nerves and vessels are excessively numerous is shown by the prick of a needle in any part giving pain, and by the blood which issues from some very minute vessel having been pierced. The change in a large portion of the circulation taking place, as we have stated, in the skin, it is obvious that whatever impedes in any degree the healthy action of this organ must affect the whole system, as far as the circulation is concerned; and it is to preserve its most important functions that the use of the bath, friction, and similar processes are resorted to. These minute blood-vessels approach very near to the surface of the skin, and the cutis being transparent, they give the flesh colour, which is more ruddy in some places than others, as upon the cheeks, from their greater size or number in that part; and the want of healthy action in these vessels is indicated by the paleness of the complexion. In the skin there are, likewise, innumerable minute pores, by which the insensible perspiration exudes.

Paints for the Face.

6017. Since this species of decoration, once so general, is now almost out of fashion, it is unnecessary for us to inveigh against it; whether there are not cases where the practice may still be allowable, we shall not determine, but proceed to point out the materials that are usually employed, with cautions against such as are deleterious.

6018. *Pearl white* is a preparation of bismuth, which is sold under that name, but which is extremely injurious to the skin. It is also liable to turn black if exposed to the fumes of sulphur, or the sulphureted hydrogen of certain mineral waters, such as the Harrowgate. On this subject an anecdote is told. A lady thus painted was sitting in a lecture-room, where water impregnated with sulphuretted hydrogen was handed round for the examination of its odour. On smelling the liquid, the lady became *black in the face.* Every person was, of course, alarmed at the change, till the lecturer explained the cause of the accident. The lady received no serious injury, but had a salutary lesson.

6019. *Ceruse*, a white paint, was formerly much used, but now it is never employed, from its dangerous properties being known. It is a carbonate of lead, and the same as *flake white*, or the *white-lead* used by painters. It is poisonous, and extremely pernicious to health when put on the skin; it is also liable, when exposed to sulphuretted hydrogen, to turn black, and, of course, to produce lamentable accidents. It ought to be entirely excluded from the toilet. As an instance of ceruse turning black, as well as pearl white, may be mentioned that, in a receipt for changing the hair to black, it is directed to mix this with the pomatum.

6020. *Pearl powder* is the name of a cosmetic that was formerly much in request; and from its name it ought to consist of pearls ground to powder; but this would evidently be too expensive for common use. It is, we believe, made of briançon, or French chalk, powdered fine, and perhaps mixed with pearl white, or bismuth; and if the latter is added, it will be liable to turn black. (See "Pearl White.") The French chalk alone is harmless.

6021. *Carmine* is a well-known red paint, prepared by precipitating the colouring matter of cochineal upon alumina, and is perfectly harmless if genuine. Different qualities of carmine are sold in the shops, distinguished by numbers, and having various prices. As the manufacture is in few hands, it is kept secret, and it is not well known what are the causes of these differences of colour; but they are supposed to be owing either to the greater quantity of alumina, or an adulteration by vermilion. The latter is a poisonous substance, a preparation of mercury and sulphur, that ought in every form to be entirely excluded from the toilet.

6022. *Cochineal* is the red juice of an insect peculiar to Brazil, the *Caccus Cacti*, and carmine is prepared from it in the following manner: Boil 1 lb. of cochineal, powdered, and 6 oz. of alum in 40 lbs. of water; strain the decoction; add ℥ss. of chloride of tin, called dyers' spirit; and after the carmine has precipitated and settled, decant the liquid, and dry the carmine in a gentle heat.

6023. *Rouge* is a well-known red paint for the face, so named from the French word for red. There are several kinds of rouge, but they are all composed of some vegetable colour, and talc, or powdered French chalk. The most common kind of rouge is produced from the colouring matter of the safflower (*Carthamus tinctorius*). The flowers are digested in a weak solution of carbonate of soda, which extracts the colour; and to precipitate this in the form of a fine powder, lemon juice or pure vinegar is added; but, previously, some fine carded cotton wool is put into the vessel for the colour to be precipitated upon. The cotton is then washed in cold water, to separate some yellow colouring particles, and a fresh solution of carbonate of soda is poured upon it to take up the colour, now of a pure red. The colour is then precipitated again, by more acid, upon a layer of finely-powdered talc; and afterward it must be triturated with a few drops of olive oil, to give it smoothness and fatness. The fineness of the talc and the proportions of the colouring matter occasion the difference in the price of the article.

6024. *Another kind of rouge* is made by reducing French chalk to a fine powder, and triturating it in a mortar with carmine. As some makers of rouge sometimes add vermilion to the carmine by way of adulteration, it will be well to apply a chemical test for that, as it is dangerous: if there be any considerable quantity, the weight will discover the adulteration, vermilion being a very heavy substance. Those who wish to make their own rouge may easily rub the briançon, or French chalk, in a mortar with good carmine.

6025. An inferior rouge is made by employing the colouring matter of Brazil wood or sandal wood. It is difficult to distinguish these among the specimens kept in shops; and the venders themselves only know the articles by the beauty of the colour, and the prices. It requires different tints to suit different complexions; and trial alone can determine which ought to be preferred, if any should be used.

6026. *Portuguese dishes*, or *rouge dishes*, are small dishes containing paint of a very pale pink hue, said to be a beautiful application; but what is made in London is of a dirty colour. The genuine dishes are rough on the outside.

6027. *Chinese wool* contains a very lovely colour; but an inferior kind is generally mixed in a parcel with the best. The colour is very fugitive.

6028. *Spanish Wool.*—Of this there are several sorts. The best comes from Spain: an inferior kind is made here. The colour is from cochineal.

6029. *Chinese Boxes of Colours.*—Little japanned boxes are sometimes brought from China, containing materials for adorning the face—black for the eyebrows; red for the face; and a white powder, said to be real pearl powder.

6030. *With respect to red paints*, vegetable reds alone are safe to use; they are dyeing substances, and are harmless; such as those made from cochineal, safflower, carthamus, sandal wood, and Brazil wood; but the mineral reds, such as minium or red-lead, and vermilion or cinnabar (a sulphuret of mercury), are poisonous, and ought to be entirely excluded from the toilet, together with every composition into which they enter as an ingredient. All these metallic preparations, and also ceruse, or white-lead, destroy the texture of the skin, cause wrinkles, and compel those who begin their use to continue the practice, although dangerous. The consequence of this is nervous affections, and perhaps palsy.

CHAPTER IX.

SUBSTANCES USED AS PERFUMES.

6031. The use of perfumes is of Eastern origin. They were much used among the Hebrews and Persians, and likewise among the Greeks and Romans. In Eastern countries, at present, it is the custom to compliment distinguished guests by sprinkling them with rose and other sweet-scented waters; and to burn incense, aloes wood, and other perfumes in silver censers, or to throw them on a tripod with burning coals; and this is sometimes done as a sign that it is time for strangers to take leave.

As the nervous system is strongly affected by the volatile drugs made use of as perfumes, medical men now condemn their general use as prejudicial to health; and they are among us limited to particular occasions, or to be employed in dress.

6032. *The substances used as perfumes* consist of aromatic gums, resins, and balsams; aromatic leaves, flowers, fruits, and roots of plants, or woods; also, animal perfumes: and the art of the perfumer is the preparation of various products from them, as pomades, essential oils, or essences, distilled waters, pastes, pastils, &c. We shall first describe the substances themselves from which these are prepared.

Sect. I.—GUMS AND BALSAMS.

6033. *Frankincense*, sometimes called *olibanum*, though the last is somewhat different, is the *incense* used in Roman Catholic churches, and was used for the same purpose by the ancient Egyptians and Israelites. It is a gum-resin that distils from a tree, the *Junipera Lyciæ*. The best comes from Syria and Arabia. It is in pale, yellow drops, like mastic, and when laid upon coals, or red hot iron, it gives out a sweet-smelling odour. It is employed in pastils, but is very liable to be adulterated with turpentines.

6034. *Myrrh*, an ingredient in many tooth-powders, is a gum-resin that exudes from a small scrubby tree that grows in Arabia Felix, the *Balsamodendra myrrha*.

6035. *Gum benjamin*, or *benzoin*, is a resin extracted from a tree called *Styrax benzoin*, which grows in Siam and the Indian islands, Java, Sumatra, &c. It has an agreeable smell, somewhat like vanilla. It is much used in fumigating pastils, and in certain varnishes which exhale an agreeable odour when heated by the hand. It is the perfume used in court-plaster, and in perfumed sealing-wax.

6036. *Storax* is a gum-resin that exudes from a tree called *Styrax officinale*, that grows in countries bordering on the Mediterranean, and likewise in America and India. It is a valuable perfume for some purposes, resembling benzoin, of which it contains 1·4 per cent. Genuine storax is very difficult to procure; what is usually had is an inferior kind that comes from Holland.

6037. *Balsam of Peru* is a resin used in perfumery, and is obtained by making incisions in a tree which grows in Peru and Mexico (*Myroxylon ceriferum*), or by evaporating a decoction of its branches and bark. It is brown, and of the consistence of turpentine, has an acrid, bitter taste, but an agreeable colour. It is high priced, and, consequently, often adulterated. It contains a portion of benzoic acid.

6038. *Balsam of Gilead* is a turpentine, not a balsam; it is a perfume much esteemed by the Turkish ladies, but scarcely known here. It is obtained from a tree, the *Amyris Gileadensis*, a native of Abyssinia; but the balsam is generally procured from Gilead, in Judea, whence the name.

6039. *Gum elemi* is a gum-resin, procured by incision from *Amyris elemifera;* yields a sweet odour when burned.

6040. *Labdanum* is an unctuous resin, of an agreeable odour, found upon a plant (*Cystus creticus*) which grows in Candia and Syria. The genuine sort is rare, very heavy, and light brown; the impure kind is generally darker.

6041. *Dragon's blood* is used in tooth-powders. It is obtained by macerating and steaming the fruit of the *Calamus draco.* It is in round masses, of a brownish red.

6042. *Gum copal* is a resin which exudes from two trees, of which one grows in India and the other in America. It is used in pastils.

Sect. II.—aromatic leaves, flowers, roots, and woods.

6043. *Orange flowers* cannot be had in sufficient quantity in this country, but are abundant in the south of Europe, and are also procured in tolerable quantity in the vicinity of Paris, where they are collected every morning from private and public establishments. They should be made use of immediately they are gathered from the tree, as they very soon lose their fine odour.

6044. *Rose Leaves.*—The flowers of the damask and the red rose yield a strong perfume, either dried or by distillation. They should be gathered in dry weather; and if they are to be salted for winter use, this should be done as soon as possible after they are picked from the stalks.

6045. *Lavender Flowers.*—These are used for making oil of lavender, and lavender water. They should be gathered dry, and kept in paper bags; if put into boxes they are apt to heat and spoil. Their use, put among linen, is well known.

6046. *Jessamin flowers* are abundant only in warmer climates than ours; the odour of what grows here is sweet, but not powerful. They are so delicate that they will not bear the heat of distillation; and their perfume is collected by means of wool, in the manner described under "Still-room." They do not preserve their perfume long when dried.

6047. *Violet Flowers.*—The same observations apply to violets as to jessamin.

6048. *Rosemary.*—The leaves and flowers are used in making Hungary water and oil of rosemary. Young plants produce the best flowers.

6049. *Marjoram, lemon thyme,* and *basil* should be preserved as lavender.

6050. *Myrtle leaves and peach leaves* are used in herb snuff.

6051. *Tonka bean,* properly *Tonquin bean,* is used here to perfume snuff; but in the West Indies and America it is employed to put among clothes and to keep away moths. The aroma of the seed is owing to a volatile oil which it contains.

6052. *Orris* or *Iris root* comes chiefly from Florence. It is white, and has a fragrant smell, very like violets. It is used in various ways.

6053. *Calamus root* belongs to the *Acorus calamus,* or sweet flag. It grows in this country in ponds. The smell is powerful, but coarse.

6054. *Cyperus Root.*—The best kind comes from Florence; one kind, nearly equal to it, long-rooted cyperus, is found wild in this country. When first powdered, the scent is weak, but by keeping it becomes stronger. It is used in making the cyperus powder of the perfumers.

6055. *Cedar.*—This sweet-smelling wood is in great request for drawers for wearing apparel, and the shavings are used to keep away moths.

6056. *Rhodium wood* is said to be the wood of a Chinese rose tree; its perfume is similar to that of roses, and is sometimes used with orris root. If bought rasped, it is probably adulterated.

6057. *Yellow sanders wood* has a smell resembling that of a green citron; from it an oil is prepared having a powerful odour.

6058. *Cinnamon and cloves* may be reckoned among the perfumes.

6059. *Various mixed odoriferous substances powdered,* called *sachet powders,* are put as perfumes among linen and other articles of dress in wardrobes or drawers; one of them is the following: Take the dried leaves of roses, pinks, hyacinths, lavender, balm, stock, gilliflower, or any other sweet-smelling flowers; dry them in the shade; then powder them coarsely, and mix them with powdered nutmeg, mace, or a very little musk, and add to them some powdered sugar to preserve them. Put all this into bags of taffeta, and lay them among the wearing apparel, to give a perfume and to drive away moths.

Another.—Lavender, thyme, marjoram, sage, vervain, rosemary.

Sect. III.—animal perfumes.

6060. *Musk* is a concrete substance found in an animal having a near affinity to the deer tribe, the *Moschus moschiferus,* a native of Thibet, China, and Siberia. The musk-deer is a timid animal, and rarely appears during the day; consequently, the musk collectors watch and surprise it at night. The best musk comes from China; and, to have it genuine, it should be purchased in the natural bag, or pod, as it is very often adulterated. The Bengal musk is inferior, and that from Russia the worst of all. The hair on the pod of the best musk is a fawn colour, that on the inferior a dirty white. A variety of musk is found in the musk-rat of Canada, an animal about the size of a small rabbit. Musk is of a bitter taste, and of an odour more powerful than anything known; substances in its neighbourhood become strongly infected by it, and, when once perfumed with it, long retain the scent. It has been known to affect chests of tea placed at a considerable distance, even though both had been packed up in leaden boxes; for which reason, the East India Company gave an order not to import musk and tea in the same ships. Many persons dislike the odour. It has the property, when employed in very small quantities, of augmenting the scent of other substances without imparting its own.

6061. *Ambergris* is much used in the composition of perfumes; its origin is not yet satisfactorily ascertained, but is supposed to be a morbid concretion in the spermaceti whale. It is usually found floating on the sea or on the seacoast, and comes to us from the East and West Indies, but sometimes also from the northern seas. It is generally found in small pieces, but occasionally in masses of fifty or a hundred ounces. Ambergris has a good deal of resemblance to amber; but it is opaque, fatty, and inflammable, remarkably light, melts readily when heated, and is scarcely soluble in spirits of wine. There are several varieties; gray, and black, or dark brown; the former is the best, easy to break, and lightest; the latter is harder and heavier, and has very little smell. This substance is very liable to be adulterated by an admixture of wax, gum, storax, &c., by which the odour, which is agreeable, is impaired. It is generally joined with musk. Its odour is so strong, that if the box in which it is contained be left open for five minutes, it will perfume the whole chamber.

6062. *Civet* is a substance taken from the civet cat, and having a perfume approaching to that of musk and ambergris. Its consistence is like that of honey; it comes from the East and Africa, and is brought to us chiefly by the Dutch. It is very liable to adulteration by honey. It was chiefly used for perfuming wash-balls, &c., but it is little employed at present.

6063. *Spermaceti* is much used by the perfumer in making pomatum. cold cream, &c. When good, it has no rancid odour.

Sect. IV.—ESSENTIAL OILS, OR ESSENCES; PERFUMED SPIRITS AND WATERS.

6064. The nature of oils, or essences, has been already described in Book VII., Chap. VII., Sect. X. Some of what are called essences by perfumers are essential oils diluted with alcohol; or they are expressed oils impregnated with odorous essential oils.

Attar of roses, sometimes called improperly *otto of roses*, is the essential oil of the rose, and the most fragrant and precious of any known: it comes from India in small gilt bottles, each containing an ounce. The smallest drop on a pair of gloves will perfume them for a long time. An inferior kind comes from Barbary. The manner of preparing it is described in Book XX., Chap. III.

Oil of roses is made here, but this is merely spirit strongly impregnated with the essential oil of roses.

Oil of rhodium in fragrance resembles roses. It is prepared from rhodium wood *by distillation*, and comes chiefly from the Levant; it is of a pale brownish red colour. The oil of sandal wood is sometimes sold for it.

Oil of lavender is made in this country as well as in France, and it is said that our lavender is richer in perfume than the foreign. It is always best during the year in which it is made, and does not keep long.

Oil of rosemary comes chiefly from Italy; but the English is considered to be better. It is used in making Hungary water, and in scenting soaps.

Oil of cloves and oil of cinnamon are occasionally used by the perfumers; they are made in the Indian islands.

Oil of coriander is very fragrant, but scarce; it costs three guineas an ounce.

Essence of rondatella, much recommended for perfuming handkerchiefs, &c.; it retains its perfume for several days.

Essence of jessamin is a fixed oil saturated with the aroma of the flowers of jessamin. It is expensive, as it comes from India, and some from Italy; it is little known here. The best has a double impregnation of the flowers, and will keep several years; but that which has only a single impregnation will not keep above a year.

Essence or oil of orange flowers, called neroli, is made abroad, as it cannot be obtained but from the fresh flowers of the orange.

Essence of bergamot is prepared from a species of lemon, *Citrus limetta*. The essence is extracted by pressure from the rind of the fruit; it is extremely common, and is brought from Italy.

Oil of citrons and of lemons; oil pressed from the peel of the citron and lemon

Essence of Violets.—What is sold under this name is said to be from the root of the Florentine orris, and has an odour like violets.

Essence of jonquil, prepared from narcissus flowers.

6065. *The spirits of the perfumer* are odoriferous substances dissolved in spirits of wine, whether the essential oils of plants or other matters, or spirit of lavender, ambergris, &c. There is much confusion in the mode of designating these preparations, some calling them waters; thus, Hungary water and eau de Cologne, though named waters, are spirituous preparations. The manner of preparing these will be given in Book XX., "On the Still-room."

6066. *List of perfumed spirits :*

Spirit of bergamot.	Esprit de Venus.	Spirit of citron.
" lavender.	" millifleurs.	" cloves.
" ambergris.	Eau de Cologne.	" goujac.
" musk.	Hungary water.	" jonquil.
" roses.	Spirit of tuberose.	" pinks.
" jessamin.	" cassia.	" orange.
" mint.	" violets.	Eau de lis.
" benjamin.		

Some of these are used for perfuming wearing apparel, as handkerchiefs, shawls, &c.; others are partly remedial, and are employed by apothecaries.

Tincture of roses is easily made, by taking the leaves of the common rose and putting them, without pressing, into a bottle. Pour some good spirits of wine upon them; close the bottle, and let it stand until it is required for use. This will keep for years, and yields a perfume little inferior to attar of roses.

6067. *It is essential that the rectified spirit, or spirit of wine, used in making perfumes should be perfectly good.* To try its purity, rub a little in the palm of the hand very quickly, until it has completely dried away; if the smell it leaves be agreeable, it is good; but if it be empyreumatic and nauseous, the spirit is foul, and should not be used.

6068. *Perfumed or distilled waters* consist of water having dissolved in it a small quantity of odoriferous essential oils, and the manner of preparing them will be given in Book XX. As an example, we may give here honey water:

Honey Water.—Take two pounds of the best clarified honey; add a little water, and melt it in a water-bath; put in rose petals, orange flowers, the rind of two lemons, some coriander, vanilla, and cloves: add then a sufficient quantity of rectified spirit of wine; bruise the ingredients again, and add another pound of honey, and mix the whole well. Suffer this to infuse for eight days, and then distil with a water-bath.

Rose Water.—The manner of preparing this will be described in Book XX., "Still-room." That sold in the shops is chiefly made from rose petals preserved with salt.

6069. *List of perfumed waters :*

Lavender water.	Portugal water.	Jessamin water.
Rose water.	Eau de millifleurs.	Myrtle water.
Honey water.	Eau sans pareil.	Cordova water.
Hungary water.	Eau de Carmes.	Eau de mousseline.
Bergamot water.		

SECT. V.—PASTILS.

Pastils are small conical shapes made up chiefly out of aromatic resins, which, when set on fire, give an agreeable odour for the purpose of perfuming the apartment; and it is by some persons *erroneously* supposed to correct the bad air which it may contain. (See Book III., "On Ventilation.") They are made by mixing gum benjamin, storax, labdanum, frankincense, or any other similar odoriferous gums, finely powdered, into a paste with gum water, and powdered charcoal and saltpetre. When the paste is stiff enough, it may be rolled up into the conical shapes, about three quarters of an inch long, and dried.

6070. *Pastilles à la Rose.*—12 ounces of gum, 12 do. of olibanum in tears, 12 do. of storax, 8 do. of nitre, 16 do. of powder of pale roses, 3 pounds of charcoal powder, 1 ounce of essence of roses.

6071. *Pastils of Orange Flower.*—12 ounces of gum galbanum, 12 do. of olibanum in tears, 12 do. of storax 8 do. of nitre, 1 pound of pure orange powder, 3 pounds of charcoal powder, 1 ounce best oil of *neroli.*

6072. *A few drops of the oil of sandal wood,* dropped on a hot shovel, diffuses a most agreeable balsamic perfume throughout the atmosphere of sick-rooms, or other confined apartments. Frankincense may likewise be used to perfume an apartment. Pastils may be burned upon anything that will protect the table; but the most elegant mode is to place them in a pastil-stand sold for the purpose.

6073. *Highly-concentrated smelling salts* are, in some respects, preferable to pastils, where fumigation is required. It is sufficient to leave out the stopper of the bottle containing the salts for a short time, to perfume a chamber.

SECT. VI.—POMADES, OR POMATUMS.

6074. These are preparations for softening the skin and hair, and consist of fats or oils with the addition of some perfume. It is necessary to choose such fats as do not become rancid; the best are clarified *beef suet,* or *clarified beef marrow,* and *hogs' lard.*

6075. *Beef or mutton suet and hogs' lard are clarified* from the raw materials by chopping them fine, and rolling them out to break the cells in which the fat is lodged, then melting the fat in a water-bath, or other gentle heat, and straining it while warm; it is then put into bladders to keep it from the air. Or it may be made by boiling it in water, and skimming it off when cold; but by this method it contains water, and does not keep so well as when melted by itself.

6076. *Purified beef marrow* is preferred by some perfumers to hogs' lard. It is purified in the same manner as the last and is thought by some to make the hair grow.

6077. *Veal fat* is used by some perfumers, as it will keep long.

6078. *Oil of cacao* is much used as a pomade by the ladies of Mexico, and by many of the African tribes, and is highly spoken of. In England, from the coldness of the climate, it grows too hard to be used by itself, but may be softened by an admixture of some pure oil, as oil of behn, or cold-drawn oil of almonds.

6079. *The expressed oils used by perfumers are, olive oil, oil of almonds, trotter* (neats' foot) *oil*, chiefly used in making cold cream, and oil of behn, expressed from behn nuts; this last is imported from Italy, and has the valuable property of not becoming rancid.

6080. *Common soft pomatum* is made of equal parts of beef or mutton suet and hogs' lard melted together; while they are liquid, put to it a little bergamot, or any other perfume that may be agreeable, and beat the whole well together, and then pour the mixture into pots.

Another Receipt.—Soak in water for two or three days half a pound of clean beef marrow and a pound of fresh hogs' lard, changing and beating it every day. Put it into a sieve, and when dry into a jar, and the jar into a sauce-pan of water. When melted pour it into a basin, and beat it with two spoonfuls of brandy; drain off the brandy, and add bergamot, or any other perfume.

Another.—An ounce of hogs' lard, one of beef marrow, one of spermaceti, and a pint of almond oil, melted together; add oil of bergamot and oil of roses, or any other perfume.

Hogs' lard alone, perfumed, will serve for pomatum for ordinary purposes, if it be required very soft; and oil of almonds and spermaceti melted together form a useful unguent for the hair; a little bergamot may be added.

6081. *Hard pomatum* may be made by melting together equal quantities of beef and mutton suet, the former being in the largest proportion, and making it up into rolls with paper round them.

6082. The French make a great variety of pomades; above twenty are sold by the perfumers in Paris.

Pomade à la rose.	Pomade au graisse d'ours.	Pomade au neroli.
" à la jonquille.	" à la citrouille.	" à la fleur d'acacia
" au jasmin.	" en crême.	" au barjoin.
" à l'œillet.	" à la moëlle de bœuf.	" au narcisse.
" à la fleur d'oranger.	" au concombre.	" à la fluer de lavande.
" à la digitale.	" à la frangipane.	" aux limaçons.
" à l'heliotrope.	" au baume.	" au lilas.

Highly-scented pomades are often preferred to scented oils.

6083. *Some pomades are made by infusion* in those southern countries where odoriferous flowers are abundant. Beef suet and hogs' lard are melted together; to this the petals of roses, orange flowers, or other sweet-scented flowers are added. This remains at rest for twenty-four hours, and it is then remelted and well stirred. It is next put into canvass bags, and pressed, to separate the solid from the fluid part. This process is repeated with the same fat several (perhaps ten or twelve) times, till the pomade has enough perfume. In this process it requires 3000 lbs. of fresh rose petals to make 500 lbs. of good pomade.

6084. *Pomades are also made without infusion*, as those of jessamin, tuberose, jonquil, narcissus, and violet. A square frame, called *tiame*, is made of four pieces of wood, well joined together, two or three inches deep, into which a pane of glass is laid, resting upon inside ledges, even with the bottom. Upon the surface of the pane the simple pomade of hogs' lard and suet is spread with a pallet-knife; and into this pomade the sweet-scented flowers are stuck, fresh, in different points, each successive day during two or three months, till the pomade has acquired the desired richness of perfume. The above-described frames are piled closely over each other. Some establishments at *Grasse* possess from 3000 to 4000 of them.

6085. *An experienced perfumer* states that, notwithstanding it is the custom to employ the flowers themselves in making perfumed pomades in those countries where the flowers are abundant, yet they can be made equally well, and with much more expedition, with the essences of the flowers; and these have this advantage, that pomades can be made when the flowers cannot be procured; also, that the perfume can be communicated with more precision by means of the essence, since, in the other process, the mucilaginous portions of the flowers sometimes alter the odour.

6086. *Pomades are likewise made of compound perfumes;* as *Roman pomade*, or pomade à la vanille, which consists of twelve pounds of pomade à la rose; three pounds oil à la rose; one pound best vanilla; six ounces bergamot.

6087. *Pomade au Pot Pourri.*—This pomade is made by adding to a fatty basis the essences of several odoriferous substances, and may be varied at pleasure. It retains its odour very long.

6088. *An agreeable perfumed oil may be made thus:* Dip cotton wool in clear olive oil, and, having procured a tall glass vessel, lay the cotton alternately with jessamin flowers. In a few days the flowers will have imparted their perfume to the oil, which may then be squeezed out for use; and the cotton may be employed by laying in band-boxes or drawers where perfume is required.

6089. *Cold Cream.*—This *pomade en crême* is very useful for chapped hands or face, and softens the skin. Melt together in a water-bath eight ounces of fine neats' foot oil or almond oil, three ounces spermaceti, and one and a half white wax. When thoroughly melted, pour the whole into a pan, which in winter must be kept very warm by the fire. Then with a wooden spatula beat the whole constantly, until it becomes a very uniform white body; pour into it half a pint of rose or orange-flower water, with about a quarter of an ounce of spirit of ambergris, or bergamot, or any other perfume. Next beat the mixture well again, until the whole of the water and spirit is absorbed by the unctuous substances. It ought then to be as white as snow, whence the name cream. Pour it now into pots, and keep it cool. If made in cold weather, all the materials must be warmed as they are mixed, or the whole will be lumpy. A marble mortar, if at hand, is convenient to mix it in.

Another.—Melt together four ounces of spermaceti and one of lard; add bergamot and rose water.

Another.—Melt one drachm of white wax, one of spermaceti, and two ounces of olive oil; add two ounces of rose water, and half an ounce of orange-flower water.

Another.—Melt together equal parts of almond oil and white wax. Add to the mixture, put into a marble mortar or strong glass basin, a few drops of some perfumed water, as rose, orange, or elder-flower water, and rub them together with a pestle till they are thoroughly incorporated; then add more and more drops, rubbing all the while, till the mixture, when cold, is of the consistence of cream.

6090. *Lip Salve. Pomade pour les Lèvres.*—This is a preparation extremely useful as a remedy for chapped lips, by applying it pretty freely at bedtime. It is made of equal parts of almond or olive oil, and the best white wax. Melt the wax in a clean gallipot, set at the side of the fire, then add the oil. It is customary to colour the salve by adding a little alkanet root suspended in a piece of muslin, while the salve is hot, and melted, or a little carmine; but this colouring has frequently the inconvenience of reddening a cambric handkerchief if accidentally applied to the lips. Some perfume is also generally added, as bergamot, oil of lavender, oil of cinnamon, &c., but it is not essential.

Pastes.

6091. To soften and improve the skin of the hands and arms, some use pastes of various kinds.

6092. *Almond paste* is one of those most generally used; the oil of the almond has some effect in rendering the skin supple. One receipt is, beat in a mortar four pounds of sweet almonds, blanched and dried, with lavender or Hungary water. Add to this one pound of white drained honey, two ounces of oil of jessamin, half a pound of the best almond powder, and four ounces of orris powder; the whole to be well incorporated. This will keep, if no eggs or milk be added. Almond powder is made by extracting the oil from the almonds by pressure, then drying what remains, and grinding it.

Another Way.—Take one pound of sweet almonds, a quarter of a pound of crumb of bread, and the yolks of two eggs. Skin the almonds and pound them in a mortar, and sprinkle them with vinegar, that the paste may not turn to oil; add the crumb of bread and the eggs, and moisten the whole with brandy, diluted with an equal quantity of water; mix all this well together, set it over a slow fire, and keep stirring it all the while, so that it does not burn to. Add the brandy and water till the consistence is right.

Another.—Warm in three separate vessels two ounces of sweet almonds blanched and pounded, three drachms of fine white wax, and three drachms of spermaceti. When these are melted, pour them together, and stir them well with a wooden spatula, and throw them into some water; keep stirring in the water, which you must change frequently till the pomade becomes very white. Keep it in rose water, or spring water, which must be changed every day.

Liquid Almond Paste.—Mix six pounds of honey, six pounds of paste of bitter almonds, twelve ounces of oil of bitter almonds, and twenty-six yolks of eggs. The honey should be heated apart and strained; then the almond paste kneaded with it; and, lastly, the eggs and almond oil by degrees.

6093. *Bean flour is said to be an excellent detergent for the hands.* Take half a peck of white and well-dried split horse beans; having separated them from their shells, or skins, beat them as fine as possible in an iron mortar, or have them well ground in a mill. Pass the powder through a fine sieve. About four pounds of powder will be obtained from the above quantity of beans.

6094. *Paste for chapped Hands.*—Wash a quarter of a pound of fresh hogs' lard in water, beat it up with the yolks of two new-laid eggs and a large spoonful of honey. Add as much almond paste, or fine oatmeal, as will work it into a paste.

6095. *Almond oil* is procured by expression from bitter almonds, or from old Jordan almonds, by heat. Cold-drawn almond oil is obtained in the same way from fresh Barbary almonds. It keeps longer than the common oil.

6096. *Milk of almonds* is used to bathe the face, and is made thus: Bruise some sweet almonds in a mortar, and add water by slow degrees in the proportion of a pint to twenty or thirty almonds; put to this a piece of sugar, to prevent the separation of the oil from the water, rubbing assiduously. Pass the whole through a flannel, and perfume it with orange-flower water.

BOOK XX.

STILL-ROOM, AND THE MANNER OF FITTING UP A DOMESTIC LABORATORY.

6097. Time was, when in the *still-room* "strong waters," "distilled waters," and "cordials" were drawn and dispensed as specifics for maladies to guests and dependants, as well as to poorer neighbours. Many of these preparations have gone out of use, and others may be purchased more conveniently, and even cheaper, than they could be made at home. We are far from recommending the complete revival of this part of domestic economy; yet we cannot, with propriety, omit the still-room altogether, since it may be extremely useful, on occasion, to certain families residing in the country, at a distance from medical practitioners, and where economy is an object; but the information we give is rather with the same view as that with which we have explained the manufacture of spirits, and not to teach accurately the art of preparing what is now seldom attempted at home. We might observe, however, that a *still-room* might be more elegantly considered as a species of *chemical laboratory*, or a private culinary room, where certain processes may be carried on that would not agree with the bustle of the kitchen, and where the superiors of the family might make experiments and trials without infringing upon the convenience of the cook, or interrupting her regular avocations. With this view it might be fitted up in a very neat and useful, though not extensive plan, with convenient apparatus, so as to furnish a source of amusement and instruction; and we shall proceed to describe the principal apparatus required for such an apartment, as well as to explain some processes which are likely to be performed there, and the usual terms used in speaking of them. All this may, to some persons, appear to be encroaching too far upon the province of the chemist and *his* laboratory; but it should be recollected that many processes in domestic economy are *strictly chemical*, and that it is only by borrowing a little from practical chemistry that they can be improved. We wish to see our improved still-room become *the domestic laboratory;* in which, likewise, such operations as pickling, preserving, &c., may be carried on by the housekeeper and still-room maid. Adjoining to this might be the *medicine closet.*

Some of the principal operations in the still-room were the making of *liqueurs* and the preparation of *distilled waters*. The first we have already described in the Chapter on Spirituous Liquors, Book VIII., Chap. VIII.; and we shall presently treat of what are called distilled waters, and the essential oils of plants, which contain the perfume or odoriferous principles essential to perfumery, and which are procured by distillation. But first it will be necessary to describe the apparatus made use of, together with the principal operations usually performed in the kind of laboratory we have talked of.

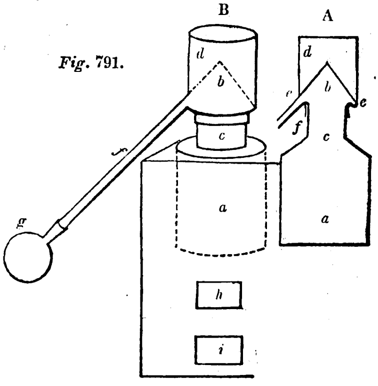
CHAPTER I.

APPARATUS FOR DISTILLATION.

6098. An essential part of the apparatus of the still-room is, of course, the *still;* but having already described the common still in Book VIII., Chap. VIII., "On Spirituous Liquors," we refer the reader to its explanation in that place.

6099. *The vessel called an alembic* is the oldest that was invented for the purpose of distillation. It is still employed; and as, from its simplicity, it has some advantages over the common still, we shall describe it. A, *fig.* 791, is a section of the alembic, and B is a view of it as fitted up. *a* is the body into which the materials are put, and to which the fire is applied; *b* is the head, which is in the form of a cone, and fits on the neck, *c*. The vapour rising out of the body fills the conical head, and is there condensed by means of a vessel, *d*, full of cold water, which surrounds it, called the refrigeratory; but instead of any of it falling back again into the body of the still, as it is apt to do in the common, or swan-necked still, it is stopped by a channel, or groove, *e e*, all round the inside of the head, which collects it; and from this groove a pipe, *f*, conducts the condensed product of the distillation into the receiver, *g*. *h* is the fire-door, and *i* is the ash-pit door. The cold water in the vessel *d* must be frequently renewed by a pipe leading to it from a cistern, and there must be a small pipe to carry off the warm water.

Fig. 791.



The simplicity of this apparatus would enable a tinman to make it who could not make the head of a common still: the worm of the latter is expensive, and, from its form, does not admit of being easily cleaned out, which proves very inconvenient when some oily matters have passed through it; whereas the beak of the alembic, being straight, is easily cleaned.

6100. *For some nice purposes, the alembic is made of glass in the form* A, *fig.* 792; but as this is expensive, and very liable to be broken, its use is generally superseded by that of the retort.

6101. *The Moor's head* is another form of still that has been used, and is found convenient for distillation on a small scale. *a, fig.* 793, is the body of the still, to which the

Fig. 792.

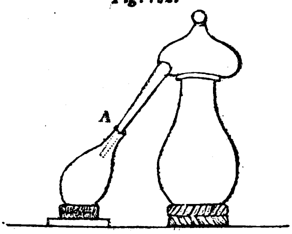
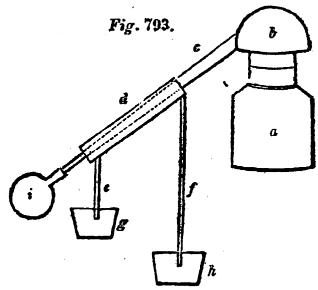


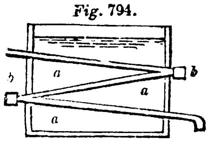
Fig. 793.



fire is applied; *b*, the head, of a semi-globular form, which has a groove all round the inside in the same manner as the alembic; *c* is the nose of the Moor's head, through which the vapours pass from the head: to condense these, the nose is surrounded by another larger tube, *d*, kept always full of cold water by a very ingenious contrivance. *e* is a pipe proceeding from the lower end, and *f* is a longer pipe from the upper end: these two pipes form, with the tube, *d*, a siphon, and as the short leg, *e*, is immersed in a vessel of cold water, the water will rise, on the principle of the siphon, pass to the upper end of the tube, *d*, in a continual stream, and descend by the longest leg, *f*, into the vessel, *h*. The pipe of the Moor's head is inserted into the receiver, *i*, for the product of the distillation. We have omitted the supports of these several vessels, as those can easily be imagined.

6102. Should it be preferred to have a tube in water, on the principle of the worm of the common still, a form which admits of being cleaned out is the following: *a a a, fig.* 794, is a straight pipe bent in angles, and laid in a vessel of cold water, in the same way as the spiral worm of a still; and the vapour passing through this is condensed in a similar way; but at the angles, *b b*, where the pipes join, there are caps that screw off, and admit the access of a brush, or similar instrument, to clean the pipes.

Fig. 794.

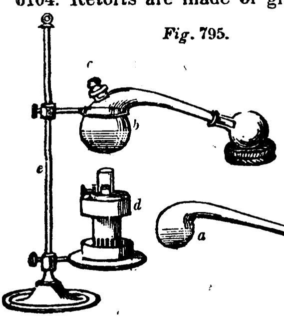


All these stills, the common still with the swan's neck, the alembic, and the Moor's head, when large, are fitted up in brick-work, and set in the manner of a copper for washing; but when they are small, they may be heated by a portable furnace of sheet iron, the fire part being coated with brick in the interior; very small ones may even be heated by a chemical lamp.

6103. *Vessels called retorts* are likewise employed for distilling on a small scale. The materials are put into the vessel called the retort, to which the heat is applied; and the fluid distilled, after rising in vapour and condensing, passes over into the receiver, which is kept cool.

6104. Retorts are made of glass or of earthen-ware. The first are used when no greater heat is required than what a lamp or a sand-bath will afford. It is a very elegant apparatus, because, through the transparency of the glass, the operation can be watched and examined. Great care is required in managing the heat, so as not to allow the substances to boil up and fill the neck. Some practice, likewise, is necessary to use them without breaking, to which they are very liable, particularly if a drop of cold water should fall on them while they are hot. *a, fig.* 795, represents a common retort; *b* is one tubulated at *c*, where an opening is provided with a ground glass stopper, to add occasionally fresh materials. If the heat of a furnace is required, the glass retort is coated with clay, or earthen-ware retorts are used.

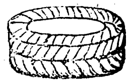
Fig. 795.



The lamp used for heating a retort may be a spirit lamp; but if more heat be required, then an Argand lamp, of a particular construction, called a *chemical lamp*, *d*, *fig.* 795, with a short copper chimney, instead of a glass one, is employed, and the retort is suspended on the ring of the stand *e*.

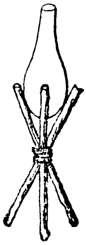
6105. *Circular bands worked of straw* are very convenient to place retorts, flasks, or basins upon, to prevent breakage, *fig.* 796. *Bladders* are used to tie round the necks of bottles, &c. Very thin caoutchouc is now prepared as an elegant substitute for bladder.

Fig. 796.



Stands for many vessels may be of three pieces of wood fixed together, as in *fig.* 797.

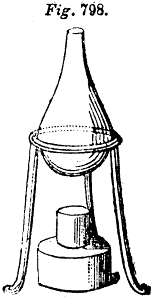
Fig. 797.



6106. *In distilling with the retort*, it is sometimes necessary to fix the neck of it into that of the receiver, so as to prevent any of the product of the distillation escaping at the joint, as in *figs.* 795 and 800. This is performed by putting round the joining a substance called a *lute*, which is composed of various materials, according to the nature of the distillation. For common lutes, where no great degree of heat is employed, a strip of linen dipped in paste or starch is sometimes sufficient. When stronger lutes are necessary, clay mixed with drying linseed oil may be used, or clay and sand: a paste of linseed meal is an excellent strong lute, but is so hard that it can scarcely be removed. Slacked lime and glue does not set quite so hard. Plaster of Paris will serve as a lute, and particularly if it be washed over with drying linseed oil after it has set.

6107. *The thin pint Florence flasks*, in which we receive olive oil from Italy, are extremely useful for many operations where heat is concerned, as their thinness enables them to resist sudden changes of temperature better than our flint-glass flasks; but they should be chosen as free as possible from knots and flaws, and should be carefully handled, as they are not strong. They have the advantage of being cheap, and may be procured of the oil-men. The wood-cut, *fig.* 798, represents boiling in a flask placed upon a stand made of thick wire. These flasks, when got from the oil-men, are generally oily. They may be cleaned by putting a little alkali in the water to wash them; but it is better to pour in a little strong nitric acid, or some oil of vitriol, and then heating them over a lamp; after that, everything will come away on washing with water.

Fig. 798.

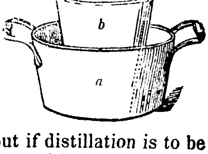


6108. In preparing distilled waters, or in distilling liqueurs, if the copper body of the still holds two quarts, it will be easy to draw off a gallon of liqueur at each distillation. To obtain the spirit in its utmost purity, the process of distillation must be conducted slowly and carefully, and the vapour that is raised condensed effectually. For this purpose, the refrigeratory, or worm-tub, should be supplied with cold water as fast as it becomes warm, and in winter ice may be used instead of water. If the heat applied is violent, the vapour will rise so fast as to blow off the head of the still, or the charge in the copper will boil over, pass into the worm, and spoil the process; also, by using too great a heat, the materials may be burned, and acquire an empyreumatic taste.

6109. *In many cases of distillation*, therefore, such as the preparation of essential oils, or the finer kinds of ardent spirits, &c., where an excess of heat might injure materially the products, instead of applying the fire directly to the vessel containing the substances to be distilled, these are placed in another vessel having in it some fluid or powder, through which the heat is communicated in a more gradual and uniform manner.

6110. *The water-bath*, or *balneum mariæ*, *fig.* 799, is a very ancient apparatus, which is used where the heat required does not exceed that of boiling water. *a* is a vessel half filled with water: another vessel, *b*, containing the substances to be heated, is placed in the water. As the fire is applied only to the outside vessel, the materials in the inner one can never be heated more than 212°, the heat of boiling water; and the heat will always be equal so long as the water boils; therefore there can be no burning to, as is often experienced when there is only one vessel, and that exposed to the open fire. In the wood-cut the inner vessel is supposed to contain some substance merely to be heated by this method; but if distillation is to be conducted in this manner, then the body of the still is to be immersed in the water.

Fig. 799.



The water-bath has another convenience, besides equalizing and limiting the temperature; it affords the facility of applying any required degree of heat below 212° to a substance in an operation; for it is only necessary to raise the temperature of the water to that degree, which may be ascertained by plunging a thermometer into it, and then immersing the vessel containing the substance into the water; and this degree of accuracy could not be attained in any other way. If it were required to know at what degree wax, or any resin, melted, the substance might be put into a thin glass tube, and the tube into the water of the bath, then raising the temperature of the water till the wax melted, the temperature might be ascertained by the thermometer.

6111. *A temporary water-bath may even be made* by a tin sauce-pan; but it is necessary to observe that the interior vessel should not touch the bottom of the exterior one, for it will then get heat from the fire, and be raised above that of the water. Should this be used for distilling with a retort, the neck may be supported by passing through a hole in a wooden cover to the sauce-pan.

A Florence oil flask, very well cleaned, may sometimes be used instead of a retort, if a bent neck be cemented to it. If it should be desirable to have the heat of the water-bath somewhat greater than 212°, that may be effected by using a saturated solution of salt in water, which will bear to be heated to 238°; oil, or mercury, or melted metals, will give much higher degrees of heat; but these are seldom used.

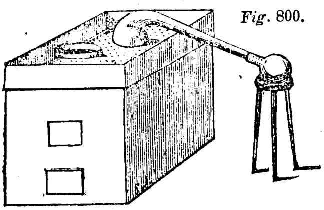


Fig. 800.

6112. *The sand-bath* is an analogous method of preventing the effects of a violent and unequal heat upon the still. Sand is put into a flat iron vessel, *fig.* 800, and the fire applied below to heat the sand; and the retort, or still, is placed in the sand in the same manner as in the water in the last method. The sand-bath differs from the water-bath in this respect, that the heat may be raised considerably above the temperature of boiling water. It is generally set in brick-work, and the fire is made to circulate backward and forward under the iron plate.

In chemical laboratories there is always a sand-bath large enough to receive several vessels for different operations; but when only a single vessel is employed, any iron pan capable of holding a sufficient quantity of sand may do. Where they are much used, sand-baths are best made of plates of cast iron; but these crack, unless made in separate pieces, and they are expensive, and, upon the whole, difficult to fit up, though the most durable. Those made of wrought iron are not liable to this inconvenience, though they are to another one, that of warping; but for domestic purposes they may frequently answer sufficiently.

6113. *Distilling in vacuo* is a modern improvement of great importance. It is a well-known fact that liquids boil, or are converted into vapour, at a much lower temperature when the pressure of the atmosphere is removed from their surface. This is easily illustrated by the air-pump. If a tumbler of water, lukewarm, be introduced under the receiver, and the air exhausted, the water will exhibit all the appearance of boiling, and be converted into vapour, although the actual temperature is not increased; that is to say, when the air is extracted, water heated only lukewarm will exhibit the phenomena of boiling or ebullition. This fact has been happily applied to distillation. The heat of boiling water, 212°, is capable of injuring many substances required to be distilled; but if the air be removed from the surface of the liquor in the still, the liquor will boil, and be raised in vapour, at a heat much lower. Where the air is removed, which is described by the term *in vacuo*, water boils at 90° instead of 212°, so that the fluid need never be heated more than 100°, or much above blood heat. This is particularly useful in medicinal preparations, as in distilling many extracts from vegetables which have their virtues destroyed, or much impaired, by the temperature of 212°; and it prevents all burned flavour, or empyreuma.

6114. This process has likewise been found particularly useful in boiling the sugar in refining. Instead of boiling at a heat of 218° or 220°, sirup requiring this to drive off the water is now boiled and evaporated, by means of the vacuum, at a very low temperature, which cannot burn the sugar; and thus a great saving is made. This has been already mentioned under "Sugar-making."

6115. *Many other improvements* have lately been made in the apparatus for distilling in manufactories, and several patents have been taken out, both in France and this country, for inventions of various degrees of merit; but the description of these does not enter into the plan of this work.

6116. *Sublimation* is a species of distillation in which the substance rises in a light flocculent form, instead of vapour, and condenses in form of a powder, as in the case of flowers of sulphur.

6117. *Rectification* is the repeated distillation of any fluid.

CHAPTER II.

VARIOUS PROCESSES PERFORMED IN THE LABORATORY.

6118. *When substances are to be comminuted*, or divided into small pieces, various methods are to be resorted to, according to the nature of the substances, and the use that is intended to be made of them.

6119. *Mortars* are well-known implements for pounding. When very hard substances are to be pounded, an iron mortar, with a pestle of the same material, may be conveniently placed upon a strong block of wood in a corner of the apartment. Sometimes a heavy hammer is required first to break the substances into pieces. For table mortars, those of brass are sometimes used, or, what is better and cleaner, Wedgewood's white-ware, or the Berlin, which is excellent. Some mortars are made of white marble, but they are less hard, though sufficiently so for ordinary purposes. For very nice purposes, small mortars are made of steel, agate, porphyry, and even of glass. For bruising succulent herbs, roots, and other recent vegetable substances, which do not require trituration, mortars made of box-wood or oak are sometimes used. To prevent substances from being scattered about while being pounded, the mortar should have a loose cover of wood or pasteboard, with a wide hole in it for the pestle; when such a cover is not at hand, a piece of pliable leather may be tied over it, or a clean cloth, held tight with one hand on the top of the mortar and round the pestle, may be used as a makeshift. After pounding, some substances are reduced to a still finer powder by rubbing or grinding with the pestle against the inside of the mortar. To pound properly in a mortar requires some practice, and should be learned by frequent trials; for this purpose, it would be well to observe the modes used by apothecaries. In general, a small quantity only at a time should be put into the mortar, otherwise some of the material may escape the complete action of the pestle. In many cases it is best to reduce the whole first to a coarse powder, and then to pound this over again finer, by small quantities at a time. Some soft substances, as chalk, require only bruising. Charcoal is best pulverized while hot: it may be ignited, and immediately introduced into a metal mortar, and rubbed to powder. Camphor has a toughness under the pestle, but is easily reduced to powder when moistened with a few drops of alcohol, or almond oil. Gum and resin, when pulverized, should be kept perfectly dry, or they will concrete again: they are best pulverized in cold weather; in summer they get too soft.

6120. *Trituration* and *levigation* mean a very minute division of substances in mortars of agate, or some very hard material, by a rotatory motion given to the pestle, or on a levigating stone, as a slab of marble or porphyry, or thick ground glass, *rubbing* or *grinding* the substances on it with a *muller*. In some cases it is necessary to add a little spirit or some liquid during the levigation, or reduction to an impalpable powder, to prevent its flying about.

6121. *Granulation* is the reduction of substances to visible grains. Salt may thus be made finer by rolling it with a rolling-pin. *Rasps* are necessary for reducing to powder woods, barks, horn, ivory, bone, &c. *Chipping* and *scraping* are likewise employed for the same purpose.

6122. *The emulsive seeds* cannot be reduced to powder except some dry powder be added to them. For the aromatic oily substances, sugar is the best addition.

6123. *Grinding with a mill* is also employed for many things, chiefly seeds, as coffee, pepper, &c.

6124. *Solution.*—In many operations it is necessary first to dissolve some of the substances. Every one knows that salt will dissolve in water, but that sand or flint will not; this may give an idea of the distinction between *soluble* and *insoluble* substances; but every substance, though insoluble in water, is soluble in something else; and that something is called its *solvent* or *menstruum.* Thus, limestone will not dissolve in water, but it will in strong acid, like oil of vitriol; likewise all the metals are insoluble in water, but they are all soluble in some acid or other: thus, oil of vitriol will dissolve copper easily, but lead scarcely at all, except it be heated. Resins are not soluble in water, but they are so in spirits of wine. Salt is soluble in cold water as well as in hot; but water can dissolve only a certain quantity of it, and then the solution is said to be *saturated.* Hot water dissolves more of some salts than cold, and when the hot water cools, it lets fall all the salt above the quantity that it could hold in solution when cold. On the contrary, water will dissolve sugar without any limit, until it becomes a sirup.

Solutions are said to be *concentrated* or *inspissated* when some of the water is driven from the solution by evaporation. This process, with most animal and vegetable matters, is best performed in a water-bath, to prevent burning, as in the case of portable soup.

6125. *Infusions* are made by pouring water, either boiling, merely warm, or even cold, upon vegetable substances, and letting it stand for some time, without farther boiling. It is evident that the water here can only extract such matters as are soluble in that fluid. The ordinary beverage called tea is an infusion of tea leaves.

6126. *Maceration* differs from infusion, in being continued for a longer time, and can only be employed for substances which do not easily ferment or spoil.

6127. *Digestion,* on the other hand, differs from maceration and infusion, in the water or other menstruum being kept in a state of *continued heat* over a fire, but gentle, and *not* boiling.

6128 *A decoction* is the extraction by water of certain principles in vegetables, by subjecting them to boiling for some time. Many parts of vegetables are not soluble in water, as the resinous substances; but others, as mucilage, are entirely soluble in that fluid. Decoctions, from the nature of their constituents, very soon ferment and spoil; consequently they should be prepared in small quantities only as they are wanted, and never used, particularly in summer, forty-eight hours after they have been made. The well-known beverage, barley water, is a decoction of barley.

6129. *Coagulation* is a thickening of a substance that has been fluid, as the formation of curd from milk when rennet is boiled with it.

6130. *An extract* consists in dissolving by water, spirit, or any other menstruum, such parts of vegetables as are soluble, and afterward inspissating this by heat.

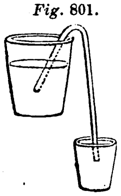
6131. *A tincture* is a solution of any coloured substance in spirit of wine; when not coloured, the solution is called a *spirit*.

6132. *Precipitation* is the reverse of solution. It is the falling down in a solid or powdery state something that had been dissolved, in consequence of the addition of some other body to the solution. Thus, iron may be oxydized and dissolved by diluted sulphuric acid, and the solution will be transparent; but if an alkali be added, the oxyde of the iron will fall down, or be precipitated, in form of a greenish powder.

6133. *A sediment*, on the contrary, is the falling down of a substance that had been *merely mixed* with water or other fluid, but not dissolved, and all that is necessary to produce it is rest for some time. Thus, water may be muddy, that is, contain various matters in a state of mechanical suspension, not chemical solution; but if that water be suffered to rest long enough, all these matters will subside to the bottom as a sediment, leaving the water clear. Substances actually dissolved never subside by standing any time; thus, flour mixed with water will subside; sugar or salt dissolved in it never.

6134. *Decantation*, or to *decant* a fluid, is to pour off gently the supernatant fluid from the sediment without disturbing it.

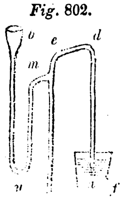
Fig. 801.



6135. *A siphon*, *fig.* 801, is often useful for decanting where there is danger of disturbing the sediment. The siphon may be first filled with the fluid to be decanted, by taking out some carefully with a spoon; then, with the long end of the siphon closed with a cork, plunge the short end into the liquid, and keep the finger upon the opening of the siphon till it is fairly below the surface; now withdraw the finger, and open the long end, and the siphon will run.

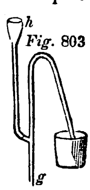
6136. *A small glass siphon*, *fig.* 801, which is easily made out of a piece of tube, is sometimes used for decanting very minute quantities of a fluid; and having stopped the end with the finger, the mouth may be applied to the arm, *h*, to draw the fluid over the turn of the tube; when it has passed that, the fluid will continue to run.

Fig. 802.



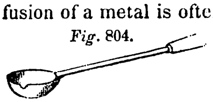
6137. In the siphon invented by M. Collardeau, *fig.* 802, it is not necessary to apply the mouth, nor even the finger, to either end of the tube, a circumstance that may be important when the liquor to be transferred is of a corrosive nature, or otherwise improper to touch with the finger. Dip the end *a* into the fluid to be transferred, and pour into the funnel side opening, *b*, a quantity of the same fluid, until it flows out of the end *c*. The fluid in the vessel then rises, and continues through *a*, *d*, *e*, *c*. In this case the branch *m n* remains full, while the liquid in *b n* subsides to near the bend *n*. The same object is effected by the more simple form of *g*, *fig.* 803, provided the opening of the longer leg is closed with the finger until that branch is full; or the application of the finger is unnecessary if the fluid be poured into the funnel faster than it can be discharged through *g*; in that case the long branch of the siphon will fill, and then act in the usual way.

Fig. 803



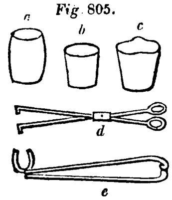
6138. *Fusion* is the conversion of a solid into a liquid by the application of heat. The fusion of a metal is often called *melting*; but, in common language, the term melting is often, also, applied to the solution of a solid in water; thus, we say, sugar *melts* in water; *dissolves* in water would be better. *Liquefaction* means the same thing. The fusion of metals is conveniently effected by an iron ladle, *fig.* 804.

Fig. 804.



6139. *Crucibles* are little vessels, *a*, *b*, *c*, *fig.* 805, for putting certain substances into that are to be exposed to a violent heat of a fire or a furnace. Common ones are made of a particular kind of earthen-ware that resists heat. Some larger ones are made of black-lead. They must be put in and taken out of the fire with a small pair of crucible tongs, *d*, *e*, and they should have covers to protect the substances from the fuel. The bowl of a tobacco pipe makes a very good small crucible.

Fig. 805.



The heat of a furnace will probably be very seldom required in domestic economy; if it should, small portable furnaces may be procured at the dealers in chemical apparatus. Some are made to stand upon a stool, by putting a few loose bricks beneath; but great care must be taken in their use to prevent accidents from the fire.

6140. *The process called washing* is employed for separating powders that are not soluble in water into various degrees of fineness, with greater delicacy than can be effected by any sifting. The substance, after being ground to a fine powder, is mixed with a good deal of water, and agitated; the coarsest and heaviest portion of the powder will settle to the bottom, while the smaller and lighter particles will remain some time suspended in the water. But before they have time to subside, the water is poured off with them into another vessel, and then they are suffered to subside. If it be required to separate a third degree still finer, the water must be poured off again before the whole falls down, and the sediment of this water will give the finest powder. In this manner, every powder may be separated into the various degrees of fineness which are required.

6141. *Lixiviation* is the washing a soluble substance from an insoluble one; as, for instance, to produce the potash from wood ashes. The whole substance is mixed with water, and suffered to stand some time, till the water has dissolved all the salt. The water is then decanted, or filtered off; if this water be evaporated, the salt will be left behind.

6142. *Filtration* is the depriving liquids of some solid particles that are mixed with them. It is to be observed that, if substances are actually dissolved in a liquid, no filtration can separate them: thus, salt can never be separated from water by any kind of filtration whatever, although some persons erroneously suppose it can. Filtration can only separate what is mechanically suspended, and what would mostly fall down of itself by subsidence.

Fig. 806.

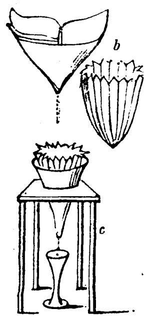
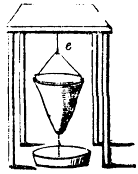


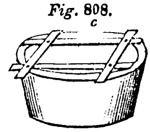
Fig. 807.



6143. Filters for delicate purposes are made of white unsized paper, and they are folded up so as to make a cone, as in the wood-cut *a*, or as *b*, *fig*. 806; to support this, the paper so folded is put into a funnel, and this funnel into a filtering-stand, *c*. These filters can only serve once.

When large quantities are to be filtered, filtering-bags are used, consisting of a piece of flannel or linen fastened to a hoop, *e*, *fig*. 807; what passes the first time is sometimes not fine enough, and requires being refiltered. Where no great nicety is required, it is sufficient to have a frame, as at *c*, *fig*. 808, and to throw over it a cloth. In filtering thick, adhesive substances, such as sirup, it is sometimes necessary to moisten the filter with water. In filtering very small quantities, the paper cone may be simply put into a glass.

Fig. 808.



6144. *Strainers* are for the same use as filters, and are only coarse filters. They are made of cloths, of metal, or earthen-ware pierced with holes, or wire cloth. Flannel is often used.

6145. *A tamis* is a worsted cloth, sold at the oil shops, made on purpose for straining sauces: the best way of using it (says Dr. Kitchener) is for two people to twist it in contrary ways; this is a better way of straining sauce than through a sieve, and refines it much more completely.

6146. *The operation of sifting* is well known. It is employed for separating certain substances from others, or for mixing together powders very completely; and likewise for procuring particles as nearly as possible of equal sizes, whether coase or fine. Sieves are made of wire cloth, hair cloths, or of open lawn or muslin. Pierced zinc is also used; and in some countries where persons are obliged to make their own sieves, parchment strained over a frame, and pierced with numerous holes with a hot iron wire, answers tolerably well.

6147. *Clarification* is the process of clearing and fining any fluid from all impurities or feculence. It is performed either by heat, or by the addition of some substance which will unite with and precipitate or raise to the surface the matter which makes the liquor turbid. The substances usually employed are the white of eggs, blood, and isinglass. The first two are generally used for such liquors as are clarified when hot, since the albumen of the egg, or of the blood, when beaten up with a portion of the fluid, coagulates by the heat, and, rising to the surface, carries with it the impure matter in the form of a scum. Isinglass dissolves in the liquid, and sometimes rises with the impurities as a scum, but sometimes falls down to the bottom, as in the case of wine.

6148. *To express* is to separate fluids from solids by mechanical pressure, and is used chiefly for obtaining the juice and oils of vegetables. It is performed by a lever or screw press. The substances are enclosed in a bag of cloth, introduced between the plates of the press. Hair cloth is the best for the bags, as it does not impart any peculiar taste. To some vegetables that are not juicy enough, the addition of a little water is necessary. For unctuous seeds, heated iron plates are sometimes used; when the iron is cold, the oil is styled *cold-drawn*.

6149. *Evaporating*, or *vaporization*, is the conversion of a liquid into the state of vapour, as water into steam. No body in nature can be destroyed; and what is commonly called the drying up of water is but its conversion into vapour, which is either dissolved in the atmosphere, or rendered visible as steam. Water, when exposed to the air, is constantly evaporating, but heat accelerates this process; consequently, when we wish to evaporate water quickly, we employ heat. The larger the surface of the water, the more rapid will be the evaporation, and therefore we put it into large shallow vessels. It is to be observed that the atmosphere is not a necessary agent in evaporation, but rather, by its pressure, it tends to prevent it; for, if we take off the pressure of the air by removing it altogether from the evaporating surface by exhausting, the evaporation will go on much faster; an instance of which was mentioned in an improvement in the manufacture of sugar; and the same principle is applied in procuring the extract of vegetables. Shallow pans, or basins, are made for evaporating in, of which those of a kind of porcelain, called Wedgewood's, are the best when heat is used.

6150. *Decomposition* is the complete separation from each other of the elementary principles of which compound bodies consist; by decomposition all the properties of such a substance are destroyed.

6151. *Effervescence* is the bubbling occasioned by the escape of gas from any liquid, giving an appearance like boiling. An example of this is seen when muriatic acid is poured upon chalk.

6152. *Funnels* are made of tinned iron, pewter, stone-ware, white or brown, glass, and of various sizes. Very small funnels are useful to fill vials and other small bottles. Where acids are to be poured, glass or earthen-ware are requisite, as metal will be corroded. Glass is excellent, because one can see if it be perfectly clean.

6153. *Test Papers for detecting Acids and Alkalies.*—These are sold at the chemists'. That for ascertaining whether any acid exists in a liquid is blue; if there is any acid, the blue paper, tinged with litmus, will turn red when dipped into it. Those for alkalies are yellow, with turmeric; any alkali in a liquid state will turn them brown.

6154. *The ground stoppers of vials sometimes get so fixed* that they can scarcely be moved. Several methods have been practised for loosening them. When the hand is not strong enough, a hand-vice may be tried; but great care must be taken that it does not break the vial. Tapping each side of the neck successively with a piece of hard wood sometimes produces the desired effect. When these methods fail, heat may be tried. Plunge the neck of the vial into boiling water, or heat it gently by a spirit lamp. Here care must be taken that the contents are not very volatile, or they may burst the bottle. When the neck has been warmed, which expands it, a smart blow with the hand, struck upon the bottom of the bottle, sometimes detaches the stopper A little olive oil put round the stopper for a day or two, will soak into the neck and often loosen the stopper When all these methods fail, the stopper, if it be worth the expense, as in the case of a decanter, may be got out by sending it to the china-mender, who works it out by a drill.

6155. *With respect to quantities in the preparations of the still-room or kitchen*, it is very important to have a certain precision, and in some cases it is absolutely essential. Instead of the frequent ill-defined directions of a bit of this, a handful of that, &c., Dr. Kitchener particularly recommends that cooks should accustom themselves to use weights and measures more frequently. There should be a measure for a gallon, a quart, a pint, and half a pint. Graduated glass measures are sold at the chemists', which save much trouble, *fig.* 809. One of these, containing a wine pint, is divided into sixteen ounces, and the ounce into eight drachms of water, by which a certain weight, which is mentioned in a receipt, can be measured out. Measures of this kind are easily made by weighing the water, and scratching a mark on any tall glass for the space it occupies. A file will do to mark with.

Fig. 809.

6156. *A table-spoonful* is often mentioned as a measure or quantity in a recipe or prescription, as given by medical men, or in books. By this is generally meant and understood a measure or bulk equal to what would be produced by half an ounce of water.

6157. By *dessert-spoonful* is meant the half of a spoonful; and a tea-spoonful is in quantity equal to a drachm of water. This is best adjusted by a graduated glass measure, sold at the glass shops, for spoonfuls.

6158. *A drop* is the name of a vague species of measure, so called because the liquid is dropped from the mouth of a bottle; but the quantity of a drop may vary, depending upon the consistency of the liquid, and upon the size and shape of the mouth of the bottle from which it proceeds. The London College of Physicians have fixed the quantity of a drop to one grain, sixty drops being a fluid drachm. This sixtieth part of a fluid drachm they call a *minim:* and glass tubes, graduated for the purpose of measuring minims, may be purchased at the glass shops.

6159. *A good balance or pair of scales* is necessary. It is requisite to have scales for ordinary uses, and others for occasions where greater delicacy is required. Fine scales should be kept in a box secluded from the air, and should never be overloaded. They should be used in a good light.

6160. *Glass rods, or tubes*, are convenient for stirring; so are the stems of tobacco pipes. As glass tubes are liable to be broken by rolling off the table, soften one end in a flame, and bend about an inch; they will not then roll.

6161. *Glass tubes may be bent* and drawn out by the heat of a good spirit lamp, and may be broken at any required place by first making a mark on it with the corner of a file. Larger tubes may be softened and bent over a charcoal fire in a small portable furnace. *Glass blowing*, with a table and bellows on purpose, might afford an elegant and useful amusement, as thermometer bulbs and other useful things are easily made.

6162. *Spoons* of metal and wood are used for various purposes; a *spatula* is for rubbing pastes

6163. *Cements of various kinds* should be kept in the still-room for occasional slight purposes, or for mending furniture. Of the first, *flour paste* is well known: if required to be stronger than usual, a little glue may be boiled in it: some put powdered resin in it. *White of egg*, or a *solution of glue* and *strong gum water*, are good cements. *A paste made of linseed meal* dries very hard and adheres firmly. *A soft cement* is made of yellow wax melted with its weight of turpentine, and a little Venetian red to give it colour. This, when cold, is as hard as soap, but can be softened by the warmth of the hand, and is very useful to stop up cracks, and is better to cover the corks of bottles sent to a distance than sealing-wax or hard cement. *Plaster of Paris* may serve as an occasional cement.

6164. *Other fittings-up in the still-room* should be the following:

A small sink with water laid on, which may be covered over when not wanted; towels, brushes, and other apparatus for keeping everything perfectly clean, should be always at hand. *Cupboards* for keeping things out of the dust; and shelves along the walls to keep things on that are wanted often. On no account should any bottle or vial be suffered to remain without a carefully-made and accurate label, as numerous accidents have happened through neglect of this caution. *A strong table*, and two or three small ones, as well as stands; *a nest of drawers*, to keep small articles and materials; *a grate*, with a boiler on one side and an oven on the other, is necessary; the latter will often be useful for drying things. Hobs of the grate should have a sort of canopy, to prevent dust from falling upon whatever is placed upon them.

6165. *For fuel, in the operations of the still-room*, besides coal, coke and charcoal are wanted. Coke has the advantage of giving a great heat without any smoke; the Staffordshire coke is the best, though dearest. Anthracite, likewise, gives no smoke. Charcoal is the best fuel for many nice operations. Boxes with fuel should be kept in the room: they may be on rollers to slide into recesses. See Section "On Fuel."

6166. *The walls of the still-room should be whitewashed* and painted of a light straw colour, both for the sake of having the most light, and that it may be easily renewed and kept perfectly clean.

CHAPTER III.

DESCRIPTION OF ESSENTIAL OILS, OR ESSENCES, AND THE MODE OF PREPARING THEM.

6167. We here beg to remind our readers of what has been stated in a previous part of this work, that vegetables yield two distinct kinds of oil; one called *fixed*, or *fat oils*, because they do not rise, nor are volatilized, except at such temperatures as are sufficient to decompose them; such is olive oil. These are also termed *expressed oils*, because they are obtained by employing strong pressure. The other kind of oil is called *volatile oil*, because it rises by vapour at a gentle heat, and is easily obtained by distillation: these are also sometimes termed *distilled oils* and *essential oils*.

6168. *The essence of a vegetable* is a term that was given by the old chemists to that principle in which resided the taste and odour, as well as the pungency, which peculiarly distinguished it from other vegetables. Thus, the fragrance of orange or lemon peel, of peppermint, or of cinnamon, and the pungency of cloves, were found by experience to be separable from the other parts of the vegetable by means of distillation, &c.; and the result of this was a small portion of a highly aromatic and odoriferous oil, in which was contained the entire odour that had been dispersed through the whole mass; hence the oils thus procured obtained the name of *essences*.

6169. *These essences, or essential oils, most of which are highly odorous*, furnish the most valuable materials to the perfumer (See "Perfumery," Book XIX., Chap. IX.), are employed in spirituous liquors used at the table, and in cookery, and likewise in medicine, painting, &c. They exist in various parts of plants: in some, as thyme, the oil is contained in all parts of the plant; in others it is contained only in the leaves, the fruits, the seeds, the flowers, the roots, or the bark. In some cases, different parts of the same plant contain different oils: the orange, for example, has three different oils; one in the leaves, another in the flowers, and a third in the fruit. The quantity of oil varies not only with the species of plant, but with the soil and culture, and particularly with the climate; thus, in hot climates, plants yield most essential oil. In some plants the oil does not escape in drying; others lose it immediately, particularly flowers.

6170. The essential oils are chiefly obtained by distillation: a few are obtained by expression, as those of the orange, lemon, and bergamot. To extract the odorous oils of certain flowers, as jessamin or tuberose, infusion in a fat oil is sufficient. These are called, also, volatile oils.

Their taste is exceedingly hot and pungent, and in some, particularly the oil of peppermint, followed by a remarkable sensation of coldness, though the thermometrical temperature undergoes no change. The acrimony of some of the oils, as the oil of cloves, is so great as actually to destroy the outer skin of the tongue, and of other sensible parts. They have not always the same tastes with the plants they are distilled from, or, at least, not in the same degree. Nothing is more bitter than wormwood; yet the oil of wormwood has no remarkable bitterness. Anise, which is of a sweet taste, yields, on the contrary, an oil infinitely more sweet than the seed; and pepper, which is so remarkably hot and acrid, affords an oil no way remarkable for its pungency. Thyme, which is in itself very acrid and pungent, conveys that property in a yet greater degree to its oil; there is, indeed, no essential oil so acrid and fiery as that of this plant.

The number of these oils is so great as to baffle all enumeration, almost every odoriferous plant being distinguished by a peculiar oil, to which it is indebted for its perfume.

6171. *The following table* exhibits the most prominent properties of most of the essential or volatile oils :

Name.	Colour.	Specific Gravity.	Consistency at 60°.	Odour.	Procured from
Rosemary	none	·934	thin liquid	like the plant	Ros marinus officinalis.
Fennel	—	·997	becomes solid at 50°	—	seeds of Anethum fœniculum.
Sassafras	none	1·094	oily	like the root	root of Laurus Sassafras.
Tansy	—	·946	—	very strong	leaves of Tanacetum vulgare.
Caraway	none	·946	—	very strong and pungent	seeds of the Carum carri.
Pennyroyal	—	·978	—	like the plant	flowers of the Mentha pugilium.
Anise seed	none	—	becomes solid at 50°	very strong	seeds of Pimpinella anisum.
Thyme	brown	—	crystallized	like camphor	leaves and flowers of Thymus serpillum.
Lavender	none	—	thin liquid	like the plant	flowers of Lavendula spica.
Wormwood	green	—	—	—	leaves of Artemisia absynthium.
Chamomile	blue	—	—	—	flowers of Arthemus nobilis.
Hops	green	—	like butter	like the flower	
Parsley	green	—	—	—	flowers of Humerus lupulus.
Peppermint	green	—	thin liquid	like the plant	leaves of Apium Petroselinum.
Savin	none	—	—	disagreeable	leaves of Mentha piperitis.
Coriander	—	—	—	—	seeds of Coriandrum sativum.
Saffron	—	—	—	—	pistils of Crocus sativus.
Turpentine	none	·742	fluid as water	strong	resin of Pinus sylvestris.
Juniper	green	·611	very fluid	strong smell	seeds of Juniperis communis.
Cloves	none	1·034	oily, very fluid	like cloves	capsules of Eugenia caryophillata.
Lemon	yellow	—	thin liquid	like the fruit	rind of the fruit of Citrus medica.
Orange	yellow	·888	ditto	ditto	rind of the fruit of Citrus aurantium.
Neroli	yellow	·800	ditto	ditto	flowers of ditto.
Cinnamon	yellow	1·035	oily and liquid	like cinnamon	bark of the Laurus cinnamomium.
Nutmegs	none	·948	like butter	like nutmegs	seeds of Myristica moschata.
Bergamot	yellow	—	not oily ; solid at 23°	like oranges	rind of the fruit of Citrus aurantium.
Mace	—	—	oily	—	seeds of Myristica moschata.
Roses	none	—	like the flower	—	petals of Rosa antifolia.
Pepper	none	—	like butter	very acrid	seeds of Piper nigrum.

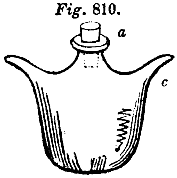
6172. Essential oils are not obtained from odoriferous substances in quantities proportioned to their degree of odour. Some which, if we were to reason from analogy, should seem very well fitted for this process, yield extremely little oil, and others none at all. Roses and chamomile flowers, whose strong and lasting smell promise abundance, are found to contain but a small quantity of oil ; the violet and the jessamin flowers, which perfume the air with their odour, lose their smell upon the gentlest coction, and do not afford any oil on being distilled, unless immense quantities are subjected to the operation at once ; while savin, whose disagreeable scent extends to no great distance, gives out the largest proportion of volatile oil of almost any vegetable known.

6173. As examples of the quantities of essential oils yielded by different plants, the following may be mentioned : 6 oz. of the *oil of juniper* may be procured from 48 lbs. of the berries ; 1 lb. 9 oz. of the *oil of lavender* may be obtained from 80 lbs. of lavender flowers ; 1 oz. of *oil of rosemary* may be had from 24 lbs. of the plant.

6174. *Obtaining the essential oils themselves from the several productions* is seldom attempted in domestic practice, as they may be purchased ready prepared from a respectable chemist or apothecary : when they are procured by distillation, the processes are the same as those which we shall describe for obtaining the distilled waters, with the exception that less water is employed, and, of course, a much larger quantity of the leaves, flowers, or other parts of the plants. Many of them are made in those warm climates where the plants grow in greater abundance than with us. The chief manufacture of the essential oils or essences which we have is in the south of France; as those of rose, neroli, lavender, thyme, lemon thyme, and rosemary. Some of them, as the oil of lavender and fennel, are made of the best quality in this country : the English oil of lavender is three times as dear, and very much superior to the French.

6175. *We cannot separate the volatile oils from the aromatic plants by distilling them alone,* because the proportion of these oils is so small that they could not be collected ; and, besides, it would be impossible to regulate the heat so as to be sufficient, and yet not burn the materials, and destroy the product. Hence it is necessary to distil them with a proportion of water. During the process of distillation, the volatile oil rises with the watery vapour, and condenses with it in the receiver, where it is partly dissolved by the water. The greater part, however, of the oil again separates from the water, after it has remained at rest for some hours in a cool place, and either floats on the surface, or sinks to the bottom, according as it is lighter or heavier than its bulk of water.

Fig. 810.



The essential oil thus procured can be completely detached from the water by an instrument called a *Separatory.*

The fluids to be separated are introduced through the orifice *a*, *fig.* 810, which is then closed with a stopper. One neck is then shut with the finger, and the vial is to be inclined to the other side. As soon as the fluids have separated by means of their specific gravity, the finger is to be removed, and the whole of the heavier fluid will run through the lower neck before any of the lighter escapes. Another method of effecting the same thing is to put the whole into large narrow-necked bottles, setting them in a cool place, that the portion of the oil which is not dissolved in the water may rise to the top, or sink to the bottom. It may then be separated, either by a small glass syringe, or by means of a filter of paper; or, lastly, by means of a woollen thread, one end of which is immersed in the oil, and the other, the lower end, in a vial; the oil will thus pass over into the vial by capillary attraction; and the thread is to be squeezed dry.

6176. In proceeding to procure a greater quantity of the oil with fresh leaves or flowers, the whole of the water produced by the first distillation is employed in the next, instead of plain water, so that thus the produce of oil in the second distillation will exceed that of the first by the whole quantity held in permanent solution by the water of the former process. By this method the amount of oil yielded by equal quantities of the same substance will form a constantly increasing series, till the whole of the water drawn off by each distillation is completely saturated with oil. It is not till the seventh, or even sometimes the tenth distillation, that the produce of oil attains its maximum. Tall alembics are the best for these distillations. It is to be observed that, if too much water be used, the oil will dissolve in it, and only an aromatic water will be procured; if too little water, the plants may be charred.

6177. *In this manner the essence of roses* is procured: Put into the body of the still 40 pounds of rose petals and 60 quarts of water; distil off one half of the water. When a considerable quantity of such water of the first distillation is obtained, it must be used as water upon fresh rose petals; a process of repetition to be carried to the fifth time. In the distillation of orange flowers, to obtain the essence of neroli, the same process is followed. If orange-flower water merely be wanted, then it is obtained at one distillation, by reserving the first fifth part of water that comes over.

6178. *The celebrated attar of roses*, a precious perfume, which is the essential oil of roses, is prepared in Persia and India. Ghazipoor, on the Ganges, seventy miles below Benares, is famous for its manufacture of this costly perfume; hundreds of acres are there employed in the cultivation of roses, and it is said that it requires 200,000 roses to produce half an ounce of the attar. To procure it, a clean cask, or glazed earthen jar, is filled with petals of the musk rose separated from their calyces, and they are then covered with spring water: the vessel containing them is set in the sun for two or three days, and brought under cover in the night. At the end of the third or fourth day small particles of yellow oil float on the surface of the water, which, in a week, accumulates into a thin scum; this scum, which is the attar, is taken up by a little cotton tied to the end of a stick, and squeezed into a small vial. It sells for from £2 to £3 per ounce. The Persian attar of roses is said to be superior to the East Indian.

6179. *The essences of the lemon, the orange, and the bergamot* are the only ones that are so abundant as to be obtainable by *expression*. For this purpose, a small wheel, with its circumference set with stout nails, is put in motion, and a lemon or orange is applied to it till the whole of the yellow outer rind is rasped away. The raspings fall to the bottom of the case in which the wheel turns, and they are then squeezed between two plates of glass. By this gentle pressure the oil flows from the ruptured cells into an adjoining vessel, and is there suffered to rest till the water and the other impurities have subsided. This essential oil is soluble in all proportions in pure alcohol; but only 14 parts dissolve in spirits of wine.

6180. *A very ingenious mode is employed for fixing the aroma, or perfumes, of plants in expressed oils* without the assistance of any but the gentlest heat. The oil which is used is either oil of behn or the purest olive oil, both of which are entirely scentless. The flowers whose aroma is to be extracted, jessamin flowers for example, are thickly spread upon flakes of wool, previously soaked in the oil; then they are enclosed in tin boxes, and suffered to remain till the flowers begin to decay, and lose their colour and texture. They are then removed, fresh flowers are added, and the maceration repeated till the oil becomes richly impregnated with the jessamin scent. This oil is then put into a still with water, and the essential oil comes over with the water; or the wool is pressed, and the fragrant oil separated from the flowers is put into closely-stopped bottles, and sold under the name of *essence* of jessamin. These essences, therefore, consist of a fixed oil saturated with the aroma of the plant.

CHAPTER IV.

SIMPLE DISTILLED WATERS, AND METHOD OF PREPARING THEM.

6181. When any vegetable matter is boiled with water in a vessel fitted to collect and condense the vapour, the distilled water so obtained is, in almost every instance, somewhat impregnated more or less with odorous or sapid particles, which it has extracted from the vegetable, and carried up with it in the process. But the difference in the degree of impregnation, according to the substance employed, is extreme. Sometimes only a faint and nauseous taste is given, which soon goes off; but in other instances the water is highly scented, and has much taste. The first occurs where the plant is of the herbaceous and nearly insipid kind, or only bitter without being aromatic; but where the plant is rich in essential oil, or strongly aromatic, the water partakes largely of these properties. What are called distilled waters, therefore, consist of simple water slightly impregnated with the essential oils of different plants. A great variety of these have been used formerly, most of them obtained from the vegetable kingdom; and many were procured from the inodorous herbaceous plants for purposes of pharmacy. In France they enumerated no less than 125 different distilled waters, one half of which have scarcely any flavour or virtue. The greater part are now disused in this country, being considered of no value; and a very few only are retained.

6182. *The distilled waters made in Britain* are prepared from the *aromatic vegetables*, from most of which an *essential oil* may also be obtained; and as the water distilled from them tastes and smells strongly of the oil peculiar to the plant, and also as a water very similar to that which is distilled may generally be made by dissolving some of the oil itself in plain water, there can be no doubt but that the distilled waters of the aromatic vegetables owe their strong smell and taste to the essential oil which they hold in solution. It has, indeed, been suggested that the principle which occasions the odour may be in some cases distinct from the essential oil itself; but as these have never been separated, and as their distinction is a point which chemistry has not yet determined, it is sufficient for us here to adopt the prevailing opinion.

6183. *The process for preparing these simple aromatic distilled waters* is as follows: The herbaceous or dried plants should first be thoroughly macerated in water, to open their texture, and make them yield their essential oil more abundantly. When herbaceous plants are used, such as peppermint for example, they become sufficiently macerated in the time that it takes to bring the water to a boiling heat, so that no previous preparation is necessary, it being sufficient to put them into the still with the requisite quantity of cold water. But the woods and other hard parts of plants should be macerated for some time before distillation, being previously well bruised, and their texture broken down. If a glass alembic is used, it should be placed on a sand-bath; if a copper or tin one, it should be put into a water-bath. The quantity of water required must vary, of course, according to the nature of the substance used. Herbaceous plants recently gathered require that the still, or alembic, should be filled only to two thirds of its capacity, with the plants moderately pressed, and so much water added as will fully cover them: if too many plants are put in, as they swell much, they would choke up the head of the still. The fire should be raised expeditiously at first, as a long-continued heat is apt to impair the aromatic flavour. The first drops that come over are insipid, and should be thrown away: soon the water which comes is milky and turbid, owing to an excess of essential oil, which it carries up with it above the quantity which it can hold in clear solution; this excess of oil, when the distilled water cools gradually, collects at top in form of a thin film, or subsides to the bottom according to its specific gravity. As the water distils over it becomes clearer, and proportionally less aromatic to the taste; till at last, when perfectly limpid, it appears nearly insipid, and the fire should then be withdrawn. Much care is necessary to prevent any of the vegetable matter from being scorched during the process, and the distillation should be stopped before any burned or empyreumatic flavour is perceived.

6184. *Another method of procuring distilled waters is sometimes employed* by what is called the *cold* still, and which has been much practised in private families. A shallow leaden vessel is filled with fresh herbs, flowers, &c., which are heaped above it; so that, when the head is fitted on, this also may be filled a considerable way. A little fire is made under the vessel, sufficient to make the bottom much hotter than the hand can bear, care being only taken not to heat it so far as to endanger the scorching any part of the plants. If the bottom of the vessel be not made so hot as to have this effect on the part contiguous to it, there is no fear that the heat communicated to the rest of the included materials will be so great as to do them any injury. By this management the volatile parts of several odorous plants, as mint, are effectually forced over with the moisture, and if the process has been skilfully managed, the distilled liquor which collects in drops in the glass receiver proves richly impregnated with the native odour and flavour of the plants, though it will be small in quantity.

6185. *Still another mode has been used*, which is more expeditious and certain. A quantity of water being poured into the still, and the herbs, or flowers, placed in a basket over it, there can be no possibility of burning. The water may be made to boil, but so as not to rise up into the basket. The steam, only passing gently through the leaves, imbibes and carries over it the volatile parts unaltered. In the common still, the vapour rising upward before it is condensed, the distillation is said by chemists to be *per ascensum;* but there is another mode of distillation, *per descensum*, in which the vapour descends to be condensed. A cylinder of copper, tinned inside, may be cased in wood; the leaves may be stuffed into this, and steam forced down through them.

6186. *When an alembic, or still, is not at hand, a small quantity of simple distilled waters may be procured* by the following method: Put a small quantity of water into a glazed earthen jar, and tie a piece of open muslin or gauze over the mouth, leaving it to hang down inside a little loose: place the flowers on the muslin, and having put some lighted charcoal into any metal vessel, such as a warming-pan, place the bottom of it (just hot enough not to burn or scorch) so as to fit tight to the mouth of the jar containing the leaves. By the heat the essential oil of the flowers will be forced out, and not being able to ascend, will descend into the water, which will be richly impregnated.

6187. *The degree of the impregnation of the water*, or the quantity of water which a plant is capable of saturating, is by no means in proportion to the quantity of its oil. The oil saturates only the water that comes over at the same time with it; if there be more oil than is sufficient for this saturation, the surplus separates, and concretes in its proper form, not miscible with that which rises afterward. Some odoriferous flowers, whose oil is in so small a quantity that scarcely any visible mark of it appears, unless fifty or one hundred pounds or more are distilled at once, give, nevertheless, as strong an impregnation to water as those plants which abound most with oil.

6188. *Most distilled waters, when first prepared,* have a somewhat unpleasant smell, which, however, they gradually lose; it is therefore advisable to keep them for some days after their preparation in vessels but slightly covered, and not to cork them up until they lose that smell. After some months they frequently spoil; but to make them keep better, one twentieth of their weight of proof spirit may be added. If they be rectified by distilling a second time, they will keep for several years without the addition of any spirit, which always gives an unpleasant flavour, and is often objectionable for other reasons.

6189. *The distilled waters, as commonly prepared for sale,* are seldom of the best quality; and the housekeeper who wishes to possess them in a state of perfection must distil them under her own inspection, and preserve them with the caution that will be directed. In the country, where there is generally a gardener, this may likewise be a desirable object of economy, and may afford an amusement neither inelegant nor uninstructive to the several branches of the family.

6190. *To prepare Rose Water.*—When the buds of the red rose begin to expand into the full-blown flower, their perfume is most perfect, and in that state they should be gathered in a dry morning, the heels cut off, and the leaves only put into a clean cask in layers, with salt sprinkled between them, to preserve them till they are collected in quantity sufficient for distillation. Fill the still two thirds with the petals and salt together, with a little water at the bottom to prevent burning, or have the still put into a water-bath; proceed to the distillation with a very slow fire, and receive the first product in several vials, in order to examine it. The first will be highly impregnated; and, as soon as the slightest empyreumatic odour or burned smell is perceived, throw away the portion that is contaminated, and stop the distillation. Rose water should be kept in a cool, dark place, as heat and light speedily cause it to spoil. It is best to put it into a stone jar with a cork, that it may be drawn off without disturbing the sediment, which is apt to be the case if decanted from small bottles. It should be made in small quantities at a time, as it will not keep long: the salted leaves will keep for months, and do as well for distillation as when fresh gathered; but it is to be observed that it is an error to suppose that the salt is of any farther use in the distillation than to keep the leaves from spoiling.

6191. *Perfumed tepid water* for the finger glasses before the dessert may be easily prepared by infusing a few fresh or dried rose petals, lavender, or any other flower, in the morning for the purpose.

Rose water is said to have been first made in Persia; and the Persian rose water was long esteemed as the best. Our roses give but little perfume.

6192. *Distilled waters may be prepared in a similar manner from any of the fragrant herbs or flowers.* The fragrance of lavender and jessamin, with many others, when distilled very slowly with a weak spirit, are readily extracted.

6193. *Orange-flower water,* which is in the highest request, cannot be made from the flowers in this country; it is chiefly imported from France and Italy; the best is from Leghorn. Orange flowers are collected every morning in May and June for thirty miles round Paris from both public and private gardens, and, likewise, the buds that fall from the trees, to make this perfume. When this water is obtained by distillation from the fresh flowers, it contains a peculiar principle, in consequence of which the water becomes red by a few drops of sulphuric acid; and the intensity of the rose colour is, in some measure, a test of the richness of the water in essential oil. Orange-flower water may be made by dissolving a little of the oil of orange flowers, called *neroli,* in water. What is imported may be improved by putting into a jar containing from fifteen to twenty gallons, two or three lumps of white sugar, having dropped upon them about forty drops of bergamot.

What is called essence of *petit-grain* is obtained by distilling the leaves of the orange shrub.

The only distilled waters retained at present by the London and Edinburgh Colleges for the purposes of medicine are those prepared from orange peel, sweet fennel, rose leaves, peppermint, pennyroyal, spearmint, lemon peel, cinnamon, cassia cinnamon, dill seeds, and pimento.

6194. The following directions for preparing distilled waters used as medicines are from those in the dispensatories:

Distilled Water.—Take of water ten gallons. Distil four pints, which are to be rejected; then distil four gallons, to be used. The first and last portions of the water are rejected as impure.

Peppermint Water.—Put a pound and a half of the peppermint into the still. Pour over it as much water as will prevent empyreuma, or burning, during distillation. Distil a gallon.

Pennyroyal Water.—The process is the same as the last. Distil as long as the water has the fine flavour of the herb.

Spearmint water is procured in the same manner.

Cinnamon Water.—Steep one pound of bruised cinnamon in a gallon and a half of water for two days; then distil off the water till it ceases to run milky; put what comes over into the still, and distil again.

Water of Orange Peel.—Take of fresh orange peel two pounds; add so much water that when ten pounds have been drawn off by distillation there shall remain a sufficient quantity to prevent empyreuma. After due maceration distil ten pounds, to which add five pounds of diluted alcohol.

CHAPTER V.

MODE OF PREPARING SPIRITUOUS AROMATIC DISTILLED WATERS, AND SPIRITS OF THE PERFUMERS.

6195. There is some ambiguity and confusion in the names usually given to these preparations, but they will be easily understood from the following explanation. We stated that the vapour of water and the essential oils rise together in distillation, and form the simple distilled waters, but that water would only take up a certain portion of the essential oils, the remainder separating from it on cooling; water is therefore only slightly impregnated with the essential oils of vegetables. Spirit of wine has this advantage over water, that it keeps all the essential oil in a state of solution, and can therefore be much more highly impregnated with the odours and other properties of the oils. Nevertheless, as spirit of wine is extremely volatile, it is sometimes more so than the essential oils, and therefore it will rise first, and, consequently, without the oils; whereas water, requiring more heat to be converted into vapour, will not rise until the essential oil does the same. Thus, if cinnamon, for instance, be committed to distillation with a mixture of spirit of wine and water, or with a pure proof spirit, which is no other than a mixture of equal parts of the two, the spirit will rise first, clear and transparent, and almost without any taste of the cinnamon; but, as soon as the watery part begins to rise, the oil comes over freely with it, so as to render the liquid highly odorous and sapid. The proof spirits commonly sold have a certain disagreeable flavour, owing to the essential oil of the barley from which it is made, which, though in general concealed, in a great measure, by certain additions, plainly discovers itself on distillation; but this nauseous smell is not perceived until after the purer spirituous part has come over, which is the very time when some of the essential oils also begin to distil. On this account it is of great importance to have very pure spirit for the purpose of procuring spirituous waters.

6196. What are called *spirituous waters* are where only proof spirit, that is, half pure spirit and half water, has been employed.

An example of a spirituous water may be given in the case of orange-peel water, the receipt for the simple distilled water of which has already been given.

6197. *Spirituous Orange-peel Water.*—Take of the outer rind of Seville orange peel, dried, half a pound; proof spirit, one gallon; water, as much as is sufficient to prevent empyreuma. Distil off one gallon. This is considerably stronger than the simple orange-peel water. It is used as a cordial and stomachic.

6198. *Spirituous Jessamin Water.*—Take of Spanish jessamin flowers twelve ounces; essence of Florentine citron or bergamot, eight drops; fine proof spirit, one gallon; water, two quarts. Digest for two days in a close vessel; after which draw off one gallon, and add sugar.

6199. *Spirituous Peppermint Water.*—Take of peppermint leaves, dry, a pound and a half; proof spirit, one gallon; water, as much as is sufficient to prevent empyreuma. Distil off one gallon. This smells and tastes very strongly of peppermint, and is used medicinally.

6200. *What perfumers term spirits of certain plants*, as spirits of lavender, *consist of* the essential oil of the plants dissolved in proof spirit, by putting the plants, with alcohol, into a still, and drawing off the scented spirit; or they are obtained by digesting the odoriferous substances with spirit in a sand heat.

6201. Formerly the term *spirit* was applied by chemists to all volatile substances collected by distillation, and hence some of the essential or volatile oils were termed spirits. Some of these names are not yet entirely banished; thus, the essential oil of turpentine is still improperly called spirits of turpentine. The term spirit is at present, among perfumers, usually confined to alcoholic solutions. But while some perfumers call these spirits, others name them *essences*, a term which ought to be confined to the pure essential oils.

6202. *Spirituous perfumes are also prepared* by putting the essences procured by means of the fat oils into a distilling vessel with alcohol. The aroma which was joined to the oil leaves it for the spirit, and the fixed oil remains; thus a highly perfumed spirit is procured instead of an oil.

6203. *To avoid the trouble of distilling* with the plants themselves in preparing perfumers' spirits, it is very usual now to mix a small quantity of the essential oils of the several plants with proof spirit. Thus, spirit of roses may be made by adding three drachms of attar of roses to two pints of rectified spirits: spirit of jessamin may be procured by adding half a drachm of the essential oil of jessamin to eight ounces of rectified spirit; but the best method of combining the perfumes with spirits is the following: Into each of three digesters, immersed in water-baths, put twenty-five pounds of any one of the essential aromatic oils, and pour into the first digester twenty-five quarts of spirit of wine; agitate every quarter of an hour during three days, and at the end of this period draw of the perfumed spirit, and pour it into the second digester; then transfer it after three days into the third digester, treating the mixture in the same way; and the spirit thus obtained will be perfect. The digesters must be covered carefully during the process of these operations. On pursuing the same process with the same oil and fresh alcohol, essences of inferior qualities may be obtained. Some perfumers state that it is better to use highly-scented pomades than oils.

6204. *Spirit of Bergamot.*—This fine perfume comes from Italy, and cannot be prepared in perfection in England for want of the fruit from which it is prepared, which is a species of lemon (*Citrus limetta*). The best is from Rome; that from Leghorn is inferior. Directions are given for making an inferior kind, as follows: Mix one gallon of proof spirit of wine and one gallon of water with half an ounce of Roman oil of bergamot beaten in a mortar with fine sugar. Put the whole into a still in a water-bath, and draw off six quarts.

6205. *Spirit of Lavender.*—Infuse six ounces of fresh lavender flowers in one gallon of proof spirits, and digest in a sand heat. Repeat the infusion of fresh flowers four times, and an excellent spirit will be obtained. The flowers should be gathered very dry, stripped from their stalks, and kept in paper bags. Or, put a pound and a half or two pounds of fresh lavender flowers into a still; add one gallon of proof spirit of wine. Distil off one gallon. This, by some perfumers, is called *lavender water*. It is apt to be adulterated with oil of turpentine.

6206. *Spirit of Ambergris.*—Reduce to powder with loaf-sugar 1½ oz. ambergris, 20 grains civet, musk 30 grains. Add the fourth of a green lemon, and digest the whole in 3 pints of rectified spirits of wine.

6207. *Spirit of Musk.*—Reduce to powder with loaf-sugar 1½ oz. musk, 40 grains civet, and ¼ oz. red rose-buds. Digest the whole in 3 pints of spirit of wine; or they may be distilled by an alembic.

6208. *Hungary Water.*—This, though it retains the name of water, is properly a spirit. Take of rosemary flowers, just gathered, two pounds; rectified spirit of wine, three pounds; put them together, and distil in a water-bath. Some add lavender flowers. That which is imported is generally superior to what is made here, which is probably owing to the manufacture. A very pure spirit should be employed. The best method of managing the distillation is to place the spirit in the still, and then place above the liquor either an iron hoop, with a hair cloth stretched over it, upon which the flowers are to be lightly spread, or, rather, a basket, supported on three pins, reaching down to the bottom. A gentle heat being applied, just sufficient to raise the spirit, its vapour, lightly percolating through the flowers, will imbibe their essential oil, which thus is obtained extremely pure.

A simpler Hungary Water by infusion.—Add to a pint of rectified spirit of wine an ounce of oil of rosemary and two drachms of essence of ambergris; shake the bottle well several times, then let the cork remain out for twenty-four hours; shake it each day for a month, and then put it into small bottles well sealed.

6209. *Eau de Cologne,* improperly called a water, as it is a spirit.—The following recipe is given by Dr. Granville for making this celebrated perfumed water equal in quality to that of Farina in Cologne, and at one fourth of the expense: Take of the essence of bergamot, lemon peel, lavender, and orange flowers each one ounce, 15 ounces of the spirit of rosemary and of the spirituous water of balm, 7½ pints of strong alcohol. Mix the whole together, and let the mixture stand quiet for a fortnight. Put this in a glass retort, placed in a sand or water bath, the latter of which may be heated by a lamp, and lute a glass receiver to the beak of the retort. The water-bath being kept boiling, the mixture in the retort will distil over into the receiver, which should be kept cool with wet cloths. It should be kept for some time in a very cold cellar, or an ice-house.

6210. *Another Receipt.*—Distil as before, in a water-bath, 3 ounces of essence of bergamot, 3 ounces of essence of lemons, 1 drachm of oil of rosemary, 1½ ounce of essence of neroli, 1 ounce of oil of lavender, and 12 pints of alcohol.

6211. *Another.*—Mix two drachms of essence of citron and of bergamot, and 1 ounce of lemon peel, ½ drachm of oil of lavender, 10 drops of essence of orange flowers, 3 drachms of tincture of benjamin, and 2 drops of oil of rosemary. The most celebrated maker of eau de Cologne is Jean Farina, of Cologne.

6212. *Eau de Lis.*—Put highly rectified spirit of wine and oil of amber into a bottle, in the proportion of four pounds of the former to one ounce of the latter. Let these remain five days, shaking the bottle from time to time, by which means they will combine. Add to this four ounces of the best amber, powdered, and let the whole digest for three days. Having decanted this clean, add to it sixteen pounds of the strongest spirit of sal ammoniac and eight pounds of highly rectified spirit of wine. Take care the amber be genuine, for a great deal of what is sold for amber is a fraudulent composition.

6213. *Eau de Cannes.*—Take of fresh-gathered leaves of balm a pound and a half; the recent yellow rind of lemons, four ounces; nutmeg and coriander, each two ounces; cloves and cinnamon, each one ounce; the ingredients being sliced and bruised, pour upon them six pounds of rectified spirits of wine and three pounds of balm water. Digest the whole for three days, then draw off six pounds by distillation.

6214. *The French prepare a great variety of scented spirits,* in which are numerous ingredients, of which the following may serve as an example: *Spirit of Cytherea.*—1 quart of spirit of violets, 1 of jessamin, 1 of tuberose, 1 of clove gilliflower, 1 of roses, 1 of Portugal, and 2 of orange-flower water.

6215. *The following general directions are given for gathering and preserving leaves, flowers, roots, and sweet herbs for the purpose of distillation,* or for seasoning in cookery: Vegetables should be gathered in dry weather, and when no dew is upon them; they should be gathered fresh every year, and those which have been longer kept should be thrown away. Roots, for the most part, are to be dug up before their stems or leaves shoot forth. Barks are to be collected in the spring, when they are most easily separated from the wood. Petals should be gathered after the flowers have fully expanded, and before the seeds are mature; flowers, in general, when they are just full blown; seeds when they are ripe, and before they drop from the plant; they ought to be preserved in their seed vessels.

Some vegetables are to be used in their fresh state; others are first dried. When the latter is the case, they should be dried as quickly as possible, that their principles may be the least dissipated; for this purpose, they should be spread out in thin layers in baskets, or strewed upon a sieve, according to the nature of the substances, and exposed to the gentle heat of a stove or a common fire, so as not to alter their colour; when the leaves begin to shrivel, they should be turned frequently, and the heat should be continued till they begin to crumble in the hand. When perfectly dried, they should be preserved in glazed jars closely covered, not in paper bags, as often directed, and kept in a dry and warm situation. Some plants, the essential oils of which are very volatile, require to be powdered immediately when dried, and to be preserved in well-stopped opaque bottles. The greater part of the oils prepared for perfumery and medicine are from dried plants.

6216. *Steam affords a very excellent and regular heat for drying many substances,* such as leaves of various kinds. For this purpose, nothing more is necessary than a common tea-kettle to generate the steam, and a metal pipe fixed on to its spout, and connected with a tin box, about eighteen inches or two feet long, or any other size that may be convenient. Near the top of this box a tin cover is to be fixed, having circular holes cut in it to receive capsules or any other vessels, into which the substances to be dried are put, the bottoms of them being exposed to the steam, which fills the box. When a quantity of leaves are to be dried, a tin tray fits on the top of the box to hold them, and the circular holes are left open to suffer the steam to come to the bottom of the tray. The application of this principle of using steam heat may be varied in an infinity of ways, as it is easily conducted by means of pipes to any place in the apartment.

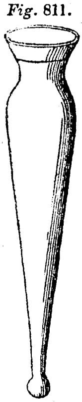
6217. *Aromatic flowers may be preserved for distillation* by the following method: Bruise the petals with salt, three pounds of rose leaves with a pound of common salt. Put the paste into an earthen jar, or water-tight barrel. This must be kept in a cool place. When it is wanted for distillation, a quantity of this paste may be put into the still with twice its weight of water. By applying heat in the usual way, the distilled water comes over perfumed with the essential oil. This process may be performed at any time of the year. Some chemists have been of opinion that herbs and flowers, moderately dried, yield a greater quantity of volatile oil than if they were distilled when fresh. It is, however, improbable that the quantity of volatile oil will be increased by drying; on the contrary, part of it will be dissipated and lost; but drying is useful in other ways, either by diminishing the bulk of the substance to be distilled, or by causing it to part with its oil more easily.

CHAPTER II.

TINCTURES AND EXTRACTS.

6218. *A tincture is a solution of any coloured substance in spirits of wine.* Rectified spirits of wine is the direct menstruum of the resins and essential oils of vegetables, which, not being soluble in water, or in a very small degree, cannot be extracted by it. Pure alcohol dissolves the greater number of the active principles of vegetables, except the ligneous fibre; viz., sugar, resin, extractive, tannin, camphor, the essential oils, several acids, and the narcotic principle. Gum is soluble in water, but not in alcohol; and rectified spirit, containing a portion of water, dissolves gum resins, which are intermediate between gum and resin. Pure alcohol is seldom required in the formation of tinctures, rectified and proof spirit being adequate for most purposes. Tinctures are not liable to suffer spontaneous decomposition, as is the case with infusions and decoctions; and if the bottles containing them be closely corked, they may be kept for any length of time unchanged. When spirituous tinctures are evaporated till they are of a thick consistence, they are called *balsams*.

Fig. 811.



6219. *Tinctures are prepared* by pounding the ingredients to be acted upon, putting them into a close vessel with alcohol or spirits of wine, and assisting the solution by a temperature not exceeding 80°, at which heat, by allowing the menstruum to act upon the ingredients for a sufficient time, all the principles that are soluble in them are extracted. The liquid should then be passed through filtering paper: the balneum mariæ is the best method of applying the heat, and the vessel should be frequently shaken during the digestion.

6220. *Tinctures may also be prepared rapidly* by moistening the pounded materials with some of the spirit intended to be used to the consistence of a thick paste; then putting it into a percolator, *fig.* 811, and pouring over it the remainder of the spirit. As it passes through the paste, the spirit dissolves the soluble matter, and drops as a tincture into a bottle placed to receive it. When it ceases to drop, water should be poured into the percolator, which will draw out the tincture without mixing with it. A piece of rag should be tied over the lower orifice of the percolator.

6221. *Tincture of Lemon Peel.*—This is a very easy and economical way of preserving the aromatic flavour of lemon peel. Whenever a lemon is used, pare the rind off very thin, and put it into a wide-mouthed bottle containing brandy or proof spirit. The spirit will, in a few weeks, be strongly flavoured.

6222. *Dr. Kitchener's Quintessence of Lemon Peel.*—Procure a drachm of the essential oil of lemons, and mix it gradually with two ounces of the strongest rectified spirit. This possesses all the delightful fragrance and flavour of the freshest lemon peel. A few drops on the sugar put into punch instantly impregnates it with as much of the flavour as is obtained by the troublesome and inelegant process of rubbing the sugar upon the rind of the lemon. It is likewise admirable for flavouring blanc-mange, jellies, negus, custards, and everything for which the aromatic flavour of the lemon is wanted.

6223. *Tincture of Ginger, improperly called Essence of Ginger.*—Infuse three ounces of grated ginger and two ounces of the thin parings of the rind of lemons in a quart of brandy or proof spirit.

6224. *Tincture of Cayenne, improperly called Essence.*—Steep half an ounce of Cayenne pepper in half a pint of brandy or wine for a fortnight. Pour off the clear liquid. This is preferable for preparing fish sauces and many other articles of cookery, as the flavour is instantly and equally diffused; and it is likewise more easy and accurate to season with this than with the pepper itself.

6225. *Tincture of Chili.*—Steep 50 fresh red Chilies in half a pint of brandy for a fortnight; this has the same properties as the last. This is also usually called essence of Chili, but improperly.

6226. *Essence of Lemon or Orange Peel, by Dr. Kitchener's Method.*—Wash and brush clean the lemons; let them get perfectly dry; take a lump of sugar, and rub them till all the yellow rind is taken up by the sugar; scrape off the surface of the sugar into a preserving pot, and press it hard down; cover it very close, and it will keep some time. This method of preserving an essential oil is termed an *oleo-saccharum.*

6227. *Tincture of Allspice, usually called Essence of Allspice.*—This is very useful in making mulled wine, and in flavouring gravies, for which a few drops will suffice. It is made by adding a drachm of oil of pimento to two ounces of strong spirit of wine.

6228. *Another Method.*—Steep three ounces of allspice, bruised, in a quart of brandy. This is used for the same purpose as the last.

6229. *Tincture of nutmeg* is made as that from allspice.

6230. *Tincture of Cinnamon.*—Macerate three ounces of bruised cinnamon in a bottle of French brandy or rectified spirit. This was at one time much in vogue as a stomachic, and is still considered as a useful remedy.

6231. *Compound Tincture of Cinnamon.*—Macerate for fourteen days, in two pints of proof spirit, six drachms of cinnamon bark, bruised, three drachms of cardamom seeds, bruised, two drachms each of long pepper and ginger; filter.

6232. The *spirits*, or, as they are usually called, *essences*, of nutmeg, cloves, and cinnamon are prepared by adding the essential oils to brandy or rectified spirit.

6233. *Spirits are also prepared from various sweet and savoury herbs,* which are extremely convenient in culinary preparations. These are obtained by steeping the dried herbs in brandy or proof spirit.

6234. *Dr. Kitchener's Soup-herb Spirit.*—Infuse for ten days, in a pint of brandy, half an ounce each of lemon thyme, winter savory, sweet marjoram, and sweet basil, two drachms of lemon peel, grated, the same of eschalots, and one drachm of celery seed.

6235. *Dr. Kitchener's Spirit of Savoury Spice.*—Infuse for ten days, in a pint of brandy, one ounce of black pepper, half an ounce of allspice, and a quarter of an ounce of nutmeg, grated.

6236. *Dr. Kitchener observes*, that "cooks who are jealous of their reputation, and housekeepers who value their health, will prepare these articles, and some other ingredients for sauces above mentioned, at home; there are quite as many reasons why they should as there are for the preference usually given to home-made bread and home-brewed beer."

6237. *The term extract* refers more properly to the mode of preparation than to the nature of the substance prepared. Although chemists in general have described *extractive* or the extractive principle as a peculiar proximate principle in vegetables, yet it is now doubted whether there is any one principle to which this name can with propriety be applied. Making an extract consists in dissolving by water, spirit, or any other menstruum, such parts as are soluble, and concentrating or inspissating this solution by heat to a thick consistence, or sometimes to entire solidity. Hence we find in an extract generally a great variety of substances, as mucilage, sugar, tannin, resin, gluten; in short, whatever happened to be present, and could be dissolved by the menstruum employed. If water alone is employed, the solution is called a *watery* extract; if alcohol, or proof spirit, then the produce is a *spirituous* extract.

6238. *To make a watery extract*, the substances are generally boiled in water, the decoction is strained, and then boiled down till it has attained the required consistence, and, perhaps, gently dried on a stove. If a spirituous extract be required, a tincture of the substance is first made, and this is evaporated gently in a water or sand bath; or, a distilling apparatus may be employed, and thus the spirit be saved. In performing the operation of making watery extracts, a higher temperature than boiling water must not be employed, and yet the evaporation must be effected as quickly as possible, by having the evaporating vessel broad and shallow, and set in a water-bath. Some extracts are made by a mixture of spirits and water, it being found that certain plants contain both a resin and a gum, the first being soluble only in spirit, and the latter in water, as extract of jalap, of Peruvian bark, &c. Some extracts require long digestion.

To prevent too great a heat affecting the properties of extracts, a method has been invented by Mr. Barry for preparing them *in vacuo*, that is to say, in vessels from which the air has been expelled, by which the virtues of the plants are more effectually preserved, from the boiling or evaporation being effected with less heat than in the common pressure of the atmosphere; that is, less than 212°. These extracts are generally green, and contain saline crystals, but some of them will not keep. Extracts are chiefly used medicinally, as extract of liquorice, of aloes, of rue, &c.

CHAPTER VII.

ADULTERATION OF ESSENTIAL OILS.

6239. *The adulteration of essential oils* is very common, since many of them are of high price, and come from abroad. They are sophisticated in several ways.

1. They have expressed oils mixed with them. 2. They are mixed with alcohol. 3. They are adulterated with cheaper essential oils. *If any essential oil be adulterated with expressed oil*, it is easy to discover the fraud by adding a little spirit of wine to a few drops of the suspected oil, and shaking them together; the spirit will dissolve all the oil that is essential, or procured by distillation, and leave all the expressed oil that was mixed with it untouched. *When an essential oil is adulterated with alcohol*, or rectified spirits of wine, this may be done in any proportion, up to that of an equal quantity, without being easily discoverable either by the smell or taste. The way to discover this fraud is to drop a few drops of the oil into a glass of pure water; and if the oil be adulterated with spirit, the water will immediately turn milky, and by continuing to shake the glass, the whole quantity of spirit will be absorbed by the water, and the oil left pure at top. *If an essential oil be adulterated by another but cheaper essential oil*, the detection is more difficult. As all volatile oils agree in the general properties of solubility in spirit of wine, indissolubility in water, or miscibility with water, by the intervention of certain intermedia, volatility in the heat of boiling water, &c., it is obvious that they may be variously mixed with each other, or the dearer sophisticated with the cheaper, without the possibility of discovering the fraud by any ordinary trials; and, indeed, it would be of more advantage to the purchaser if he had infallible criteria for the discovery of the *goodness* of the manufacture than of the *genuineness* of each oil; for genuine oils, from inattention in distillation, or long and careless keeping, and other causes, are often weaker, both in smell and taste, than the common sophisticated ones. The smell and taste seem to be the only certain tests of which the nature of the thing will admit. Most of the volatile oils, indeed, are too hot and pungent to be tasted with safety; and the smell of the subject is so much concentrated in them, that a small variation in this respect is not easily distinguished, but we can readily dilute them to any degree. A drop of the oil may be dissolved in spirits of wine, or received in a bit of sugar, and dissolved by that intermedium in water. The quantity of liquor which it impregnates with its flavour, or the degree of flavour which it communicates to a certain determinate quantity, will be the measure of the degree of goodness of the oil.

6240. *Some consider the specific gravity* of essential oils as a certain criterion of their genuineness. This, however, is not to be absolutely depended upon; for the genuine oils, obtained from the same subjects, often differ in gravity as much as those drawn from different ones. Cinnamon and cloves, whose oils usually sink in water, yield, if slowly and carefully distilled, oils of great fragrancy, which are specifically lighter than the water employed in their distillation; while, on the other hand, the last runnings of some of the lighter oils prove sometimes so ponderous as to sink in water. Some plants and barks yield both a light and a heavy oil

BOOK XXI.

JEWELRY.

GENERAL REMARKS.

6241. *Jewels comprehend all those ornaments* of dress in which the precious gems form a principal part. Some of these constitute very expensive, although, on frequent occasions, indispensable articles of dress; the nature and distinctive qualities of the gems should therefore be well understood.

6242. *The business of the jeweller* is, in strictness, distinct from that of the goldsmith; the latter, working only in gold, does not employ any precious stones, whereas the jeweller employs gold merely to hold, or *set*, as it is called, the several gems. The jeweller, however, does not cut the gems; he procures them ready cut from the diamond cutter and the lapidary, and his business is merely to group and set them.

6243. *Great care should be taken in the purchase of jewels*, and in particular to ascertain that the several stones are genuine, or are really what they are called. Some precious stones are easily known, but others are extremely difficult to be distinguished; and though it may appear extraordinary, yet it is a fact that many jewellers in England, particularly the working jewellers, are but indifferently acquainted with several of the stones they have to make use of, sometimes deceiving their customers through their own want of knowledge. At the same time, it is also true that some of them, possessing the requisite information, employ it to practise fraud, by changing the colour of stones by heat, by putting foil behind one kind of stone to make it pass for another, and by similar tricks. One caution we may give. Paste, a kind of coloured glass, is sometimes sold for the gems they imitate; but this may easily be detected, for glass may be scratched by a good file, whereas none of the gems can.

6244. *To determine accurately the species of precious stone* when there is any doubt, the specific gravity sometimes offers a guide, as almost every one has its particular weight; but this requires a delicate hydrostatic balance, and an acquaintance with its use, as well as the proper weight of stones. As an example: if a stone of a fine crimson red is called an Oriental ruby, the purchaser must ascertain whether it be not a Siberian tourmalin, or ruby spinelle, which are of inferior value. For this purpose, the stone must be unset. Suppose its weight in air to be 100 grains, and he finds it reduced to 69 grains when weighed in water. Now, a real sapphire of the kind called Oriental ruby, which weighs 100 grains in air, would have weighed 76·6 in water; a spinelle ruby of 100 grains would have weighed 72·2 in water; and a Siberian tourmalin would weigh only 69 grains in water. From this, therefore, it appears that the stone offered as an Oriental ruby is only a red or Siberian tourmalin.

6245. *The cutting of gems* into the usual shapes, and the polishing of them, are performed by the lapidary, who employs diamond powder for this purpose, as the hardest thing known. In slitting stones, the diamond powder is used with a fine wire coated with it, and which acts like a kind of saw; in grinding down surfaces, the diamond powder is put upon a wheel of soft metal, in which it is imbedded.

6246. *Flaws in rough, unwrought stones* may be made more perceptible than when viewed in air, if they are plunged into water; but still more so if they are immersed in some denser fluid, as Canada balsam, oil of sassafras, fluid oil of anise seeds, &c.

6247. *There is much confusion in the common mode of naming the precious stones used in jewelry;* and many jewellers themselves are ignorant of their proper names, as distinguished by eminent mineralogists. These valuable substances were formerly classed and named according to their colours; hence all red gems possessing a certain degree of hardness were called rubies; the blue, sapphires; the yellow, topazes; the purple, amethysts, &c. But at present gems are not classed by mineralogists merely according to their colours, but according to the nature of their crystallization, their chemical composition, or the earths of which they consist, and their specific gravity. The true classification of gems or precious stones, according to the modern system of mineralogy, is into the diamond, the varieties of corundum, the sapphire, the emerald, the topaz, the spinelle, the garnet, the tourmalin, &c. Each of these differs from the rest in its crystallization, hardness, and chemical composition, forming a separate and peculiar mineralogical species; and as each of these appears under various colours, colour alone cannot be considered as a complete distinction. Besides the stones just mentioned, there are a few others of less value, which we shall also describe. We shall treat of these according to their mineralogical distinctions, at the same time mentioning the popular names used by jewellers.

SECT. I.—DIAMOND.

6248. *The unrivalled brilliancy of this gem* has always attracted universal admiration, and among ornaments it has ever occupied the highest rank. No other substance, natural or artificial, can rival its lustre, rich with prismatic colours. The beauty of other gems is almost lost to the distant beholder; the diamond alone diffuses its starry radiance to the most distant parts of the assembly, and has acquired, by common consent in all ages, a prodigious value that continues undiminished. But notwithstanding the immense value of diamonds of large size, small stones are sufficiently abundant to be within the reach of most persons in easy circumstances, and are therefore in very general request.

6249. *Large diamonds* have ever been extremely rare; and a few, celebrated for their magnitude and beauty, are in the possession of sovereign princes.

1. The largest diamond on record is mentioned by Tavernier the traveller as having been in the possession of the Great Mogul; it weighed 296 carats, and was found near Golconda in 1550. Its size is about half of a hen's egg. 2. A very large diamond, weighing 193 carats, is said to have been the eye of an idol, and about the size of a pigeon's egg. It was stolen by a French soldier, who escaped with it to Madras; and it came subsequently into the hands of Prince Orloff, of whom the late Catherine, empress of Russia, purchased it for £90,000, an annuity of £4000, and a title of nobility. 3. The Pitt or Regent diamond is said to have been found in Malacca, and was purchased by a Mr. Pitt for £20,000; it weighed 210 carats. He brought it to London, and had it cut, which reduced its weight to 136½ carats; and he then sold it to the Duke of Orleans for £100,000. It is now in the crown jewels of France, and may be said to be the finest brilliant in Europe. 4. The Emperor of Austria possesses the largest yellow diamond known, weighing 139½ carats; this formerly belonged to the Grand-duke of Tuscany. 5. The Pigot diamond is valued at £40,000, and is said to have been sold lately to the Pacha of Egypt by a jeweller in London. It is of the finest water. 6. A green brilliant, of exquisite beauty and great size, but of irregular form, is worn by the King of Saxony, when in court dress, as a button to the plume in his hat. 7. Several fine diamonds are among the crown jewels of our royal family. Models in glass of the principal diamonds in Europe may be purchased.

6250. *The Greek and Latin name* of this precious gem is *adamas*, invincible, in allusion to its extreme hardness, whence is derived the English adjective adamantine.

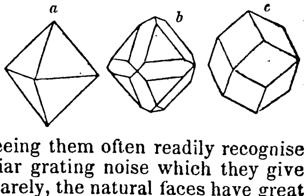
6251. *It differs from all other gems* in not being composed of earth, but of carbon; and it is remarkable that Sir Isaac Newton conjectured that it was a combustible body long before it was discovered by experiment to be so, from observing its great power to refract light. The colours of diamonds are various. The finest are colourless in themselves, and have only what they derive from refracting the rays of light. These are said to be of the purest water. Some have a tinge of pink, red, blue, or green, which are next in estimation. Yellow diamonds are common, though much esteemed. Brown diamonds are less valuable, and still less so are those which are cloudy or have flaws.

6252. *Diamonds are always found* in the loose, alluvial soil, and not imbedded in ancient solid rocks like the other gems. India and Brazil are the two chief countries which produce them: in the former, Golconda, Visapour, Bengal, and Borneo are the principal diamond districts. What are called diamond mines are places where the loose sand and other stony materials are washed in water, to separate the precious stones: a great number of persons are employed in these works. It is said that the diamond mines of India are nearly exhausted, and that Brazil now chiefly supplies the markets of Europe; the mines are the property of the crown, and strangers are not permitted to visit them.

It is a curious fact in the history of Brazilian diamonds, that, when they were first discovered in that country, they were kept as pretty pebbles, and used for counters by card-players, long before their true nature and value were ascertained by the Dutch consul, who accidentally saw them.

6253. *Rough diamonds*, that is, diamonds in their natural state, before they are cut by the jeweller, are crystallized, and when perfect exhibit regular forms, of which the simplest is the octohedron, *a*, *fig.* 812, or modifications of it, as *a*, *b*, *c*, without the polish and brilliancy which is given by art; indeed, in their rough, unpolished state they would not be readily distinguished from common pebbles by persons not practised in examining them. In general, also, their angles have been much rubbed off, so that they appear nearly round, resembling, in a considerable degree, gum Arabic. Those, however, who are in the habit of seeing them often readily recognise them among other pebbles, and this partly by a peculiar grating noise which they give when rubbed against a pebble: occasionally, though rarely, the natural faces have great brilliancy. The diamond is the hardest of all known substances, and it is supposed by some not to be capable of being broken by the blow of a hammer; but though the substance is extremely hard, it is not difficult to fracture: a slight blow will cause it some-

Fig. 812.



times to split, and the sharp side of a cut diamond is often chipped off by careless management.

6254. *Attempts have been made to fabricate the diamond* by chemical means, but hitherto always without success: the idea is, however, not absurd, since we know its composition to be pure carbon only; and could the means of crystallizing carbon be discovered, this object would be attained. Diamonds would then be more useful to mankind in the arts, though their great value might cease to exist.

6255. *We hear sometimes of Cornish diamonds, Bagshot diamonds,* &c. These are merely small, transparent quartz crystals which have been rolled and water-worn, and are found among the sand or gravel on the surface; they are sometimes cut and polished, and, though brilliant and sparkling, have little of the splendid tints of the diamond, and do not come near to it in hardness, being only a little harder than glass: they are of very little value.

6256. *The art of cutting diamonds,* the hardest gems in the world, is so curious that we shall describe it. This gem may be split by a steel tool, if a blow be applied; but to effect this it is necessary to have a perfect knowledge of its crystallized structure, because it will only split in the direction of the laminæ formed by the crystallization, and the workman cannot form facets at pleasure by splitting. To produce the faces which are required for exhibiting the gem in all its beauty, the process called *cutting* is resorted to, but which is, in fact, abrasion rather than cutting, and was first discovered in Europe, in 1476, by Louis de Berghen, of Holland, though probably known in China and Hindostan in very remote periods. For this purpose, the diamond to be cut is fixed on the end of a stick or handle, in a small ball of cement, that part which is to be reduced being left to project. Another diamond is also fixed in a similar manner, and the two stones are rubbed against each other with considerable force, until they are ground away as much as is necessary to produce a facet. Other facets are formed in a similar manner by shifting the position of the diamonds in the cement. When the faces are thus completed, they are next to receive an exquisite polish. Nothing is capable of polishing the diamond except its own powder, which has been collected for this purpose in a small box during the process we have just described. The stones are now imbedded in soft solder, contained in a small copper cup, the face to be polished being left to protrude. A flat, circular plate of cast iron is then charged with diamond powder produced in the abrading process, and the stone is held against this plate, while it is made to revolve until the polish is complete. Those diamonds that are unfit for working on account of their imperfections are sold under the technical name of *bort.* These are broken by repeated blows in a steel mortar, until they are reduced to powder, for various purposes.

6257. *The diamond is a substance of considerable utility in the arts,* independently of its value as an ornament. Fine drills are made of small splinters, which are used for drilling holes in rubies and other hard stones used by watch jewellers in the best kind of clock-work, gold and silver wire-drawers, and others who require very fine holes drilled in such substances. These drills are also used to pierce China-ware, where rivets are to be inserted; also for piercing holes in artificial enamel teeth, or any vitreous substances, however hard. The fine powder is used for grinding down other very hard stones, none of which can be cut or engraved without this material; arms, crests, cameos, intaglios, are engraved upon carnelian, onyx, agate, &c., by means of diamond powder.

6258. *Diamonds are cut and polished in particular shapes,* which have received the names of *brilliant, rose,* and *table-cut.*

6259. *The brilliant* is in the highest estimation, as it is the form which shows to the greatest advantage the peculiar lustre of the gem. It may be considered as composed of two truncated pyramids placed base to base, the upper pyramid being more deeply truncated than the lower one.

6260. *The rose diamond* is the form given to those stones the spread of which is too great, in proportion to their depth, to admit of being brilliant cut without a great loss of substance. It is formed by covering the whole surface of the stone with equilateral triangles.

6261. *The setting of diamonds* is of great importance, and depends partly upon their quality. The finest brilliants are always *set open,* that is, without a back. Shallow brilliants, that have a great surface, are generally *set close,* or with a back of a black substance; and then frequently much ingenuity is exercised, an inferior stone being sometimes made, by concealing defects, to appear like a perfect brilliant. What are called *foils* are thin leaves of metal placed under a precious stone, in order to increase its brilliancy or to give it a different colour. They are of gold, silver, or copper.

6262. *Diamonds are bought and sold by weight,* for which a peculiar standard, called *a carat,* is universally adopted. The carat is an Indian denomination of weight, and 150¼ carats are equal to 1 oz. Troy. The carat is divided into four parts, called grains; and the grains are subdivided into fractional parts, which are ascertained by scales with great nicety. Sometimes the weight is expressed simply in grains; as, a diamond of two carats, or of eight grains. The smallest flaw greatly lessens their value; and the same happens if they be tinged with any dull tint of yellow or brown, though defects are not unfrequently concealed by the mode of setting.

6263. *Rough diamonds are valued* by squaring the number of carats they contain, and multiplying the product by 2, which will give the value in pounds sterling. Thus, for a rough diamond weighing 4 carats, $4 \times 4 \times 2 = 32l.$; and so in other cases. As wrought diamonds are supposed to have lost half their original weight in cutting and polishing, the square of double their weight, in a finished state, must be multiplied by two: thus, to value a wrought diamond of 3 carats, $6 \times 6 \times 2 = 72l.$ Or the weight may be squared, and the product multiplied by 8, which will give the same result: $3 \times 3 \times 8 = 72l.$ Brilliants from 1 to 2½ grains are worth from 7*l.* to 8*l.* Those from 5 to 6 grains are worth from 14*l.* to 15*l.* Brilliants of 2 carats are worth from 28*l.* to 30*l.*; those of 4 carats are worth 100*l.*; those of 5 carats are rare; they may vary from 180*l.* to 200*l.*

6264. *In the purchase and sale of diamonds by private individuals*, it should be remembered that there is a material difference between the jeweller and the diamond merchant, though sometimes, but not often, the two trades are combined. The diamond merchant is a trader who buys rough diamonds, and employs his men to cut and polish them. He offers them for sale in this state, in single stones or in lots, agreeably to the desire of the purchasers. They are not set, but laid openly on a sheet of white paper, so that there can be no possibility of concealing flaws or enhancing beauty by any of the artifices often practised in setting. The diamond merchants are very limited in number, and are generally men of opulence, well acquainted with the details of the art of cutting, but little known except to the importers of rough diamonds and to the *trade*. Persons who, from the pressure of necessity or from other motives, may be induced to convert their diamonds into specie, should carry them to the diamond merchant; he will take them from their setting, weigh them, and offer the fair market price for them, without taking advantage of the inexperience or the embarrassed feelings of the owner.

The business of the jeweller is, to set the diamonds in such form as is most tasteful and agreeable to his customer, and so as to show them to the greatest advantage. He purchases from the diamond merchant such stones as he has a demand for, or supposes to be saleable, and forms them into necklaces, ear-drops, rings, &c. Setting costs but little; a hoop-ring consisting of 12 stones, suppose the 12 stones to weigh 1 carat, may cost, on an average, about 24*s.*; a cross, 13 or 14 stones, gold and open, 50*s.*; a necklace 16 inches long, and composed of 28 or 32 stones, might cost, to set in gold, about 15*l.* The diamond merchant charges for his diamonds a regular wholesale price, and gives, perhaps, six months' credit. The jeweller charges what he thinks proper above the price which he has given, or according to the nature of the jewel; or, if it be made to order, according to the opinion he may entertain of his customer.

Diamonds, when set, always appear larger than they really are; and even the most experienced dealer will not venture to pronounce on the exact value of a diamond when set. As their value is ascertained by their weight, a working jeweller can take them out of the setting in a few minutes, when their proper value can be ascertained.

6265. *Ladies who purchase jewels* should always inquire what weight of diamond is in any particular jewel, and of what weight are certain single diamonds; how many of the smaller stones, for instance, are in a carat; by which means they will easily ascertain the total weight of the diamonds that the article contains. In having their diamonds re-set, great care should be taken that the stones may be identified when they are returned. A judicious precaution is, to draw the flower or other device which they intend to have made up, and to assign to each stone its position in the group.

6266. *The trade of the diamond cutter* is wholly distinct from that of the lapidary, whose business it is to polish the inferior gems. The diamond cutters of England are confessedly the best in Europe, but their number is, unfortunately, so small as to occasion many stones to be sent to Holland, where, from the greater number and more active competition of the artists, the price of workmanship is considerably lower; but the work is said to be inferior. Brilliant-cut diamonds are so much superior to the others, that frequently rose-cut have been re-cut into brilliants, although, as already observed, at a great loss.

6267. *Diamonds are always equally in fashion*, but the mode of setting them varies according to the caprice of taste or the desire of novelty. Hence the jeweller has perpetual opportunities of exercising or displaying the inventive élegance of his taste in the assortment of hues and the arrangement of groups. He will cluster together the smaller stones so as to enhance the effect of the whole; the larger and more perfect ones will generally be set open, and displayed to the greatest advantage, while the inferior ones will be assisted by setting them solid in black, or, if need be, with coloured foil. But whatever be the occasion that calls forth his art, whether the construction of a star, a bandeau, a tiara, a plume, a necklace, or an ear-drop, he should bear in mind that his greatest merit is the concealment of his art. The display of belts and borders of gold can add nothing to the superlative lustre of the diamond.

6268. *Diamonds are a species of property* little liable to fluctuation, as their value continues nearly uniform; but for diamonds of great magnitude the purchasers are very limited in number.

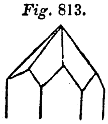
SECT. II.—GEMS BELONGING TO THE SPECIES CORUNDUM.

6269. *Corundum is the name of* an extremely hard mineral substance, found chiefly in India, and used there extensively for cutting and polishing the hardest stones. It occurs in grains, and imbedded, in small masses, in granite, and is of various shades of white, brown, green, red, &c. The common corundum is usually impure; but when this mineral is in its purest state, it constitutes some of our most precious gems, as the sapphire and the ruby; and it includes the gems denominated by jewellers the Oriental amethyst and the Oriental topaz. The basis of all these is the earth alumina, and the purest state of the species corundum consists of little else. We shall describe its proper varieties, and also the gems as designated by the various names given by jewellers.

Sapphire.

6970. Sapphire is the purest, or perfect state of corundum, and is the hardest of all earthy minerals, being inferior in this respect only to the diamond; the hardness is therefore one of its distinctive characters. What is considered as the most perfect, or Oriental sapphire, is of a clear bright blue colour, with a high degree of translucency; but it is also pale blue, and sometimes violet blue, or cloudy. Sapphires are also occasionally colourless. When they are violet blue, they are usually called by the jewellers Oriental amethyst (see "Amethyst"); when they are yellow, they are termed by the jewellers Oriental topaz. The latter are improper terms, since amethysts and topazes are quite different stones. Some sapphires show a pale reddish or bluish reflection, and are then termed *Girasol sapphires;* others, cut *en cabochon*, exhibit the appearance of a silvery star of six rays, in a direction perpendicular to the axis of the natural crystal, a variety that is termed *asteria*. The primary form of the crystals of sapphire is that of a slightly acute rhomboid, which is the same as that of common corundum; but the crystals usually occur under a secondary form of a six-sided prism variously terminated (*fig.* 813), and also in rolled masses. The crystals are readily cleavable in one direction, parallel to one of the planes of the primary rhomboid, showing the cleaved surface very brilliant; but it is extremely difficult to produce cleavages parallel with the other planes of the rhomboid. The finest sapphires come from Pegu and Ceylon, where they are found only in the beds of rivers, often in rounded fragments, generally small, and seldom exceeding the size of a hazelnut. Blue sapphires are not uncommon, and those of ten or twenty carats are easily procured, being of the value of from twenty to sixty shillings per carat, according to their beauty. Sapphires are sometimes substituted for diamonds, by exposing them to a strong heat, which destroys their colour, but improves their hardness and transparency; and this kind of fraud would be difficult to detect by any one who was not a good judge of these stones.

Fig. 813.



Ruby.

6271. The ruby is a gem which, when of the kind called Oriental (and which we stated to be mineralogically of the same species as the sapphire), is of great beauty and value. *The true, or Oriental ruby*, when perfect, is the most valuable of the gems next to the diamond; the colour is a fine, deep, cochineal red, having a richness of hue unrivalled; occasionally it is rose-red, or has a tinge of violet. The monarchs of Pegu, Siam, and Ava possess rubies of the greatest beauty, as the sovereigns of India had the finest diamonds. It is said that none equal to these are in the possession of European princes. The finest in Europe is said to belong to Mr. Hope. Rubies of ten carats are extremely rare; one weighing twenty-two grains sold for 160*l*. A perfect stone of six grains is rare, and falls little short of the value of a diamond; indeed, if some small rubies are very fine, they are of greater value than diamonds of the same weight. The natural crystal is in the form of a six-sided prism; it cleaves more readily than the sapphire, and is not so hard. It consists, according to Chenevix, of 90 parts alumina, 7 silica, and 1·2 of oxyde of iron.

6272. *But there is another stone, also sometimes called ruby*, which belongs to a different species, and is inferior in value and hardness. This is the *spinelle*, or *balais ruby*, which, when red or violet, has been called ruby; thus we have the Oriental ruby and the spinelle ruby. The crystallization of the spinelle is different from that of the sapphire, and, consequently, different from that of the Oriental ruby. It does not consist only of alumina, like the Oriental ruby, but contains also 8 per cent. of magnesia and 6 per cent. of chromic acid. It may be distinguished from the Oriental ruby by its inferior hardness and specific gravity. Its colour is usually some shade of red, as scarlet, cochineal, rose, violet, cherry, or yellowish red. When of a good colour, it is little less valuable than the Oriental ruby. Among lapidaries, the scarlet-red is sometimes called ruby spinelle; the pale or rose-red, the balais ruby. The red topaz has been called by the lapidaries the Brazilian ruby, and a variety of red quartz, Bohemian ruby.

Sect. III.—emerald.

6273. The emerald, in value, ranks next to the ruby. It is of a pure, beautiful, bright, and intensely green colour, when the stone is of the most perfect kind, called Oriental; hence the name *emerald green*. The colour, however, varies a little; sometimes it is paler, and the green less lively, or it is a pale blue, or yellowish. The form of its natural crystals is a six-sided prism, and it cleaves readily parallel to the axis of the prism. It is somewhat harder than quartz, but not so hard as beryl, though more difficult to cleave. Its composition, according to Vauquelin, is 64 parts silica, 16 alumina, 13 glucine, and 1·6 lime, glucine being the colouring matter. The finest emeralds come from Peru, where they have been found occasionally several inches in length. They are also found in Ceylon and Egypt; and in the latter country the ancients had emerald mines. A fine stone of four carats may be valued at 40*l.* per carat; and an inferior one, of one or two carats, at from forty to sixty shillings per carat. It is always cut by the lapidary into facets, and is frequently set surrounded by brilliants. Fine emeralds are extremely rare. The green tourmalin has been called the Brazilian emerald.

Sect. IV.—beryl.—aquamarine.

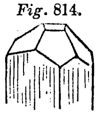
6274. The beryl is considered by some mineralogists to belong to the same species as the emerald; but it differs from it in hardness and composition, as well as in colour. The primary form of its crystals is a six-sided prism, terminated by a six-sided pyramid, truncated; and this is its usual form: the sides are striated longitudinally, whereas those of quartz, which its form resembles, are striated transversely, and it is harder than quartz. The crystals may be cleaved parallel to the planes of the prism, and more easily than those of the emerald. Its composition, according to Vauquelin, is 68 silica, 15 alumina, 14 glucine, 2 lime, and 1 oxyde of iron. The colour of the beryl is various shades of pale yellow, or green, or blue. The common beryl is scarcely employed in jewelry, on account of its numerous flaws and cracks.

6275. *The aquamarine* is a variety of beryl of a light, bluish, sea-green colour, of various shades. It derives its name from the Latin with reference to its colour. In hardness it is inferior to the topaz. Formerly it was of considerable value, but of late so many have been imported from Brazil, Siberia, and India, that their value is much reduced, except they are very fine. The best come from Ceylon. Large stones, from one to three or four ounces, are not uncommon. Small stones may be had for a few shillings each.

Sect. V.—topaz.

6276. The topaz is a particular species of mineral, occurring in crystals of the form of a rhombic prism, variously terminated (*fig.* 814). This prism is usually striated longitudinally. It cleaves readily at right angles to the axis of the prism. It somewhat resembles quartz, but is distinguished by the form of its crystals, by its superior hardness, and specific gravity. Both it and quartz scratch glass, but topaz scratches quartz. It is sometimes colourless and translucent, but usually has various pale shades of yellow, green, blue, lilac, or red. According to Vauquelin, it is composed of 50 parts alumina, 29 silica, and a quantity of fluoric acid, varying from 4 to 19 parts. It is found almost exclusively in the ancient primary rocks; and in Saxony, in a particular rock called Topaz Rock; these topazes are of a pale yellow. The Brazilian topaz is of a deep yellow, and becomes red or pink in a heated crucible, and then the price is augmented; it is also found there in rolled masses. Some from Brazil are beautifully pellucid, and are called *Minas Nova;* these have been abundantly employed in jewelry, and produce a fine refraction of light in pins and other ornaments. When topazes are naturally red, they have been called Brazilian ruby. There are also blue topazes, which have been called by lapidaries Oriental aquamarine. Yellow sapphires are by jewellers called, improperly, Oriental topaz; these nearly equal the diamond. Counterfeit pink topazes are sometimes made by interposing some colour between two thin plates of clear topaz, and then setting the whole; this fraud may be sometimes detected by holding the edge of the stone against the light, when the want of colour will be perceived. Similar impositions are practised with other stones. Various mineral substances, also, of other species, have been called topazes, and passed as such: thus, chrysolite has been called yellowish green topaz; yellow rock crystal, Bohemian or occidental topaz; and clove-brown and brown crystal have been named smoke topaz; all these are inferior in hardness to the true topaz. The topaz is easily counterfeited in glass paste; and some of the imitations are nearly as beautiful as the real stones.

Fig. 814.



Sect. VI.—chrysoberyl.

6277. This gem, called also *Cymophane*, is found chiefly in rounded pieces of a greenish colour, and somewhat opalescent; it is also found crystallized in prismatic forms, cleavable parallel to their sides. It is composed of 71·5 alumina, 18 silica, 6 lime, and 1·5 oxyde of iron. It is chiefly procured from Brazil and Ceylon. It has a particular play of light, and is so extremely hard that it has been sometimes taken for diamond. Good specimens are rare.

SECT. VII.—HYACINTH.

6278. This stone is sometimes, though rarely, of a brilliant appearance and colour, but is sometimes beautiful, of an orange-red colour, also of various tints of yellow, brown, or gray. When deprived of its colour by heat, it is said to have been sold for diamond. The best are from Ceylon. The *zircon* of Norway appears to be nearly the same mineral. The composition, which varies somewhat in different places, is about 70 per cent. of the earth called zircon, 25 silica, and 0·5 oxyde of iron. The form of its crystals is an octohedron. Except fine, this stone is not highly esteemed, being often full of flaws. The *jargon* of Ceylon seems to be a transparent, colourless variety, but it is not of much value.

SECT. VIII.—CHRYSOPRASE.

6279. This stone is rather rare, and is of a cloudy pale-green colour, having an agreeable appearance; it is translucent, and is nearly allied to the chalcedonies and carnelians; like them, it is never cut into facets, but is used for large bracelets, brooches, seals, &c.

SECT. IX.—CHRYSOLITE, OR PERIDOT.

6280. This is a stone found in volcanic rocks; and though of an agreeable colour, brownish, yellowish, or of various shades of green, yet having little brilliancy, it is little used in jewelry; it is sometimes made into necklaces, but is scarcely harder than glass, being scratched by the file. It consists of 43 parts magnesia, 39 silica, and 19 oxyde of iron.

SECT. X.—TURQUOISE.

6281. The turquoise is rare and much in request. It is destitute of the lustre which distinguishes most of the precious stones: it is opaque, and does not admit of a very high polish, but its colour is a fine celestial blue. There are two kinds of the substance called turquoise: one is a stone called *calaite*, and found chiefly in Persia, where it is in high estimation, and on that account few of the most beautiful specimens come to Europe; the other is fossil bone, coloured by phosphate of iron or carbonate of copper. The latter is liable to change in colour. The turquoise is cut spheroidal, and appears to most advantage when surrounded with brilliants or pearls. It is from the size of a pin's head to that of an almond. Malachite is sometimes sold for turquoise.

SECT. XI.—TOURMALIN.

6282. The tourmalin is occasionally used in jewelry. Common tourmalin is black and opaque, but there is a transparent precious kind, which is red, green, blue, or pink, and often sold for other stones. One of the most remarkable properties of the tourmalin is its becoming electric by heat or friction. The crystals of common tourmalin are often large, and scarcely employed by the jeweller.

SECT. XII.—MOONSTONE.

6283. The moonstone is a variety of feldspar called *adularia*, and is beautifully translucent, of a milky colour, and having a remarkable play of light, amounting to a slight pearly lustre, and sometimes iridescence, which contrasts agreeably with the delicate bluish tint of the stone, whence its name. It is used for ear drops and rings, and, when fine, sells for a high price. The best comes from Ceylon. It consists of 64 parts of silica, 20 alumina, 2 lime, and 14 potash.

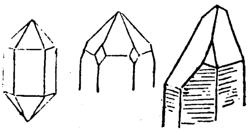
SECT. XIII.—GARNET.

6284. Garnet is a very common mineral, though beautiful specimens, called the precious garnet, or *almandine*, are classed with gems. These are usually of a deep red. The finest come from India. When large and of a fine colour they are valuable. They are much worn in beads, and are also set; they are chiefly used in mourning. What is called the Oriental is brought from Sirian, in Pegu, improperly called by lapidaries Syrian garnets. They appear to be the carbuncle of the ancients. There is also the Bohemian garnet, which is the *pyrope* of some mineralogists. Common garnet, not fit for jewelry, being ill-coloured and opaque, or only slightly translucent, is, in many countries, quite common, and is even used as a flux for ores. There is also the *melanite*, or black garnet, found in volcanic rocks, and worked into necklaces at Naples; but black glass is not unfrequently made to pass for it to English travellers. Garnet consists, according to Vauquelin, of 43 parts of silica, 16 alumina, 20 lime, and 16 oxyde of iron. Some, as the large common garnets of Fahlun, have no lime. The primary form of the crystals is the rhombic dodecahedron. They usually occur in the most ancient rocks: some are found in this country, and particularly in Cornwall. Garnets are hard enough to scratch quartz, and, of course, much harder than glass, by which glass counterfeits may be easily distinguished by means of a file.

SECT. XIV.—ROCK CRYSTAL—TRANSPARENT QUARTZ.

6285. This stone is sometimes quite colourless, and beautifully transparent; it is also occasionally, though rarely, yellow like topaz; but it is softer than topaz, and of a different crystalline form in its natural state. The form in which quartz usually occurs is a six-sided prism, terminated by a six-sided pyramid, as *a*, *fig.* 815, or modified, as *b*, by having some of the angles truncated. Superb groups of crystals are brought from Dauphiné, and are sometimes seen upon the mantel-piece. These generally have the sides of the pyramids very unequal in size, as *c*. In quartz crystals, faint striæ may be seen, which are at right angles to the sides, and these serve to distinguish them from the crystals of other substances of nearly a similar form, but which have striæ parallel to the length of the sides. It is sometimes found of a light brown, called *smoky quartz*, as in the *cairngorum* stones used for seals, so called from being found on a hill of that name in Scotland. Small rolled pieces of rock crystal are frequently found in the sand of various places, as at Bagshot in the vicinity of London, which, from their scratching glass, as all rock crystal does, and taking a fine polish, are called *Bagshot diamonds*. Rock crystal, when colourless, is worked into many forms for different purposes, though seldom used in jewelry, except when it is coloured or set in foil. Large pieces are cut for the glasses of spectacles, called *pebble spectacles*, which are much less easily scratched than any glass.

Fig. 815



6286. The stone called *cat's eye* is a variety of rock crystal enclosing amianthus. It comes chiefly from Ceylon; its colour is light gray, and it presents a peculiar luminous appearance resembling the eye of the animal from whence it receives its name. A very rare variety of it is of a dark green. It is usually cut hemispherically.

SECT. XV.—AMETHYST.

6287. There is the same confusion respecting stones of this name as with others we have mentioned. The amethyst of modern mineralogists is merely a violet-coloured quartz or rock crystal; but what has been called Oriental amethyst among jewellers is a violet-coloured sapphire, which is a stone of great beauty and value. The colour of the common amethyst is purple, of various shades and degrees of intensity; those which are of the deepest purple are the most precious, but the depth of the tint varies much, being in some scarcely perceptible, when the stone is of scarcely any more value than rock crystal. Amethysts are found in many countries; but of late many have been brought from Brazil, and some of considerable size. They are much used in bracelets, seals, and similar ornaments.

SECT. XVI.—AVANTURINE.

6288. The avanturine is a beautiful and curious stone, appearing like a translucent crystal, having gold dust interspersed through it; but these sparkling grains consist of mica, and the stone itself consists of quartz. It is employed for snuffboxes and other larger ornaments. Fine specimens are rare. An artificial avanturine is made extremely beautiful: it is glass enclosing minute crystals of metallic copper.

The *sun-stone* is a beautiful variety of avanturine, having a bright, flame-like colour. It is used in jewelry, and is rare.

SECT. XVII.—OPAL.

6289. This stone is a very pure kind of flint, and differs from chalcedony chiefly in its lustre and colour; but the difference cannot easily be expressed in words. There is the *precious opal* and the common opal: the former exhibits a remarkable play of prismatic or iridescent colours—blue, red, and yellow, green, &c. These colours are sometimes, in fine specimens, intensely bright and beautiful; sometimes the stones exhibit only one colour. It is always cut hemispherically, and it is often full of flaws, which only adds to its beauty from increasing the vivacity of the colours. When fine, the precious opal is of great value; it is brittle, and softer than rock crystal. Common opal has not any iridescent play of colour, and is seldom employed in jewelry. The red opal is called *girasole*.

SECT. XVIII.—CHALCEDONY, AGATE, AND CARNELIAN.

6290. These stones are placed together because they are all varieties of the same thing. *Chalcedony* is a sort of very pure flint; but, instead of being perfectly clear and transparent, it is tinged, more or less, with a milky hue. When chalcedony has in it various curved parallel bands or stripes of a white or other colour, it is called *agate*.

Fortification agates are those which have zigzag parallel bands, generally of white and gray, having a distant resemblance to the plans of a modern fortification. They are frequently found in Scotland, particularly in Aberdeenshire, and hence are often called *Scotch pebbles*. They are also plentiful on the banks of the Rhine. In the centre of these agates there are sometimes rock crystals and amethysts. Sometimes, instead of these bands, there are minute metallic crystallizations resembling mosses, and which have been, though erroneously, supposed to be really vegetables; these are termed *moss agates*. Those are most valuable which resemble very closely some plant. *The onyx* is a variety where the bands of different colours are perfectly straight, the stone consisting of several flat layers, whereas in agates the layers are curved. Onyxes were much used by the ancients for making cameos; a figure was produced by cutting away a part of the white layer, the remaining part constituting the figure appearing as if laid upon the darker layer. *Carnelians* are nearly allied to chalcedonies, but are of a reddish colour. Agates, chalcedonies, and carnelians are very hard, take a fine polish, and are extensively used for ornaments, such as bracelets, seals, rings, and other purposes where large stones are admissible. They are likewise employed for making cups, handles for knives and forks, sword hilts, smelling-bottles, snuffboxes, &c. At Oberstein, near the Rhine, where these stones are found abundantly, they are cut and polished on a considerable scale by means of machinery moved by water, and the expense of manufacturing them is thus very moderate. The finest antique gems are engraved on stones of this class.

Sect. XIX.—Malachite.

6291. Malachite is sometimes used for necklaces and bracelets: it is of a fine green, and consists of carbonate of copper; it is opaque, and never cut in facets. It is not very valuable.

Sect. XX.—Jet.

6292. Jet is well known to be of a deep black, and is used for necklaces, chiefly worn in mourning. It is a kind of coal, or, rather, fossil wood, and costs little more than the expense of cutting; it is made into beads, snuffboxes, and other trinkets. Cannel coal is sometimes substituted for it, but this is very inferior.

Sect. XXI.—Amber.

6293. This is a well-known transparent mineral substance, of a yellowish colour, and is supposed to be a fossil resin. Its original situation is in beds of fossil wood called lignite, and it is sometimes procured by mining operations conducted expressly for this purpose; a great quantity is also collected on the seashores in various countries, having been washed out of its native beds by the action of the sea. The greatest abundance is met with on the shores of the Baltic, particularly in Pomerania. Fine amber is employed in making various ornaments and trinkets, as beads, heads of canes, mouthpieces for tobacco-pipes, &c., for which purpose it is easily cut, and takes a beautiful polish. The Oriental nations prize amber much more than the people of Europe. Occasionally insects are found in pieces of amber, which have been enclosed while it was in a fluid state. Amber may be dissolved by drying linseed oil, to form amber varnish.

Sect. XXII.—Pastes, or Imitations of the Gems.

6294. All the gems may be imitated in coloured glass, called *pastes*, so nearly as to deceive all except those who are much accustomed to the examination of real stones; but in hardness they are much inferior. To determine whether a substance be a diamond or a paste, apply a fine file to the girdle; paste is easily cut by the file, which can make no impression on a real diamond: also, the girdle of a real diamond will scratch any other stone, as the white topaz, which is not the case with pastes. Certain optical principles discovered by Dr. Brewster will enable those who understand them to discriminate real gems from artificial imitations, even if they are set, without unsetting the stones; but they are too complicated for this place.

The following receipts for imitation pastes are not given so much to teach the art of making them, which requires considerable skill, as to give general knowledge on the subject. It is scarcely necessary to mention that these pastes are to be cut by the lapidary.

6295. *To imitate gems in paste*, first, a perfectly colourless glass is prepared of silex, potash, borax, oxyde of lead, and sometimes arsenic. This is called *strass*, and to it various oxydes of metals are added to produce the desired colours.

For the colourless diamond: 3 ounces of rock crystal, 8 ounces of white-lead, 2 ounces of borax, ½ grain of manganese.

For the yellow diamond: to 1 ounce of strass, as above, add 24 grains of chloride of silver, or 10 grains of glass of antimony.

For the sapphire: to 24 ounces of strass add 2 drachms and 26 grains of the oxyde of cobalt.

For the Oriental ruby: to 16 ounces of strass add a mixture of 2 drachms and 48 grains of the precipitate of cassius, the same quantity of peroxide of iron, prepared by nitric acid, the same quantity of golden sulphuret of antimony, and of manganese calcined with nitre, and 2 ounces of rock crystal. Manganese alone, combined with the base in proper quantity, is said to give a ruby colour.

For the emerald: to 15 ounces of strass add 1 drachm of mountain carbonate of copper and 6 grains of glass of antimony; or, to 1 ounce of strass add 20 grains of glass of antimony and 3 grains of oxyde of cobalt.

For the topaz: to 10 lbs. of strass add 1½ oz. of calcined iron.

For the garnet: to 2 lbs. of strass add 2 lbs. of glass of antimony and 2 drachms of manganese.

Sect. XXIII.—Pearls.

6296. Pearls are precious, and form beautiful ornaments highly prized. They are calcareous bodies, of the same nature as mother-of-pearl, only purer, found in the inside of certain shells, particularly a large one, called the pearl oyster (Mytilus margaritiferus, Linn.). The history of pearls is so curious that it may demand a rather detailed account. The pearl shell, the inside lining of which constitutes the *mother-of-pearl*, is found only in warm climates. The shell sometimes grows to the size of seven or eight inches in diameter, is of a flattened and roundish shape, brown on the outside, but the inside entirely covered with mother-of-pearl. The pearls are found either loose in the body of the animal, or attached to the side of the shells, and they are supposed to be concretions of calcareous matter arising from some irregularity or disease in the animal. These shells are extremely abundant near the shores of some of the East India islands, and particularly Ceylon, where the chief pearl fisheries have been established. The shells are brought up by persons who have learned to dive for them to great depths. They descend to the bottom of the sea from five to ten fathoms in depth, assisted by a large stone, which they carry down with them; and, being furnished with a basket, they collect, with as much expedition as possible, such shells as happen to lie about the spot of their descent, continuing their search for about two minutes; when, according to a signal which they make to the boat to which their cord is attached, they again ascend with their treasure. Each diver will bring up as many as one hundred shells of various sizes, and some, from long habit, acquire the power of remaining under water for five or six minutes. It is not every shell that affords pearls: some contain only small ones of little value. The largest and roughest shells generally have pearls of the greatest number and largest size. Pearls are not cut and polished by the lapidary, but are worn in the state in which they are found, being only drilled for the purpose of stringing them, and are valued according to their size and beauty. The finest are of a clear white, and very translucent: those which have a tinge of yellow are less precious.

The price of pearls increases as the square of their weight; thus, the price of a pearl of one carat being settled at 8*s.*, to find the price of a pearl weighing six carats, first find the square of 6, viz., 36; which, multiplied by 8, gives 288*s.*, or £14 8*s.*; but the value of pearls depends also much upon their quality. It is a curious fact that the Chinese know how to force the shell-fish to produce pearls. They drill holes in the shell, and the animal, to secure itself from the depredations of marine insects that attack it, secretes the pearly juice to close up the aperture, and forms a pearl over it; but the most perfect pearls are those only which, being quite detached, are found globular in the body of the animal.

Though pearls are found of the largest size, greatest beauty, and most abundantly in the shell we have mentioned, yet they are not confined entirely to these: common oysters and muscles occasionally contain small pearls; and a fresh-water shell called a *unio*, or *pearl-muscle*, is particularly remarkable for the pearls it contains. It is found in various parts of Britain, but a regular pearl fishery of this shell has been long established on the River Conway in North Wales. The people there go out at low water and gather a number of these large muscles, which they boil, and beat the fish to a pulp; they then separate the pearls by mixing this with plenty of water. The pearls are not fine, and are small: they are of the kind called *seed pearl*, which are used for sewing on various parts of dress, and similar inferior purposes.

Pearls have been employed as ornaments from the earliest ages. In the time of Job they were accounted of great value. The story of Cleopatra drinking a valuable pearl dissolved in vinegar is well known, and may possibly have been true, since this substance, from its calcareous nature, is soluble in any acid. Before being drank the solution might have been diluted with water; and it would only have affected her as so much chalk in vinegar would have done.

6297. *Artificial pearls* were invented by a French bead-maker, of the name of Jacquin, about the time of Henry IV. This man observed that, on soaking and washing the scales of the fish called the bleak, a most beautiful silver-coloured powder was obtained; and it occurred to him that, by introducing this substance into the inside of finely blown glass bulbs, slightly tinged with opaline hues, a perfect imitation of real pearls might be made. The experiment succeeded, and these pearls came much into fashion for necklaces, ear-drops, &c., and continue still to be manufactured in Paris by the descendants of the original inventor, as well as in other parts of Europe, for various parts of dress. The silvery powder is fixed upon the inside of the thin glass globules by gum; and, if necessary, the hollow is filled up with wax. It is said that white bait affords a still more beautiful powder; and roach and dace have been tried, but they are inferior

So great was the demand formerly for these ornaments, that the price of a quart of fish scales was from one guinea to five. The price of real pearls has fallen much since this invention, which imitates them very exactly.

SECT. XXIV.—CORAL.

6298. This beautiful material, of a fine red colour, is the production of minute insects that inhabit the sea, and which consist of a fleshy substance, surrounding a solid, calcareous body, which is called the coral. The species of red coral, used for ornaments, in form resembles a small branched shrub, and is attached to rocks at the bottom of the sea, from whence it is taken by divers. The finest coral is found in the Mediterranean; it is procured on the coast of Provence, and there is a considerable manufactory of necklaces, crosses, and other ornaments of this substance at Marseilles.

SECT. XXV.—VARIOUS ORNAMENTS.

6299. *With respect to the various articles made by the jeweller as ornaments in dress*, or the infinite variety classed as trinkets, their description would far exceed the limits of this work. The most important of the former are *necklaces*, which are made of gold and gems, pearl, beads of stones or coloured glass, satin spar, amber, jet, or coral: *bracelets* are formed of gold, or velvet with clasps of gold, or copper gilded, plain, or set with stones, cameos, or other ornaments. The term *cameo* is applied to gems or stones worked in relievo; that is, where the objects represented are raised above the plane of the ground; but the stones on which the objects (generally figures) are cut consist of several layers of different colours, of which the most valuable are the Oriental onyx in black and white parallel layers, and the carnelian in brown and white. Some are cut on agates, and some stones of four layers of different colours. The ground is of one shade, and the relief of another. Antique cameos are valued at an immense price; and some modern Italian cameos are extremely fine; a single cameo of a good brooch size will sometimes cost twenty pounds. They are worked by a lathe and pointed instruments of steel, with diamond dust. A cheaper kind of cameos have been made lately, cut from large shells found on the African and Brazilian coasts, which have two layers, the ground being either a pale coffee colour or a deep reddish-orange; the latter is preferred. Copies from the antique are made in this manner, in Rome, of exquisite finish; and some very good are now done in this country. A cheap imitation of cameos is also made in glass enamel. *Earrings* are of gold, or copper gilded, plain, or with gems, or pebbles; the gold is made remarkably thin, for lightness, as well as on account of the expense. To these may be added *brooches* and ornamental pins, together with various ornaments for the headdress; also *rings*, which are plain hoops of gold, or with gems, as single stones, or in clusters varied in numerous ways, or with engraved stones, antique or modern. All those in gold are now so successfully imitated in gilded brass, that it is difficult to distinguish the latter from the precious metal.

BOOK XXII.

ECONOMY OF THE LAUNDRY.

6300. *Under the title of this branch of domestic economy, we propose to take an extensive view*, not only of the ordinary processes of what are termed "washing and getting up linen," but likewise of the theoretical principles upon which complete success depends, and likewise to give a short description of the nature and manufacture of the materials employed. In addition, we shall treat of the art of scouring, which, though it does not strictly belong to the ordinary business of the laundry, yet is intimately connected with it, and materially elucidates the modes of managing the restoration to a condition fit for use of the various articles of wearing apparel and furniture; confining ourselves, however, to such facts as are useful to be known in domestic economy, and omitting those which concern the manufacturer only.

6301. It is unnecessary to remark upon what is so well understood, the importance to health and comfort of cleanliness in dress and furniture; and custom now demands, not only that this shall be effected in the requisite degree, but that it shall be made apparent by the purity of their colour and appearance. We shall begin by explaining in a general way the rationale or theory of ordinary washing, or, in other words, the reasons why soap and other detergent substances are generally used.

CHAPTER I.

THEORY OF WASHING.

6302. The primitive mode of performing this operation, before *detersive* or cleansing substances were known, was, no doubt, washing clothes in simple water, and this method is still practised in many countries. The Hindoos carry their clothes to the

Ganges, where they undergo the necessary purification in water alone. But this requires much labour; and to remove with greater facility the discoloration of linen occasioned by being worn, which is partly of an oily nature, and therefore very difficult to destroy by water only, certain substances, called *detersive*, have been introduced, which assist in the process. Of these the principal one is soap; and it is requisite that we shall first take some notice of this material, and show in what manner it is so efficient.

6303. *It is well known that oil or grease is not soluble in, and will not unite with, water*; a greasy spot cannot be washed out completely by water only, unless such a degree of rubbing be employed as will injure the cloth in some degree. But if oil be united to an alkaline substance, the mixture of the two is soluble in water; hence, if the greasy spot be touched with an alkali, as potash or soda, the latter will unite with the grease or oil, which being then soluble in water, rubbing in that fluid, or washing, will cause it to disappear. If, then, soiled or greasy linen be washed in water containing potash or soda, the labour of cleansing is much less than with water alone, and the fabric, not being necessarily subjected to so much rubbing, suffers less wear.

6304. *All the ashes of burned vegetables contain more or less of the alkali called potash*; hence wood ashes was one of the most ancient detersive substances, and is still occasionally employed for that purpose. But alkalies, when used alone, have this inconvenience, that, although they are extremely effective, yet, if employed in too great a quantity, they are capable of corroding the clothes to be cleansed, and likewise of acting in the same manner on the hands. The difficulty of regulating properly their strength has led to the invention of soap, which consists of alkali already united to a certain proportion of oil or fat of some kind, by which its power of corrosion is so much diminished as not to destroy the texture of the fabric; and yet the alkali in the soap is capable of taking up a little more oil or grease, such as may be found in soiled linen; and that is likewise converted into soap. Now all soap being soluble in water, the whole of the impurities may be thus removed by rubbing the linen between the hands in that fluid. In fact, then, in employing soap for washing, we make more soap, though the newly-formed material is in very minute quantity, and does not become solid. Soap is not necessarily solid; if oil and any solution of alkali in water be mixed in a small vial and shaken together, liquid soap will be the result. Soap is made solid by certain processes of the manufacture, on account of the greater convenience in using it, than if it were in the liquid state. It will be easy to perceive, from this explanation, that the strongest soaps have the most alkali in their composition, since it is by the abundance of this ingredient that the cleansing effect is produced; and it will likewise be evident why soaps of different degrees of strength are suitable for different purposes. It may here be observed that there are other detersive substances besides soap, as wood ashes, and other things containing alkali. Various clays, and fullers' earth, have a similar effect, but produced in a different manner than it is from soap; by their absorbent quality they attract the oily particles from the cloth, and cause them to be more easily removed mechanically by rubbing in water, but no chemical union is thus formed, as in the case of soap.

CHAPTER II.

DESCRIPTION OF THE VARIOUS KINDS OF SOAP AND OTHER MATERIALS USED IN WASHING, AND OF THE INGREDIENTS OF WHICH THEY ARE MADE.

6305. It being useful that the nature of soap should be well understood by those who superintend the business of the wash-house, we shall first describe the alkalies employed in its composition, and which are occasionally used alone as detergents; and we shall afterward explain, in a general way, the manufacture of the soaps.

SECT. I.—POTASH AND PEARLASH, ETC.

6306. *We have stated that the ashes of burned vegetables* are often used for the same purposes as soap, in places where the latter substance is unknown or cannot be procured, and that they owe their detergent property to the same cause as soap, namely, the alkali which they contain. Their employment in this way was known to the ancient Egyptians, Greeks, and Germans. Pliny informs us that the Gauls were the inventors of soap made of tallow and wood ashes: a soap-boiler's shop has been discovered in Pompeii. In every vegetable there is a little alkali, though always in a state of combination, and some have a much larger proportion than others. When the rest of the vegetable substance has been dissipated in consequence of combustion, the alkali remains in the ashes, from which it has been termed *fixed* alkali, in opposition to ammonia, or the volatile alkali; it is also sometimes termed the vegetable alkali. Wood ashes are frequently employed in scouring paint that is very dirty, or for similar coarse purposes; but it must be observed that it should be employed cautiously, since, if too much be used, it would take off the paint itself. Good housewives understand the value of this material that comes from heating the brick oven in baking bread; it is also employed by them in scouring the wood-work of the kitchen, as floors, tables, &c.; likewise for cleaning the lids and insides of sauce-pans, for which it answers instead of potash. It is also very useful to soften hard water, and to make a *lye* for washing.

6307. *The simplest and rudest preparation of potash* is called *ash balls* in England, and *weed ash* in Ireland. It cannot be said to be properly an article of commerce, although a considerable quantity is annually made by the peasantry of both countries, and disposed of among the neighbouring farmers and bleachers. The vegetable from which, in England and Scotland, this impure alkali is produced is the common fern or brake (*Pteris aquilina*, Linn.). Many rough and heathy districts are entirely covered by this plant, which, when it has attained its full growth, about the middle of July, is cut down, and, after being half dried in the open air, is gathered into small heaps and kindled. The combustion proceeds slowly, being accompanied by a smothering smoke, and little or no flame, till the whole is reduced to a reddish-gray ash; this being carefully collected, is sprinkled with a little water, and then moulded by hand into balls three or four inches in diameter, which, when they have acquired a certain solidity by drying in the sun, are ready for sale. In Ireland, thistles, docks, and weeds of all kinds are mixed with the fern, and the ashes are disposed of in their loose, pulverulent state, without any farther preparation. One thousand parts of fern, cut in August, and thoroughly dried, afford thirty-six parts of ashes, from which are obtained about four parts of alkali. The common weeds do not give so much.

6308. *The crude potash of commerce, or black potash,* as it is also called, is universally procured from the combustion of wood, and therefore its preparation can be undertaken with success only in those uncleared countries where there are vast natural forests, and where, from the badness of the roads, and imperfection of water communication, the value of timber is no more than that of the labour required to fell it. The only districts of Europe in which any considerable quantity of potash is made are the mountainous forests of Germany, and the extensive woodland tracts of Poland and Russia. The British market, however, is principally supplied from the United States of North America, a country in which, from its rapid increase of population, there is a constant demand for cleared land for the purposes of agriculture, and, consequently, where timber is looked upon rather as an encumbrance than as contributing either to the beauty or value of the ground on which it stands.

6309. *The American method of making potash* is to pile up the wood, as soon as it is sufficiently dry to burn, in large heaps, and reduce it as quickly as possible to ashes; these ashes are then put into a wooden cistern, with a plug at the bottom of one of the sides, and a quantity of water sufficient to make a strong lixivium is added; after standing for an hour or two, the plug is withdrawn, and the water holding the potash in solution runs out, leaving the earthy part still impregnated with some alkali in the cistern. This solution is then evaporated to dryness in iron pans or pots (whence the name potash), and hastily fused into compact reddish masses of semi-caustic potash, in which state it is fit for the market.

6310. *The common potash* of the north of Europe is the impurest of all, containing nearly one half its weight of earth, and is thus prepared: A large pit is dug, into which is thrown burning brands and the smaller extremities of the branches, and when the whole is well kindled, the pit is filled up with logs and other large pieces, which at length, though very slowly, are reduced to ashes. The coarser part of the ashes is then separated by sifting from the finer; all the alkali that it contains is procured by lixiviation, and this liquor is mixed with the remainder of the ashes, and wrought into a paste. A pile is then built of wood, the interstices of which are filled with this paste, which being set fire to, the whole is reduced to ashes. This process is repeated several times, till the ashes begin to clot and become hard; the most compact pieces being then selected, are packed up for sale, without any farther preparation; the rest are lixiviated and boiled down to dryness in the usual manner. All the potash we have from Russia, Sweden, and Dantzic is made in this manner. The Russian is the best of these; it is brought to us in large lumps, very hard and black, incrusted here and there with a white salt. When dissolved in warm water, it deposites a sediment of a blackish-gray colour, and the lixivium has a sulphurous smell, bitter taste, and a dark green colour.

6311. *Potash may be made from potato leaves and stalks* thus: cut off the stalks when the leaves begin to fall, spread them out and dry them thoroughly in the sun. Dig a hole about four feet in diameter and one foot deep in the ground, in a dry place; make a fire with the dried stalks in this pit, and continue feeding the fire with them till the whole is consumed; put the ashes into a vessel with water over the fire, and boil them; the potash being soluble, will be extracted by the water, and form a lye; pour off this lye, and evaporate the water by boiling; in the bottom of the vessel, when the water is gone, the potash in an impure state will remain as a grayish substance. To destroy the impurities, calcine it in an iron pot, to burn off all the charcoal and other substances mixed with it. The potash will now remain in the usual state of purity of common potash. Potato leaves give a larger quantity of alkali than most vegetables.

6312. *A very simple but rude method of effecting the evaporation of the water from the lye* is practised in some places. They place a tubful of the lye near the clean hearth of a chimney, in which they dip a handful of loose straw; the straw, thus containing a quantity of the lye, they carry as quickly as they can to a blazing fire made upon the hearth, which first dries and then consumes the straw to ashes, thus evaporating all the water from the alkali in the lye. They then prepare, in the same manner, another parcel of straw, by dipping it in the lye, and consume it as the other; and this they repeat till all their lye is expended. By this means the ashes of the straw, that of the fuel, and the alkali of the lye are left on the hearth mixed together, and they concrete the whole into a hard, solid cake, of a greenish-black colour, which they scrape off and sell for potash, but it is unfit for many purposes, and not above half the value of the foreign.

6313. *The proportion of ashes afforded by different vegetables, and that of alkali by each vegetable*, has been accurately attended to, on account of its great importance in the arts. Kirwan gives the following statement:

	lbs. of ashes.		lbs. of alkali.		lbs. of ashes.		lbs. of alkali
Stalks of Turkey wheat, or maize	88·6	and	17·5	Oak	13·5	and	1·5
Sunflowers	57·2	—	20	Aspen	12·2	—	0·74
Vine branches	34	—	5·5	Beech	5·8	—	1·27
Common nettle	10·6	—	25	Fir	3·4	—	0·45
Box	29	—	2·26	Fern, in August	36·46	—	4·25
Sallow	28	—	2·85	Wormwood	27·44	—	73
Elm	23·5	—	3·9	Fumitory	219	—	79

From an inspection of this table, it appears that, in general, weeds or succulent herbaceous plants yield a much greater proportion, both of ashes and alkali, than the shrubby and ligneous ones; but it must be observed that, as all the plants were reduced to a state of dryness before they were weighed, it required a much greater quantity of the former.

Kirwan makes the following remarks upon the processes for extracting potash from plants. The weeds should be cut just before they seed, then spread, well dried, and gathered clean. They should be burned within doors, on a grate with a brisk fire, and the ashes laid in a chest as fast as they are produced. Any charcoal found mixed should be picked out. They should be lixiviated with twelve times their weight of boiling water, and the lye thus formed is to be evaporated in iron pans, from which the term potash is derived.

6314. *Among other methods of procuring potash, one deserves to be noticed*, discovered by Mr. Birch, a bleacher at Manchester. He evaporated a large quantity of dunghill water to the consistence of treacle, and then burned the residuum in an oven, and from this he procured potash, which he employed in the operation of bucking. From a quantity of muck-water equal to twenty-four pipes full, the quantity of ashes made was 9 cwt. 1 qr. 12 lbs., valued at two guineas per cwt. In the manufacture of the potash in this manner, there was a profit of £15 4*s*., allowing for all the expenses. This alkali appears to have been formed by the process of putrefaction.

6315. *Pearlash* is a much purer state of the alkali, prepared from the crude potash. For this purpose, the potash is broken down into moderately small pieces, and is spread upon the floor of a reverberatory furnace, where it is kept hot, but not melted, for an hour or two, stirring it occasionally with an iron rake, until all the carbonaceous and colouring particles are burned out, and there remains behind a dry, porous, and considerably caustic salt, extremely deliquescent, which, from its bluish-white colour, is called *pearlash*.

6316. *Both potash and pearlash differ considerably in their strength*, as in the quantity of alkali which they contain: a circumstance of considerable importance to the manufacturer, who finds great difficulty, in consequence, of fixing accurately the value of any quantity. An analysis of any one piece would not give that of the whole parcel, as the proportion of the impurities is quite irregular. Mr. Kirwan gives an analysis of Dantzic pearlash, which may serve at least to give a general idea: Pure potash, 60·3; carbonic acid, 22·4; water, 7·2; sulphate of potash, 8·7; muriate of potash, 0·7; earth, 0·7 = 100·0.

SECT. II.—SODA.

6317. *Soda* was formerly called the *mineral* or *fossil* alkali, because it was dug out of the earth. The use of soda was familiarly known to the ancients, and abundance of it in a native state, called *natron*, was found in Egypt. It is now known to occur likewise in the vegetable kingdom, and the base of it, called sodium, is one of the components of common salt; indeed, a great part of the soda that is employed in this country is obtained from the latter source. While the vegetables that grow in common soil yield potash, those which flourish in salt-water, or on the seashore, or wherever the soil is impregnated with salt, yield soda by incineration, this alkali having existed in the plants when living, in consequence of their situation

There are two substances manufactured from which vegetable soda is procured, *barilla* and *kelp*.

6318. *Barilla is the richest in soda*, and comes chiefly from Alicant in Spain, from plants of the genera Salsola and Salicornia, which are cultivated for that purpose very extensively in the *huerta* of Murcia, and other places on the eastern coasts of Spain. The plants are sown in light, low soils, that are embanked on the side next the sea, and furnished with flood-gates, by which the salt-water may be admitted occasionally. In autumn, when the seeds are ripe, the crop is cut down and dried; the seeds are rubbed out, and the rest of the plant is burned in very simple furnaces, the temperature of which is just high enough to cause the ashes to enter into a state of semi-fusion, and to concrete into compact cellular masses. The barilla is of a grayish-blue or brownish colour, covered over with a saline efflorescence when exposed for some time to the air; it is exceedingly hard, and of a pungent alkaline taste. Barilla is also manufactured in Sicily and Teneriffe, but it is inferior to that of Alicant and Carthagena. The best barilla sometimes contains 20 per cent. of soda.

6319. *Kelp is much more impure than barilla*, containing only from two and a half to five per cent. of soda. It is made from what is vulgarly called sea-weed, chiefly of those leafy marine plants called *fuci*, which grow on the rocks in the sea, between the high and low water mark. These plants are cut down in the summer season, dried, and burned in shallow pits made in the ground, and, when care is used, in furnaces for the purpose. The combustion is kept up by throwing on a little at a time of the dried plants; and when a certain quantity has been consumed, the ashes are stirred about with an iron rake till the whole, in partly a liquid or pasty state, concretes together. When cool, the mass is broken up, and constitutes the kelp. Well-made kelp is of a bluish-gray colour, is rather cellular, and contains a good deal of charcoal from the half-consumed plants; its taste is alkaline and salt. It is rather tough, but not so hard as barilla. Kelp is much employed where soda is wanted in making glass and soap; also in bleaching, &c. Some years back a great deal of kelp was manufactured on the British shores, and formed a considerable source of wealth to the proprietors, but at present its price has very much decreased, from the great superiority of barilla and the mode of obtaining soda from salt.

6320. *The soda is extracted from barilla or kelp* by dissolving them with boiling water and filtering the solution, which is thus evaporated; by this crystals of carbonate of soda are obtained, from three to five ounces being procured from 1 lb. of barilla.

It must be observed that, though the carbonate of soda procured in this manner is sufficiently pure for many purposes in the arts, as in bleaching and washing, making soap, glass, &c., it is not so for the purposes of medicine, as it always contains more or less of the sulphate and chloride of potassium and sodium, from which it cannot be easily separated. The purest carbonate, used for pharmaceutical purposes, is made from sulphate of soda procured from a different source.

6321. *Large quantities of carbonate of soda are now made by decomposing common sea salt*, which consists of chlorine and sodium, and is called, chemically, chloride of sodium (formerly, muriate of soda). By applying sulphuric acid to this salt, the sodium is changed into soda, quits the chlorine to join the sulphuric acid, and thus sulphate of soda is obtained. This, by other processes, is decomposed, and the soda liberated, and procured in a free state; which is a modern discovery, in consequence of which soda is not a third of the price it was formerly.

6322. *The alkalies potash and soda, when in a state of perfect purity*, and not combined with any other substance, are of a highly caustic nature, that is, they powerfully corrode animal and vegetable substances; hence, although they would readily unite with oil or grease, so as to make it soluble in water, yet they would entirely destroy the texture of cloth, linen, or any similar substance, and therefore could not be used as detergents in that state.

6323. *But when these alkalies are united with carbonic acid*, and are thus converted into *carbonates*, they are rendered much less caustic, and, although they will still render grease soluble in water, yet they become so mild that they will no longer act powerfully upon the texture of cloth, and may then, in moderate quantity, be used with safety as detergents. Hence it is that in this state alone they are employed in washing, bleaching, scouring, &c.

6324. *Carbonate of soda is far preferable to carbonate of potash* for these purposes, because it is much less acrid, and is not so apt to injure the texture of linen goods as potash. It is, accordingly, much more extensively employed, particularly since means have been discovered of preparing it so cheap as to supersede pearlash almost entirely.

CHAPTER III.

ON SOAP.

6325. *The most usual and the most convenient mode of employing the alkali for the purposes of washing is when made into soap*, the action of which has been already explained. *The various kinds of soap* are made of one or other of the fixed alkalies, potash or soda, combined with fat or oil. We explained above that it is the alkali which gives to soap its detergent quality, and which renders it soluble in water. The tallow serves to moderate the sharpness of the alkali, and to prevent its injuring the hands of those who use it.

6326. *There are two principal varieties of soap, hard and soft.* The former is made of soda and tallow or oil, and the latter of potash and similar oily matters. When tallow and soda alone are employed, the soap is white; hence it is usually termed *white* soap; but, to lower the price, in forming *yellow* hard soap, a considerable portion of resin or palm oil is mixed with the tallow. When potash is mixed with tallow or oil, the resulting soap does not assume a solid form, and its consistence is never greater than that of hog's lard: this makes the *soft soap*, the detergent properties of which are nearly the same as those of hard soap, but it is not so convenient for general use.

6327. *Common hard white soap is made in the following manner:* The alkali employed is soda, procured from barilla or kelp. In order to cause the alkali to unite with the fat, oil, or tallow, to make a soap, it is necessary that the former should be in a caustic state instead of that of a carbonate, and to this end it must be deprived of its carbonic acid. To effect this, the barilla or kelp is pounded, and mixed with one fifth of its weight of fresh quicklime in a large vat, and some water is then sprinkled over it to slack the lime, which then falls into powder, and the alkali is mixed with it by means of a shovel; the quicklime then attracts the carbonic acid from the alkali, which is consequently left in a caustic state. After standing for several hours, till this is completed, some water being added, the liquid, containing the caustic soda in solution, and now termed a lye, is drawn off. More water is then put on the alkali, and is drawn off as a secondary lye. The tallow or oil is next put into a boiler, and, when it is quite melted, the lye is gradually added, and the mixture is kept constantly stirred. The alkali and oil soon begin to unite into a milky fluid, and as more lye is added, this liquid thickens. In about thirty hours it is found that the consistence is sufficient, and then a quantity of common salt is added, to cause the water to separate from the soap and to harden the latter, which floats at the top. The fire is now withdrawn, and the mass left to cool. The watery part found at the bottom is removed by a pump. When this has been effected, the fire is rekindled, and the soap is remelted, and agitated with wooden poles, until it has acquired the consistence proper for lading into square moulds, in which the soap, after it has set and become solid, is cut into the proper shapes by a piece of brass wire. It is to be observed that, of late, the boiling is often performed by means of steam. Manufacturers vary a little in the details of their process and in the proportions of their materials. The lime which was added was only for the purpose of robbing the alkali of its carbonic acid, and therefore does not enter into the composition of the soap. In the south of Europe, where the olive grows, olive oil is used for making soap instead of tallow.

The soap itself is a compound of pure alkali with oil, fat, or tallow, and a portion of water. The very hard soap, made with all soda, is not the most convenient for use; it is neither so fit for washing the hands, nor so easily reducible to the pulpy state for the different manufactures in which it is employed.

The hard white soap, made in some manufactories of tallow, with a mixture of soda and potash, is much esteemed. It appears that soap cannot be made of a great variety of proportions in the ingredients, but that the proportions are what are termed definite, that is, fixed by natural laws; so that in 100 parts of hard soap there are 60·94 parts of oil, 8·56 of soda, and 30·5 of water. If the alkali is potash instead of soda, then the proportions are 58·4 parts of oil, 12·3 of potash, and 29·3 of water; so that, in general, soap contains from 8 to 12 per cent. of alkali, 58 of oil, and about 30 per cent. of water. Soaps, particularly the hard, are frequently reduced in value by the fraudulent practice of keeping them wet; by a nefarious management, they are made to contain 60 per cent. instead of 30 of water. In this case they are found to lose weight rapidly by exposure to the air, a discovery often too late.

6328. *Yellow hard Soap.*—This soap is formed of similar proportions of soda and tallow as the last, but it also contains resin, and sometimes palm oil, which is added to correct the smell of the resin. In boiling the yellow soap, the resin, oil, and tallow are put into the boiler first, and the lye added when these are melted. The boiling likewise continues a longer time, sometimes three weeks. The rest of the management is nearly the same as in the white soap. The resin makes the soap more detersive, and enables the manufacturer to sell it cheaper. Sometimes a portion of "kitchen stuff" is used with the tallow, but this is not so good.

6329. *Soft or mottled Soap.*—This differs in its composition from the hard in containing all potash instead of soda; and in this country whale or other fish oil is used with the potash, which makes a mass somewhat transparent, and of a yellow colour. Our soft soap is always interspersed with white specks, giving the whole a resemblance to the inside of a fig; these spots are produced by the addition of a little tallow; and they do not improve the soap, but habit renders them indispensable in the trade. There is no material difference in the process of boiling it from that of the other soaps. Soft soap was the first kind invented by the Germans, who made it of tallow and wood ashes, the latter containing potash.

Soft soap made of colourless fat, such as tallow, is a white, unctuous substance, about the consistency of lard. If the fat be coloured, the soap partakes of the colour; and on the Continent it is the custom sometimes to add colouring ingredients.

6330. *A very simple method of making soft soap is used in Canada* where wood ashes are abundant. The wood ashes are put into a barrel, and a lye is made by pouring water upon them; this lye is then poured off, and four or five pounds of grease are added to it: any refuse grease may be collected for the purpose, as pot skimmings, rinds of bacon, scraps of suet, &c. The barrel with its contents, well stirred together, may then be placed in the yard, exposed to the sun and air. In course of time the lye and grease become incorporated. If any fat swims upon the surface, it is a proof that there is not lye enough, and some more must be added; if the mixture does not thicken, then soap does not form, and more fat must be added. Upon adjusting the proportions of these the thickening of the soap depends. This mode of making the soap will not be found very certain, if a good article be expected; but what is so made will do very well for the ordinary purposes of washing. In this mode boiling is not employed.

In making lye for soap of wood ashes, care should be taken to use none but the ashes of the hard woods, as oak, ash, maple, beech, &c. The resinous trees, as the pine and fir tribe, are bad for the purpose, and the lye will not unite with the fat.

6331. *Hard soap is also made* by making first a soft soap by tallow and a lye of potash, rendered caustic by quicklime; to this is added common salt (muriate of soda) or kelp lye, which contains both soda and muriate of soda; the muriatic acid of the common salt goes to the potash, forming muriate of potash, which is drawn off in the waste or spent lye; while the soda unites with the fat, and forms hard soap. Soft soap is, therefore, easily converted into hard soap by the addition of common salt in the manufacture.

6332. *Soap is the better for being kept some time;* indeed, it should never be used when newly made, but, for economy, should lay by to harden slowly; if dried too fast, it will crack.

6333. *A mixture of pipe clay with soap* has been long employed in various parts of the Continent as an economical substance for washing, producing, it is said, by its mechanical action, a saving of part of the soap. *Lately a soap has been made here called silica soap*, by combining fat or oil with silicate of potash, the latter being produced by boiling flints calcined and ground in caustic lye. But this is not, as some suppose, an increase of the actual soap made by means of the flints, but is to be considered rather as flint powder mixed with soap; accordingly, it is a harsh kind of soap; its superior detergent quality, if it possess any, being owing only to the mechanical agency of the flint powder, in the same way as the pipe clay above mentioned; and it would probably prove very destructive to linen washed with it. It ought, indeed, to be understood that the mixture of silica or clay with soap is an adulteration, and not an improved kind, neither of these materials combining with the alkali, so as to produce soap. It has been stated in a report to the commissioners of excise, that though a pound of this adulterated soap may cost only 4¾*d.*, while an equal quantity of good soap will cost 6*d.*, yet that 4 lbs. of the latter will go as far as 5 lbs. of the former.

6334. *Ball soap*, commonly used in the north, is made from lees, with ashes and tallow. The lees are put into the copper, and boiled till the watery part is quite gone, and there remains nothing in the copper but a sort of saline matter (the very strength or essence of the lye); to this the tallow is put, and the copper is kept boiling and stirring for above half an hour, in which time the soap is made; and then it is put out of the copper into tubs or baskets, with sheets in them, and immediately, while soft, made into balls. It requires nearly twenty-four hours to boil away the watery part of the lees.

6335. *The alkaline lixivia, or soap lees*, that is, the solutions of alkali alone, are capable of dissolving oils more effectually than soap, and are sometimes employed for the same purposes; but, as we have stated, from their great causticity, they are capable of destroying many substances to which they might be applied, as silk, wool, &c., whereas soap cleanses from oil almost as effectually as pure alkali, without any such danger. Those soaps which contain the largest portion of alkali, being the strongest or most detersive, act likewise most upon the skin, which is the property of the common brown hard soap, and still more of the soft soap used in the common business of the wash-house. The fine hard white soaps are preferred for the toilet.

6336. *The manufacture of soap in London first began* in 1524, before which time this city was served with white soap from foreign countries; and the gray soap, speckled with white, from Bristol, sold for a penny a pound, and black soap cost only a halfpenny the pound.

6337. *Soap-suds*, too often thrown away, even from large mills and manufactories, it is useful to know, are found highly beneficial as manures, particularly when mixed up and blended into composts with other materials. The farmers in some places understand this, and collect them, paying from 6*d.* to 1*s.* per hogshead; they are found valuable for putting upon meadows. Where there is much washing, it would be well to collect and preserve this liquid manure in a tank. What is called *soapers' waste*, in the soap manufactories, is particularly important as manure.

6338. *Potatoes have been tried with some success for washing instead of soap.* The first account we have of this method is from Cadet de Vaux, a French chemist; and a process verbal was published by M. Hericard de Thury of experiments made in the hospitals in Paris. The linen was put to soak for half an hour; then it was slightly washed, and put into a vessel with warm water; each article was then rubbed on both sides with potatoes three parts cooked, in the same manner as if they were pieces of soap. When the whole had been thus well rubbed, it was put into the copper and boiled for half an hour; after which it was taken out again, rubbed, beat, and turned and pressed in all directions, and again plunged for some minutes in warm water, and afterward rinsed. The linen is said to have been made perfectly white, while the expense and labour were less than by the ordinary method. A modification of this process is used here by the scourers. See "Scouring," Chap. XI., Book XXII.

6339. *A plant called soap wort,* belonging to a family named by botanists *Saponaria,* and which contains a good deal of alkali, is used in some places instead of soap, by making a decoction of the leaves and flowers to wash stuffs.

6340. *Rice-water is employed in India* for washing cottons and muslins.

CHAPTER IV.

WATER FOR WASHING.

6341. *The quality of water used for washing* is a circumstance of the first importance in the process. In Chap. I., Book VIII., "On Water," we explained the nature and properties of the different kinds of this fluid, as obtained from various sources, as well as the difference between hard and soft water. To this we must refer our readers. The softest waters are the fittest for washing, simply because they are the purest, containing no salts capable of decomposing the soap and destroying its action.

6342. *When water is hard,* it is owing to its containing earthy salts, generally either carbonate of lime or sulphate of lime, the acids of which seize the alkali of the soap, which is united to the oil only by a weak affinity. If the cause of hardness be carbonate of lime dissolved in the water, simple boiling for a considerable time corrects it by driving off the carbonic acid in the form of gas, when the lime falls to the bottom, leaving the water soft, which may then be poured off and used for washing; or the addition of quicklime may effect it, as has been stated. But when the hardness proceeds from sulphate of lime, or lime united to the sulphuric acid, which is the most frequent case, boiling has no effect, because the sulphuric acid cannot be driven off in this manner. It is then necessary to decompose the sulphate of lime by putting into the water some common soda, or potash, or pearlash, as may be most convenient. Even wood ashes will answer the purpose if no better material is to be had, because, as we have shown, they contain potash. As spring water and well water are very frequently hard, the addition of soda to such water is a very common and a very useful practice.

Even exposing spring water that is hard from containing carbonate of lime only, for some time in a cistern, will correct it to a considerable degree, because the carbonic acid will fly off in time, leaving the lime to fall down.

If the water be impregnated with the minutest portion of iron in any state, this will communicate a yellowish tint to the linen, which it will be very difficult to get rid of; and such water will therefore be very unfit for washing.

6343. *Sea water is not fit, in its natural state, for washing linen,* because the salt in the water decomposes the soap, and prevents its action. To remedy this, add soda to the sea water, the effect of which will be, first, that the water will become turbid, and a precipitation of earths will take place. When, by adding sufficient soda, all the white precipitation has subsided, the water will be found soft and fit for washing. The explanation of this effect is as follows: Sea water contains a certain proportion of hydrochloride of calcium and hydrochloride of magnesium, as well as hydrochloride of sodium. As hydrochloric acid has a stronger affinity for soda than for lime or magnesia, it will unite with the soda which has been added and leave the earths, which therefore fall down or are precipitated. The water is now salter than before; but more soda must be added than is sufficient to form sodium, or saturate the hydrochloric acid; then the latter is rendered ineffective, being unable to decompose soap. Sea water, therefore, with this excess of soda, acts nearly as fresh water. A kind of soap is now made and sold for washing in sea water.

CHAPTER V.

ON STARCH.

6344. *Starch is one of the essential articles in the business of the laundry,* and though it can always be purchased of good quality in Britain, yet, in uniformity with our plan, we shall describe its manufacture or mode of production, as well as its properties and the manner of using it.

In treating of the principles of vegetables, Book VII., Chap. VII., we showed that starch is ready formed in certain plants, being one of their proximate principles; and all that the manufacturer has to do is to separate it from the other constituents. It will be proper here to enumerate again the properties of starch, as far as they are concerned with its use in the laundry.

6345. *Starch consists* of extremely minute oval-shaped grains, much too small to be distinguished by the unassisted eye, but which may be plainly seen by a good microscope. When pure, the mass is of a brilliant snow-white, and without any taste. It will not dissolve in water either cold or below 160°; but in water between 160° and 180° it forms an imperfect solution, thickening into a gelatinous or jelly-like consistence, in which state it is employed by the laundress.

6346. *Although all vegetables contain more or less of starch,* yet some possess a much larger proportion than others, and are therefore fittest for the production of this substance. In treating of the constituents of vegetables in general, we pointed out those from which it is extracted in the greatest quantity.

6347. The starch made with us for the use of the laundry is procured from two vegetables only, wheat and potatoes.

6348. *Starch from wheat* is manufactured as follows: It is not necessary that the grain should be ground into flour. The entire corn, well cleaned, is soaked in cold water until the husk easily separates; and the grains, having become quite soft, give out a milky fluid by pressure. The wheat is then taken out of the water, put into coarse linen sacks, and transferred to another vat with water, where it is subjected to pressure. The milky juice exudes and mixes with the water; and when the whole has been pressed out, the sacks and their contents are removed. On the whole standing still, the starch precipitates to the bottom, but will not be quite pure, as it holds a small quantity of the gluten of the wheat, though the greatest part of this remains in the sacks. In order to free the starch from this gluten, the whole is suffered to stand still for about ten days in summer, and fifteen days in winter. During this time a fermentation takes place, owing to the following cause. Dissolved in the water, there is a little saccharine mucilage, which is also one of the principles of the wheat: it is this that begins the fermentation, which is of the acetous kind, and, in consequence, a small quantity of sour liquor or vinegar is produced. This acetous acid acts upon the gluten and dissolves it, but not the starch; which is, therefore, freed from the other matters. After this fermentation has continued long enough, the starch subsides to the bottom quite pure, and the water is let off.

The starch, well washed by several waters, is dried by a gentle heat, first in the open air and afterward in an oven, during which it cracks into those irregularly columnar forms in which it appears when sold, and which have had a slight tinge of blue given to them in the manufactory to overcome any tendency to a yellow colour which they might possess. Very fine starch is imported from Poland and from France, usually considered to be superior to the English, which is not unfrequently adulterated.

6349. *Lately a very superior kind of starch has been made from rice,* which, it is said, has some advantages over wheat starch, particularly that of not causing the linen to stick to the iron in ironing.

6350. *Starch made from potatoes* is not equal to that from wheat, but is found useful upon occasion.

6351. *To make potato starch,* procure some of the best mealy potatoes and a common bread grater. Wash the potatoes, grate them into a pan or tub of clean water, and stir the pulpy mass well about in the water: after a little time the thickest part will subside to the bottom; then pour off the white water, keeping back all the pulp. Add some more water to the pulp, stir again, and pour the whitened water off as before. Repeat this process with more water as long as the water comes off whitish. Let the whitened water that was poured off remain at rest some time, and the white part will settle to the bottom, leaving the water quite clear. This subsided matter is the starch. Pour off the water, and dry the starch in the sun; it will generally weigh one fifth of the best potatoes. Here fermentation is not necessary, because potatoes have no gluten like wheat; the starch is pure at once. This kind of starch, though it answers for some domestic purposes nearly as well as wheat starch, is sensibly different; it sets or becomes a jelly with a degree of heat somewhat lower than wheat starch, and is more apt to become moist in damp weather; but it is said to go rather farther than common starch, a smaller quantity being sufficient for the purpose of the laundress. It is, however, but little used.

6352. *A tolerable starch has been made from horse-chestnuts* by the following process, although it is now out of use: The prickly husk of the chestnut being removed, all the coloured skin must be pared off, and the chestnuts rasped, bruised, or ground very fine in water and well stirred. The white water is then poured off and suffered to stand till the starch settles to the bottom.. This, if not quite white, is again mixed with water, and passed through a flannel tamis or muslin sieve, and left to subside as before. By repeating this process as is found necessary, the starch is obtained, and is afterward dried for use. A patent was granted in 1796 to Lord W. Murray for this process.

6353. *Powder and stone blue,* used in washing linen, is a kind of coarse smalt, prepared abroad, and brought here either in the state of powder or lumps. *Smalt* is a glass coloured blue by zaffre or oxyde of cobalt, and reduced to a fine powder. The use of blue to the laundress is to mix with starch to destroy the yellow tint that the latter is apt to impart; and in general, when the linen is ill-coloured, a little blue neutralizes the yellow-brown, and makes it appear to be more white.

CHAPTER VI.

PRACTICE OF WASHING, DRYING, IRONING, ETC.

SECT. I.—WASHING.

6354. *Some directions for the management of linen previously to its being washed* may be useful; and we may, at the same time, observe that, though the term linen strictly means only cloth made from flax, yet, on this subject, it is usual to apply it in a general way to express most of the articles, whether linen or cotton, which are submitted to the various processes of the laundry.

6355. *Soiled or foul linen ought not to remain long unwashed,* as the dirt is then more difficult to be removed. Some families wash only once a month, but once a fortnight would be better; in the mean time the various articles, as they are soiled, should be put aside till washing day (for which Tuesday is usually chosen) with method, instead of being thrown together in a heap. This will save a great deal of trouble in sorting and keeping account of them. When they are numerous, each kind of article should be put into a separate division, bag, or place, by itself; and, to be very exact, it would be easy to make an entry on a tally or book of the number of things put by. What has been used in the kitchen and other offices should be kept separate, being generally greasy, or otherwise very foul; and, as nothing is more unwholesome, or more apt to injure the air of a house than collections of foul towels or rags of any kind, these should, if possible, be kept in some outhouse. Silk stockings, blonde, lace, dresses, and various nice articles that require particular skill in cleaning, come within the province of the lady's-maid. Washing blankets and bed furniture does not take place above once a year.

6356. *With respect to the persons engaged to wash,* bodily health and strength are first-rate qualities; yet general intelligence is also very desirable, since much, after all, must be left to their discretion; and it would be well that they should be of such a disposition that they will attend to any directions given to them, although these may vary somewhat from their usual practice; and that they should be free from that obstinacy and tenaciousness of old modes, which become very troublesome when improvements are introduced.

6357. *Spots of grease or gravy on table-linen or napkins* should be washed out with soap and water as soon as the cloths are withdrawn, otherwise they are sometimes difficult to remove after the linen has lain long by; and stains from ink, wine, or fruits should likewise be taken out. The manner of doing this will be pointed out.

6358. *The usual process of washing has been thus given to us by an intelligent laundress:* "On the Monday, the day previous to washing day, the business of the laundress begins by collecting all the various articles to be washed, and entering them in the washing book; in preparing the coppers, filling them with water, laying the fuel ready to be kindled, &c.

"*Soaking and Washing.*—On the afternoon previous to washing day, the linen should be put to soak in a weak lye of lukewarm water, having a little soda put into it; but first it must be well soaped in such parts as are the most soiled; and this operation should be performed with care, as it contributes much to the facility of the washing by loosening the dirt, and thus saving labour as well as the wear of the linen. For soaping the worst parts, soft soap will be found most economical. No more warm water should be used than is just sufficient to cover the linen when pressed down in it, that the strength of the soap may not be reduced. When washing is required to be done in the best manner, it is the custom with some laundresses, besides rubbing the worst parts with soap, to run the whole through water that has had soap dissolved in it by cutting it in slices, by which every part of the linen is sure to be penetrated by the soap, and no part can be missed. Care must be taken that the first washing is not done with water too warm, or it will set in the dirt."

6359. *Some have recommended to mix lime-water with the water in which the linen is soaked,* with the view of saving soap and softening the water. The lime-water is made by mixing a pound of quicklime in ten gallons of water, and letting this stand for twenty-four hours: the clear water is then decanted off from the lime. This practice undoubtedly has the desired effect of rendering less labour necessary in the subsequent washing, and does save soap; but, when used too freely, there is danger of the linen being injured, owing to the causticity of the lime. Indeed, complaints have been made that household linen has been found to be destroyed in a few weeks after coming home from laundresses who have been in the habit of using lime.

6360. *It is unnecessary to say much respecting the manual operation of washing,* since that is well known. Those who attempt it for the first time generally rub the linen against the skin, by which the latter is frayed, and sometimes rubbed off; whereas practised washerwomen take care to hold the linen so as to rub one part of its surface against another part, and, of course, not against the hand, otherwise they could not continue their work for the length of time which they do. We refer the reader to what we have said on the theory of washing for the *rationale* of the effect of the soap and friction in removing the dirt, and restoring the linen to its pristine purity.

To save soap, it is usual now to put some soda into the lukewarm water to render it soft: the quantity must be determined by experience; if too much be used it will exhibit its effects upon the hands of the operators. Soda is more particularly useful when the water is at all hard, and will not make a lather: the best way of using it is to have a jug at hand with the soda dissolved in water, and to add a little at a time as the lather becomes weak. Careless washers leave their soap in the water, where it dissolves, and is wasted unnecessarily. It is a good plan to provide little wooden bowls with perforated bottoms, placed on saucers, to put the soap into when it is not used: wood is the best, as not being liable to be broken.

"*After the linen is well washed with plenty of lukewarm water the first time*, it is to be put into a fresh quantity of water as hot as the hand can easily bear, and washed in this again, examining the whole carefully to see that no part has been missed; any such must be again washed until the whole is quite clean.

"*The next operation after washing is boiling the clothes*, in order to produce a good colour, and to remove entirely the soap or other detergent matters that have been used, which, if left in, would occasion a disagreeable smell. In the water used for boiling, a little soda is sometimes added in the proportion of half a tea-spoonful to a gallon of water. Some enclose the linen in a bag before it is put into the copper to boil, in order to guard it effectually from the scum of the water, which is apt to attach itself. After being boiled for about twenty minutes or half an hour, the linen is taken out, well rinsed in abundance of clean hot water, and afterward in clean cold water which has a sufficient quantity of blue to give the proper tinge. It is then taken out and wrung dry; and care must be taken that the texture is not injured by the operation. It is then ready to be conveyed to the place where it is to be hung up and dried. It is necessary to state that, if the operations were commenced by boiling the linen, the dirt would be fixed instead of being removed. Washing, therefore, precedes the boiling."

6361. *In some countries the manual operation of washing is different from the English mode.* In Paris, the *blanchisseuse* takes her linen, after soaking it with soap, to a large barge on the River Seine, and then, having dipped it into the water, she lays it upon the flat edge of the vessel, and beats it with a wooden beetle, dipping, rubbing, and beating alternately until all the dirt is removed. It may be supposed that this will wear the linen much more than our mode, but it does not appear to be the case; and it saves much manual labour as well as fuel. In the country parts of Scotland it is usual to take the linen to a clear running stream, and not only to wash it there by hand, after having bucked what is most foul, but to beat it on a smooth flat stone with a round wooden mallet something like that of a paviour, and to tread it with the feet in a tub of water, beating, treading, and rinsing alternately, after which it is spread out and dried upon the grass; this process renders the linen beautifully soft and white, with little expense of soap. These simple methods have suggested the idea of using machinery for washing, which we shall speak of afterward.

6362. *The directions we have hitherto given for washing apply more particularly to linen and white cottons or calico:* we shall add some observations on the modes of managing with other fabrics.

6363. *Calicoes*, and all articles made of cotton, are more liable than linen to lose their colour and turn yellow by insufficient washing or lying by: the best way of restoring their whiteness is to get them bleached occasionally by country washing, where they can be dried in the open air in the manner described under "Bleaching." The use of chlorine, or of the bleaching liquid, has been attempted with this view; but, though extremely valuable and efficacious in the hands of manufacturers, it is scarcely safe in ordinary domestic economy, as it requires more care and experience than are usually met with, and without which the articles would probably be irrecoverably destroyed. For such as wish to try the experiment, the method of proceeding may be gathered from what is said in Chap. X., Book XVII., on "Bleaching."

6364. *With respect to printed cottons and muslins*, the use of soda is apt to discharge or injure the colours, and is therefore better omitted, using soap only.

6365. *To wash Nankeen so as not to discharge the Colour.*—Put it to soak for twenty-four hours in cold water into which a handful of salt has been put; then wash it in warm lye without soap, and do not wring it.

6366. *Flannels, worsted hose, and other woollen articles* require particular treatment. It is the nature of all woollen textures to shrink considerably if put into hot water, from their property of felting, as explained under "Woollen Manufactures;" and it is therefore a good practice to shrink the flannel before it is made up into any article of dress, by soaking it in water very warm, otherwise, perhaps, it will be found too little after washing. Cold water shrinks woollen less than hot, but it is not always sufficient to remove the dirt; the water must generally be lukewarm; 85° is about the right temperature. All flannels will continue to shrink by washing in a small degree, but the Welsh flannel least. Soda should not be used for flannels or blankets: for farther directions respecting the latter, see "Scouring." Flannels should be well rinsed after washing, for any soap left in them will injure the texture.

6367. *Coloured silk* handkerchiefs require peculiar care, and are generally the worse for washing. India handkerchiefs wash best. Soda should not be used; and they should be washed with soap as expeditiously as possible in cold soft water, and perhaps afterward in a lather only lukewarm, and immediately rinsed and dried, as remaining long in the soap injures the colours. Such as are soiled by snuff require soaking over night.

6368. *It is not usual to wash silk dresses:* these are generally sent to the scourer's or dyer's; or they are turned, where economy is consulted. Nevertheless, they may be washed by using a particular method. To succeed, it is best to take the dress to pieces, or at least in great part, where there are many folds. The silk should then be laid upon a smooth board, and rubbed one way, a portion at a time, with a piece of flannel well soaped, with lukewarm water. When the dirt is removed, a sponge well wetted in cold water must be used to remove the soap. One side being done, the other must be treated in the same manner, taking special care to leave no soap on the silk. After this washing it is not to be wrung, but simply hung up to dry in the shade in the air, or on a horse within doors, for the sun will injure the colour. Some finish it by sponging it with gin; but whiskey or spirits of wine are preferable, as the sugar in gin will render it clammy. Silk ribands may be cleaned by the above process. Silk stockings may be washed with soap, then laid smooth, and dried by rubbing them with flannel. If they are ironed, the iron should not be very hot, and a fold of blanket should be interposed. Some prefer mangling.

6369. *Blonde and lace* are among the most difficult things to wash. This, however, may be effected by winding it round a glass bottle in a single fold, then covering this with two or three folds of muslin. Soak this in clean strong soap-suds, and rub and press it through the muslin till the dirt is removed. Rinse it well without taking it off, and apply to it a weak solution of gum Arabic in water to stiffen it. Dry it nearly by applying to it clean cloths; and, as it is unrolled, finish by ironing, or glazing with a glass bottle. If the articles are too large for a bottle, a smooth cylinder of hard wood may be used.

6370. *All articles that are very dirty,* such as kitchen cloths, dusters, &c., should be washed by themselves, otherwise they become a dye for the rest, which are thus infallibly spoiled. To free them from grease, they should be well soaped and soaked over night. To save soap in such cases, where that is expensive, a soapy liquid or lye may be made in the following manner, to soak them: Mix potash or soda and quicklime with water, and let the mixture stand till it becomes clear; then pour the clear part off into a vessel, and keep it for use. When the liquid is wanted to be used, add to it a thirtieth or fortieth part of oil, and shake them together: a milky compound will be formed, which is liquid soap. This may be put into the water in which the things are soaked, and will answer the same purpose as soap. Care must be taken not to put too much oil, otherwise it will not all mix, but some will float upon the surface. The difficulty in using lyes of this or any other kind is from the excoriating effect which they have upon the hands when too strong: the use of the oil is to prevent this. For a utensil for washing very dirty clothes, see Chap. VII., "Construction of the Wash-house and Laundry," &c.

Sect. II.—Drying.

6371. *It is not sufficient that linen is well washed, if it be not likewise dried in the best manner,* since the whiteness and good appearance depend much upon this. The smoke of towns is evidently injurious, from the particles of dust and soot which fall and attach themselves; hence the best laundresses generally reside on the outskirts of towns, to have the advantage of drying as much as possible in the open air, by which they also save some expense in fuel.

In treating "On Bleaching," Book XVII., Chap. X., we explained the effect which the sun, air, and water have in destroying colours; hence we may easily understand the use of drying white linen or cottons out of doors; and why exposure for some time to the rays of the sun, and occasionally sprinkling water on white linen hung out to dry, have a powerful effect in whitening it. This method, indeed, is often resorted to when linen has acquired a bad colour, from injudicious washing, lying by, or any other cause: it thus undergoes a kind of bleaching. The superiority of washing in India is to be ascribed to the great power of the sun's rays acting upon the calico often wetted.

Great care should be taken with respect to the mode of hanging up the linen to dry, avoiding palings, or any materials that may communicate a stain, particularly from iron, as this will cause iron-moulds.

In the country, or where there is convenience, a drying ground is frequently attached to the laundry, or in some situation proper for the purpose, to which the linen is carried in clean baskets. It is then usually hung upon lines fastened to wooden uprights, which should be fixed to the ground by permanent sockets, as they can thus be more firm and secure than when driven into the ground. One end of the lines is made to pass over a pulley at the top of an upright, by which the clothes may be raised or lowered together. The lines should be of worsted or soft flax.

The various articles are best secured to the lines by wooden pegs made of a branch, and having a cleft, which is bound at one end by a hoop of iron, tinned, to prevent rusting. For want of this tin the end may be bound very tight by packthread, or it may be let into a socket of wood. It is advisable to have a sufficient stock of these wooden pins, as common pins are apt to tear the articles hung up. When linen is laid upon grass to be bleached, it is often necessary to keep it down by clean stones, and to have it well watched for fear of its being blown away or stolen.

6372. *But the same cause which renders drying in the sun beneficial to white linen renders this injurious to all dyed and printed articles*, as being destructive to colour. These should, therefore, be dried in the shade, and never hung in the sun: it is the sun's rays, and not merely the air, which particularly occasion colours to fade. There may, therefore, be a shed for the purpose of drying coloured articles, or some place may be selected that is sheltered from the sun's rays. It is not uncommon for printed cottons to suffer considerable injury for want of this precaution, either from negligence or ignorance of the principles we have mentioned. Some articles require particular modes of hanging them up to dry. Very thick articles, as quilts, waistcoats, &c., are best hung over two lines placed a few feet apart, in order that both sides may be sufficiently exposed to the air. The summer months are best for washing thick and heavy articles of furniture, as blankets, counterpanes, bed curtains, &c., on account of the greater facility with which they may be dried out of doors in that time of the year, and thus, also, acquiring a better colour. Laces and lace veils require to be stretched smooth, and tacked to a piece of white calico before they are hung up. Muslin and other dresses must be stretched as smooth as possible, that they may not get wrinkled in drying. But it is unnecessary to detail all the little precautions to be observed in hanging out various articles of dress, since these are sufficiently understood by those who are practised in it, and scarcely admit of being explained by any short directions. But, notwithstanding the superiority of drying clothes in the open air, this is not always practicable, and they are then dried within doors. We shall describe the best methods of effecting this when we treat of the "Construction of the Laundry."

SECT. III.—STARCHING.

6373. As it is necessary to have certain parts of linen and various articles of dress less pliable than usual, starch is employed to give the requisite stiffness. The chemical nature of starch, and the process of manufacturing it, have been already explained.

6374. *To make the starch for use*, it must be mixed with a sufficient quantity of cold water, until it is about the consistence of common paste, carefully breaking all the lumps, and rubbing it with a wooden spoon till it is quite smooth: then add boiling water in the proportion of a pint of water to an ounce of starch; put the blue flannel bag into it, and let enough colour be dissolved to give the required tint. The making of starch properly requires some care. If made in a tin sauce-pan, it is a chance if it does not burn, like all thick liquids. The best vessels for making it in are a bell-mettle skillet, or a copper vessel, tinned, or an earthen-ware pipkin. It is said that an iron vessel would make it turn black; but this is impossible if the iron is tinned: a small cast-iron sauce-pan, tinned inside, will answer very well.

The starch being properly mixed, put it on the fire and let it boil, taking care to stir it all the while, to prevent burning. When it is taken off the fire and poured out, cover it with a plate, to prevent a skin forming. If it be wanted stiffer than common, a little gum Arabic or isinglass dissolved may be added: and for some articles of lawn, gum Arabic alone is used, without starch. Some add a bit of white wax.

6375. *As an economical kind of starch*, for articles where no nicety is required, some use common paste made of wheat flour.

6376. *The parts of linen and other articles of wearing apparel that require to be starched* are too well known to demand enumeration, and even these vary somewhat with fashion; the process of starching consists merely in dipping the part into the starch, and squeezing it.

6377. *What is called clear starching* is the starching of laces, muslins, and other transparent tissues, which requires to be done with peculiar care; for these the starch is made thicker and hotter than ordinary, and the articles, after having been well washed, rinsed, and dried, are dipped into the thick starch, previously strained, before it is quite cold. After squeezing them out, they are clapped between the hands, to produce clearness. Instead of clapping, which is apt to injure lace, some prefer, after starching and squeezing out, spreading them on a linen cloth, rolling them up in it, and letting them lie for an hour, when they will be ready for the irons. Muslins and cambrics do not require the starch so thick as net or lace. If the articles are too dry for the iron, they may be damped again by rolling them in a damp cloth; but this should, if possible, be avoided. All linen, after starching, requires to be made nearly, though not quite, dry before ironing.

6378. *It is sometimes found that starched laces and muslins stick to the iron*, and several methods of preventing this are employed. Some recommend drying the things first, then dipping them in the starch before it is quite cold; then dipping them in cold water, and drying them again; once more dipping them in cold water, spreading them on a dry cloth, and rolling up previous to ironing: by this process sticking to the iron is prevented. Some put a little tallow, hogs' lard, or olive oil in the starch; but a lump of refined sugar is preferable. In India all muslins are stiffened with rice water, which is said to be excellent; and the rice starch is said not to stick to the irons.

CHAPTER VII.

IRONING AND MANGLING.

6379. Linen and cotton, or cloth of any kind, after being washed and dried, is full of wrinkles, and a beautiful smooth appearance is to be produced by ironing or mangling. The last is the most expeditious, and least apt to injure the colour, but can only be applied to the large articles, the hot iron being necessary where there are many folds, or where the texture is too delicate for the mangle.

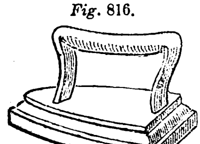
6380. *Previous to ironing*, all linen and other articles, after being washed and well dried, must be properly folded, and slightly damped by sprinkling water upon them just before the application of the hot iron. The proper degree of dampness is a nicety learned only by practice, but it is essential to the success of good ironing.

6381. *Ironing is a very important part of what is termed the getting up of linen;* bad ironing is known by the creases left, and inaccurate folding, and sometimes by the marks left by ill-cleaned irons, or even iron-moulds. To iron well, it is necessary not only to be dexterous in the use of the iron implement, but also it is essential that the mode of heating the irons should be effectual.

6382. *Smoothing irons* are employed to give smoothness to such articles of wearing apparel as do not admit of being wound round a cylinder to be mangled. These implements are of three kinds: the common flat iron, termed among ironmongers the sad iron; the box iron; and the Italian iron. The first is so named because the word sad in the North means solid.

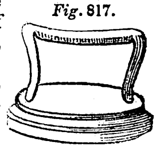
6383. *The common flat iron* (*fig.* 816), which is most frequently employed, is well known. They are manufactured of various sizes, varying in length from four to nine or ten inches. The body is of cast iron, ground smooth at the bottom, and the handle of wrought iron, turned round so as to be hollow. The larger the irons, the longer they retain the heat, and the greater the pressure they are capable of giving. Small irons are employed for more delicate articles.

Fig. 816.



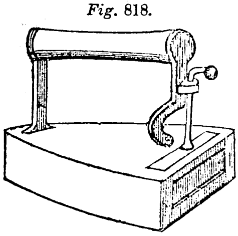
6384. *The oval flat iron* (*fig.* 817) is sometimes employed for the cauls of caps, or such things as might be apt to be torn by the pointed iron. It is to be observed that it has of late become usual to make the last iron (*fig.* 816) round at the point, instead of being sharp as formerly, and as represented in the cut.

Fig. 817.



6385. *The box iron* (*fig.* 818) is an oldfashioned implement, less used than formerly, but ingeniously constructed. As considerable pressure is frequently useful, this iron is made large and heavy; and to retain its heat longer, it is made hollow, the cavity containing an iron heater, which is made nearly red hot occasionally as the iron cools. To keep this heater in its place, an iron slider is made to shut down in front. Accidents of burning have sometimes happened by lifting these irons negligently, without seeing that the slider was down, so as to allow the heater to fall out.

Fig. 818.

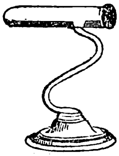


6386. *The proper degree of heat in the smoothing iron is very necessary to attend to*, and which can only be learned by practice. Before using it, it is proper to try its effect upon a piece of blanket kept on the table for that purpose; if the iron be too hot, it will scorch the linen, and if not hot enough, it will not properly perform its office. In the first case, it may be proper, not to lose time, to iron some coarse thing that a very hot iron will not injure. The best manner of heating the irons will be described under "Construction of the Laundry."

6387. *The use of the iron* in the various articles of wearing apparel can be learned only by practice under a skilful instructer; no verbal directions can be sufficient. A few hints, however, may be given. Things that require to be very flat, as shirt collars, are best to be covered by a towel in the first ironing, and then gone over on both sides with the box-iron. Laces and worked muslins require a very soft and good ironing blanket, and they are to be dried by rolling them up, and to be unrolled as they are ironed. When silks are ironed, they should be covered over with paper to prevent the iron from touching the silk itself, which produces a disagreeable glossiness. Great care must be taken not to scorch anything, for this is in fact reducing a portion of the surface to charcoal; and though receipts are given for restoring the colour, these are nearly, if not quite, useless.

6388. *The Italian iron* (*fig.* 819) affords a very neat and expeditious way of ironing certain articles, as frills, that require to be puffed. It is a hollow tube, and is heated by a cylindrical piece of iron made red hot and inserted in it. The articles to be ironed are drawn over the iron, instead of passing the iron over them.

Fig. 819.



6389. *Plaiting* is used in frills, breasts of shirts, and similar parts of dress, and is either *small* plaiting (*fig.* 820) or *box* plaiting (*fig.* 821). The plaits are first folded with the fingers, and then ironed down flat with the box heater, or a heavy common iron. If any part of the articles to be ironed have become too dry, they must be re-damped; and should the iron stick to the linen, it should be well rubbed with a coarse cloth; and should that not be effectual, it must be rubbed upon a board on which a little brickdust or powder of cuttle-fish bone has been scattered, wiping the iron afterward.

6390. *Crimping machines* (*fig.* 822) are for performing a kind of plaiting or fluting on

Fig. 820.

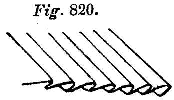
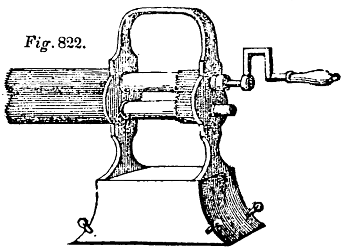


Fig. 821.

Fig. 822.



frills with much greater regularity and expedition than could be practised by hand. This is done by grooved rollers, heated like the Italian iron. The process is performed merely by putting the articles between the rollers, and turning the handle.

6391. *Gauffering machines* differ from those used for crimping only by having the grooves much larger and less regular.

6392. *The following method of gauffering by means of straws* is given in the "Workwoman's Guide:" Procure a board about a yard long and six nails broad; cover it with flannel, and fasten two tapes lengthwise, leaving about a quarter of a yard between them; then pin the net to the flannel at one end, and place a straw over the tapes (between which the net is lying) and under the net; the next straw is laid under the tapes and over the net, and so on alternately, taking care that the upper straws are put close to each other upon the under ones, forming two layers of straws. When all the net is folded, dip a coarse cloth in water, and wring it as dry as you can; lay this upon the net, and iron it dry, pressing on the board as much as you can without splitting the straws; remove the cloth, and place the board before the fire for half an hour, when you may draw out the upper straws, and run in some cotton to secure it; after which the remaining straws may be taken away, and the work is complete. Some persons hold the board in the steam of a kettle for some time, and then dry it before the fire, in preference to ironing it; others sprinkle it with starch, gum, or rice water, before ironing.

6393. *Plaiting and crimping are operations which have been long in use.* There is reason to think, from their sculpture and paintings, that the Egyptians plaited their drapery; and other ancient nations followed occasionally a similar practice. In Queen Elizabeth's time they used, for this purpose, what are called *poking sticks*, which were first made of wood or bone, and afterward of steel; and the ruffs then in vogue were plaited with great care.

6394. *Mangling* is a mode of smoothing linen that gives a beautiful flatness and even gloss not to be effected by ironing, and it is used on this account, as well as for expedition, in all the larger articles, such as table and bed linen, as well as various articles of dress; but things of a delicate tissue, or where there are folds and plaits, cannot be mangled without injury. The best construction of mangles will be described when we treat of the furniture of the laundry.

CHAPTER VIII.

CONSTRUCTION OF THE WASH-HOUSE AND LAUNDRY, AND DESCRIPTION OF THE FURNITURE AND APPARATUS USED.

In the most complete establishments these offices are always detached from the house.

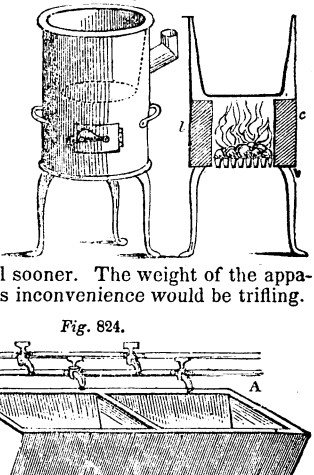
6395. *The wash-house may be fitted up* in the following manner: The floor should be of Yorkshire or other stone, laid with a sharp current towards a sink-stone, for the convenience of keeping it as dry as possible. In the roof there may be a cistern for rain water, which may be collected from this and the adjoining buildings; or, if that be inconvenient, a tank may be formed in the ground, with a pump to raise up the water.

6396. *The copper* for heating the water should be placed lower than the supply cistern in the roof, whether of rain or other water; and on a lower level than that should be the copper for boiling the clothes, so that the latter may be filled from the former by a pipe, which will save much trouble. In some cases, a filtering apparatus may be useful in case of sediment or impurities in the cistern. On a small scale, the copper is generally made round; but when very large, an oblong form is preferable, on account of the setting in brick-work, and the economy of fuel. In that case, the cover may be hinged, and made to open by a rope and pulley. A steam rim, such as that described under "Kitchen Furniture," may surround the edge, to prevent the steam from coming into the wash-house, except when it is opened.

The copper for boiling the linen should be furnished with a copper colander for holding the linen, which should be drawn up by a jack and pulleys. The jack should have a ratchet to keep the colander suspended over the copper till the water is drawn from the linen, which can then be turned out altogether into the rinsing tub; by which the usual mode of poking the linen out by a stick, which sometimes injures it, is avoided. All the coppers should be furnished with brass cocks, to let off the water.

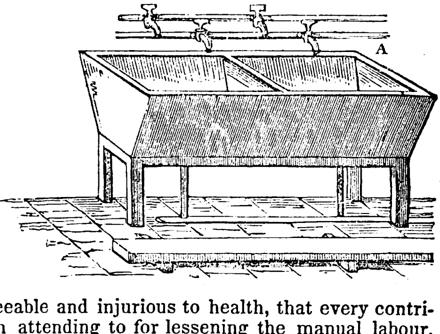
6397. *A portable copper* is very useful for heating water for washing, where there is no fixed one, and likewise on many other occasions where boiling water is wanted. The copper, *a*, *fig.* 823, is suspended by its rim in a cylinder of sheet-iron, which contains the fire. In the manner in which they are usually made, this iron gets extremely hot, sometimes red hot, and not only heats the apartment intolerably, if small, but is very apt to set fire to the clothes of those who use it. This apparatus would be much improved by lining the part which contains the fire with brick about two inches in thickness, as at *b c*. Windsor brick should be used, that bear the fire, and are so soft as to be cut. This would prevent the over-heating of the iron cylinder, would make it last much longer, and would cause the water to boil sooner. The weight of the apparatus would, of course, be a little increased; but this inconvenience would be trifling.

Fig. 823.



6398. *The wash-tubs*, large and small, are usually round, and raised upon blocks or forms; but some prefer having them of an oblong shape, narrower at the bottom than at the top, *fig.* 824, and with a groove running all round on the edge, to carry off the slop that is made. They should be placed in a good light, in a range as numerous as is necessary, and each should be furnished with pipes, A, having cocks for hot and cold water, and should also have one at the bottom for letting off the soap-suds into a waste-pipe, which goes into the drain or a cesspool.

Fig. 824.



The labour of washing is so disagreeable and injurious to health, that every contrivance which may facilitate it is worth attending to for lessening the manual labour, and even for improving the process itself. Besides the wash-tubs, there must also be proper rinsing-tubs, and trays to put linen upon, linen-baskets, folding-horses, clothes-lines, and pegs. A good wash-house should be 24 feet long, 10 feet wide, and 9 or 10 feet high; but this, of course, must be modified according to the work required.

6399. *A serious objection to washing at home arises from the steam* diffusing itself through the house, rendering the air damp, and spoiling the furniture, besides the destruction of comfort. In a wash-house constructed on purpose out of the house, ventilation is easily effected by an aperture in the roof properly contrived to carry off the steam. See Book III., "On Ventilation."

6400. *A method of destroying the steam* has lately been invented, by which it may be got rid of in any situation, and is actually here converted into fuel, and made to assist in heating the copper. It has long been known that steam, passed into the fire of a furnace, is decomposed and converted into the elementary gases, hydrogen and oxygen; and it had been observed that, when only a small stream of water was played against a house on fire, it assisted instead of preventing the combustion. Waste steam is now burned in manufactories, by conducting it into the air-flue that feeds the fire; and is thus employed in wash-houses, breweries, and several large establishments. Dr. Fife, in a paper in Jamieson's Journal, July, 1837, has shown that a great accession of heat may be gained by this process.

6401. The method of effecting this is very simple. "The boiler is kept closely covered; but at one side, that next the wall, there is a flue of communication between the upper edge of the boiler, immediately under the lid, and another flue which conducts the air down to the ash-pit. By keeping the ash-pit door shut, no air is admitted to the fire but what is drawn through this flue; and, of course, it draws down the steam along with it, and both air and steam pass upward through the fire. By having the upper opening of the air-flue immediately under the ceiling, in the case of wash-houses, breweries, &c., any steam from the washing-tubs, or any vapour which may be floating in the atmosphere, will be drawn down and consumed." Thus the wash-house, which at present is a most unwholesome and disagreeable place, may be much improved, although it will be still impossible by this contrivance to get quit of the steam that escapes when the cover of the boiler is taken off, or what rises from the wash-tubs.

6402. *The laundry should adjoin the wash-house*, and may be 18 feet square, and 11 or 12 feet high. It should be well lighted; the floor should be level, of rubbed Yorkshire stone, laid upon brick piers, to keep it perfectly free from damp. It should be furnished with a mangle, or that may be better in a separate small room, a furnace for heating the irons, an ironing board 12 feet by 3 feet, clothes-horses, large drawers for the ironing cloth, iron-holders, &c., proper places for putting away the clothes-baskets, and a place for coals. In small establishments, the laundry usually serves for the double purpose of drying and ironing the linen, particularly when there is no convenience for drying in the open air, the advantages of which have been already explained; and notwithstanding the superiority of the latter method, yet, by proper arrangements, it is possible to dry clothes perfectly well, and with a good colour, in doors.

6403. *When the laundry is used as a drying-room, the air is necessarily kept very hot and damp*, which renders it very unhealthy for the laundry maids. The usual method of heating it is by an iron stove and iron pipe for the passage of the smoke, which is simple and effectual, though less wholesome than by pipes filled with steam or hot water. It is essential that a draught or current of air should be excited in a drying-room, or a laundry used as such, to carry off the moisture from the linen. This current may be obtained by keeping a part of the upper sashes open, or panes to open, and likewise by having an opening at the lower part of the door.

6404. When a laundry is built on purpose, proper ventilation may be easily provided by proper lubber boarding in the roof; but it must be observed that it can never be expected that the hot air can pass out at the top except proper openings are made somewhere at the bottom to supply its place. Sometimes a room in the attic story can be spared, and this may be advantageously converted into a drying-room, since there openings in the roof may be easily obtained. The oldfashioned high roofs, so common on the Continent, are very convenient for this purpose, for which they are often employed, as well as for drying stores of various kinds. When the laundry is a separate building, the drying may be placed over the ironing-room. When there is no drying closet, the clothes are hung up in the laundry on standing or leaf-folding horses, or lines stretched across, or, what is better, on frames with horizontal bars suspended to the ceiling, and raised and lowered by a rope and winch.

6405. *The best method of drying in doors is by a drying-closet* adjoining the laundry and wash-house. By this the health and comfort of those employed are greatly promoted, by their being almost entirely freed from the pernicious effect of damp vapour, and in not being incommoded by great heat in hot weather; and the linen is kept quite free from smoke and dust. The drying-closet may be 8 feet by 6 feet, and may contain four wooden horses, each with five rails or bars. Each horse runs in and out of the closet upon two small iron wheels upon an iron railway. One such horse will hold six shirts, or a proportional quantity of other linen, and the whole will dry off as much and as speedily as six women can wash in succession; or the drying-closet may be so small that two horses only can be used, and the heat may be sufficient to dry the linen in an hour. The same furnace that heats the irons may likewise heat this drying-closet, by making the flue continue round the bottom of it before it is carried to the top of the building. The top of the horizontal part of the flue must be of cast-iron plates, and a few inches above it the above-mentioned iron railway is laid, between which and the flue there is a flooring of wire-work, to prevent any accident from the casual falling of linen upon the flues, but so as not to prevent the ascent of warm air. Level with the railway, inside the closet, there must be an opening 15 inches square, communicating with the external air. The ceiling of the closet should be in the form of an inverted hopper, terminating in a funnel of the same diameter (15 inches) as the external aperture. Both these openings are furnished with sliding doors, which open and shut, as required, by pulley-cords. like sashes. The principle upon which it acts is by heating it to a degree sufficient to excite a strong evaporation from the wet linen, and carrying off the moisture by means of the two openings. During the time of its acquiring this heat, both the openings and the horses are kept closely shut, so that the closet is nearly air-tight. As soon as the proper degree of heat is obtained, both the vents are to be opened, when a strong current of air rushes in at the lowermost, carrying up all the vapour from the linen through the upper opening or funnel, and thus the drying is very speedily completed.

6406. *But the best mode of heating the drying-closet is by means of a steam-pipe* passing through it; the steam may be furnished by a small copper placed in the wash-house. This will obviate any danger that there may be in heating it with a smoke-flue or iron pipes, which, except very great care is employed in the construction, will exist. In case of using steam, the drying-closet may be constructed entirely of wood, taking care that the joints are made in such a way as not to open by shrinking.

Fig. 825 represents the longitudinal section of such a drying-closet, and *fig.* 826 is the transverse section. *a*, *a*, *a*, *a* is a steam-pipe traversing the interior of the closet, which is seen at bottom again, surrounded by an enclosure; and the air that enters by an aperture underneath is heated, and issues into the bottom of the closet; on each side of this steam-pipe, in the interior, is a horse on rollers for the linen, which is represented, in *fig.* 825, as partly drawn out by a handle. In the transverse section, *fig*, 826, this horse is represented with linen hanging on it. The hot air, with the moisture, passes off at each side through a narrow aperture that communicates with an upright tube, *b*, that can be closed as much as necessary to regulate the draught by a valve turning on a centre.

Fig. 825.

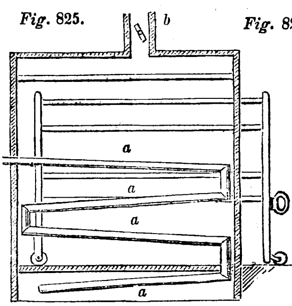
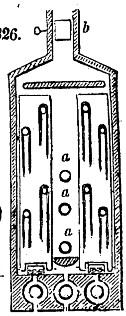


Fig. 826.



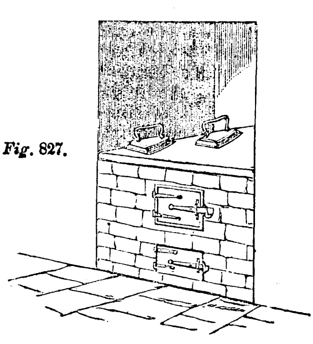
6407. *Drying-houses* are constructed for drying calicoes and other similar fabrics in manufactories on a large scale. They are heated by steam passing through pipes in the drying-house; the cloth is suspended on lines, and the vapour is carried off by apertures in the roof. The advantage of the steam is, that it is quite safe, and that the place can never be overheated.

6408. *A cleanly and expeditious mode of heating smoothing irons* is very essential in a good laundry. In a very small way, these irons are heated by placing them on a moveable iron shelf hung on the bars of a grate; but in this manner they are very apt to be soiled by the ashes and coals, and require very careful wiping to prevent staining the linen. To obviate this inconvenience, *ironing stoves* are constructed, by which the irons are heated without the possibility of their contracting any dirt.

6409. *The best ironing stove is a recess in the wall*, like a small chimney, *fig.* 827, with a hot plate and furnace below it, in the same form as the hot plate described among the apparatus for the kitchen. Upon this hot plate the irons are set to be heated; and there should be an air-flue above this plate, to carry out the hot air and prevent its incommoding the laundry. Generally, however, the ironing stoves are detached, and stand in the laundry, and then answer the double purpose of warming the room and heating the irons.

Fig. 828 is one of the smallest kind; it is all of iron; the fire is contained in the box

Fig. 827.



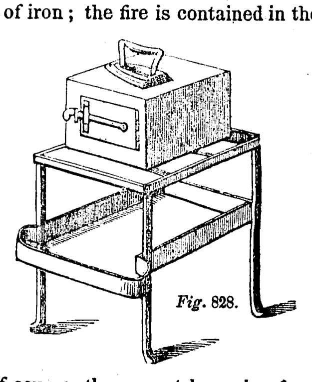
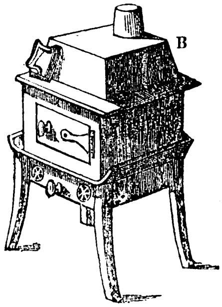


Fig. 828.

on which the smoothing-iron is placed, and, of course, there must be a pipe from the back to carry off the smoke into the chimney-flue.

6410. *Fig.* 829 is a larger one, to hold several irons all round. *Fig.* 830 is one still

Fig. 829.



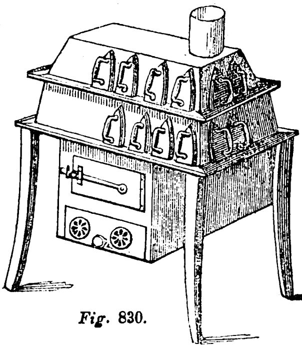


Fig. 830.

larger, for two rows of irons. Both these have registers to the ash-hole, to regulate the draught; by merely closing these, the fire will keep in with very little consumption of fuel, particularly if anthracite be used.

6411. *Joyce's apparatus for heating Italian irons, fig.* 831, is a sheet-iron cylinder within another about four inches wider, the inner one being filled with lighted charcoal, and the space between empty; four cylindrical pieces of brass pass through this space, and enter into the fire-chamber, by which means they are heated sufficiently. The fumes or deleterious gas formed by the combustion of the charcoal pass out through the tube *a*, seen in the apparatus, and when the cover, *b*, is put on they issue through the holes in it.

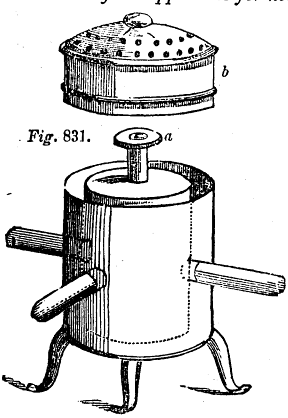


Fig. 831.

In contradiction to those who state that the fuel sold with this apparatus is charcoal, prepared in such a way as to *prevent it from giving out any noxious fumes*, we must observe that the charcoal *does give out* the same deleterious air (carbonic acid gas) as common charcoal; and therefore this apparatus should never be employed where a brazier of charcoal would be considered as unhealthy; no method has ever been discovered of depriving charcoal of its noxious quality when burning, nor is it at all probable that such discovery will ever be made.

6412. *The ironing board,* or table, should be very strong and steady; and for this purpose one end or side of it is generally placed against a wall. It should likewise be placed on the window side, to have the benefit of a perfectly good light. The iron-cloth, which is a kind of blanket made on purpose, of a proper width and thickness, should be double, and should be firmly and securely pinned down round the table, to prevent its moving. Its length must depend upon the quantity of work to be done and the number of persons employed in ironing.

6413. *The mangle* is a necessary article among the furniture of the laundry.

6414. *The common mangle* consists of a large square box loaded with heavy weights, usually stones, which is moved backward and forward upon wooden rollers placed on a level, strong table; and round these rollers the various articles to be smoothed are wound. The motion of the box is accomplished by means of straps fixed to each end, and passed over an upper roller carried round by a winch. By this machine the mangling is done sufficiently well; but the labour of working it is excessive, not only on account of the strength required to move it, but from the continual reversing of the motion; for scarcely has it been got into motion by great exertion than it becomes necessary to turn it back again, and thus power is wasted in constantly having the *vis inertia* of the heavy box to overcome. Its cheapness (the price being from £5 to £8) causes it to be most in use among the poorer laundresses.

6415. *Various patents have been taken out for improved mangles;* one of the best is Baker's mangle, in which the operator keeps always turning the winch the same way, and yet the box moves backward and forward as usual. A fly-wheel is likewise added to equalize the motion. This mangle usually costs from £12 to £18.

Another simple mangle consists of two cylinders placed near each other, as in the wringing machine, but with more pressure; round these the clothes are wound. Such a mangle may be made to take up very little room. Although the operation of the mangle has several advantages, as despatch and preserving the whiteness of the table linen, yet, if not very carefully managed, it may be very injurious to the texture of the cloth submitted to its pressure, particularly in articles where folds are necessary; the creases thus produced are very unseemly, but in the best table-cloths these are taken out afterward by ironing. When there are buttons, or hooks and eyes, in the parts of dress, they are often broken by the mangle, which can scarcely be prevented by any care; such things had better be ironed, or have the buttons taken off. Linen requires to be longer in the mangle than calico; and some things that demand a very high gloss should remain in the mangle all night.

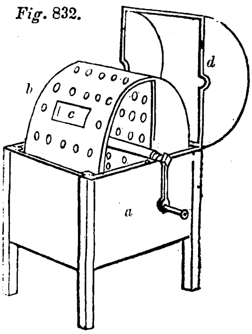
CHAPTER IX.

WASHING BY MACHINES.

6416. *Many attempts have been made to lessen the labour of washing by the use of machinery;* and although it does not appear that any method has yet been invented so simple and effectual as to do away entirely with the manual labour in the ordinary method, yet, as machine-washing has succeeded to a certain degree, and been found useful on some occasions, particularly in manufactories, hospitals, &c., it deserves consideration. One of the advantages of this method is, that hotter water can be employed than in the common way; and, likewise, that alkaline lyes may be used stronger than the hand can bear. Steam may also be combined with it; all of which has the effect of so loosening the dirt that very little hand labour afterward is sufficient.

6417. *A washing-machine was constructed by Mr. William Strutt,* being a modification of the common washing-wheel used by manufacturers, which was used in the Derbyshire Infirmary and other establishments, and is said to have answered completely, at least for the purposes to which it was applied. *a, fig.* 832, is a water-tight cistern, in which a hollow cylinder, *b*, is made to revolve by means of a winch. This cylinder is divided into four parts, internally, by partitions, and a portion of the end of the cylinder is represented as removed to show the inside; these partitions, as well as the cylinder itself, are perforated by numerous holes; and there are larger apertures with doors, *c*, through which the clothes are introduced into the divisions of the cylinder. The linen is well wetted and soaped, or dipped into a soapy liquor, or an alkaline lye, the night before washing. Before the operation commences, as much water, nearly boiling, is put into the cistern as will rise to the height of four or five inches within the cylinder. The clothes are then introduced into the cylinder, and the latter is turned round by the winch. It is necessary to regulate the velocity of the motion very exactly; for, if this be too quick, the clothes will apply themselves close to the sides of the cylinder from the centrifugal force, and if the motion is too slow, they slide down the sides, in either of which cases little effect is produced. The velocity should be such that the linen may be heard to fall from one side to the other every time it is raised out of the water. This discharges most of the water from it, and it becomes filled with a fresh portion every time it dips into the water below. The quantity of soap employed should be such that a strong lather is produced; and if enough has not been rubbed in the linen, some more must be added by cutting thin slices, or some soapy mixture may be used. The process of washing one change of linen may require half an hour; and, to keep the water hot, a pipe may convey steam into the cistern. A cover, *d*, hung on hinges, is made to shut down over the cylinder when it is revolving. The edge of the cover fits into a groove which goes round the top of the boiler, and which, being filled with water, prevents the escape of the steam. When this operation is completed, a little hand washing may be found necessary; and, finally, the clothes must be rinsed and boiled as usual. Previously to rinsing, when the clothes are taken out of the machine, they may be laid upon a tray with holes placed over some vessel, which shall receive the soapy water that drains from them, and which may be used again in the machine until it is too foul. It may be observed that, in cases where a strong alkaline lye is required, pearlash may be used as more economical than soda, although the latter answers very well. An alkaline lye may be prepared from common potash thus: dissolve it in its own weight of water, stir it frequently, and then let it stand for half an hour to settle; pour off the clear liquor for use; it will contain all the alkali, the sediment being impurities.

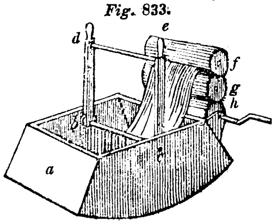
Fig. 832.



6418. *For some common purposes,* and where articles are very dirty, the alkali may be made caustic in the following manner, by the addition of lime; but this must be used with great caution, otherwise, as has been already stated, it will corrode and destroy the texture of the linen. Put common pearlash in a stone jar with five or six times its weight of water; let it stand till it is quite dissolved, and add as much weight of fresh slacked lime as that of the pearlash; stir this mixture frequently for several days, and let it stand to settle; then pour off the clear liquor, and keep it for use in a stone bottle well corked. A small quantity of this caustic solution will be more effective than soap for particular purposes; and it is to be observed that alkali may be employed without danger to some articles that would be too strong for the washerwoman's hands.

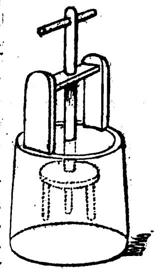
6419. *Another washing-machine sufficiently simple* is represented in the wood-cut opposite. *a*, *fig*. 833, is a box to hold the clothes and the water, with alkali or soap, in which is a frame, moveable backward and forward on the centres *b* and *c*, by means of the handles *d* and *e*. The lower part of this frame consists of a series of wooden bars to agitate or beat the linen until the dirt is removed.

Fig. 833.



6420. *The Dolly*, *fig*. 834, is a useful implement for washing such clothes as are very dirty, and is used in many laundries. It is in form somewhat like a small churn, and strongly hooped. Two uprights and a cross-piece support a shaft with a cross-handle; on the lower end of the shaft, and inside the vessel, there is a circle of wood containing three or four strong projecting pegs. When the clothes dipped in lye have been put into this vessel, with water, the shaft is turned round sharply by the handle, and by the dashing them about they are sufficiently cleaned without the usual manual labour.

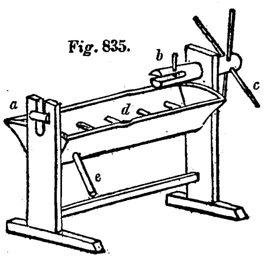
Fig. 834.



6421. *Machines for wringing the clothes* after washing and boiling have also been contrived; and it is observed that the ordinary process of wringing by hand is peculiarly destructive to wearing apparel, especially such as is of a delicate texture. One construction of this apparatus is the following: the linen is put into a square bag of strong sacking, kept open by wooden hoops; this bag is put into a strong box, which opens at one side to admit the bag, and then is closed firmly. The interior surface of the box is grooved to let the water out when pressed. A cover that fits the inside of the box is put in over the bag, and a strong pressure is applied by a lever to the cover, or by a rack and pinion. The pressing down the cover forces the water out of the clothes, which thus receives less injury than by the usual twisting.

Another wringing-machine is represented as attached to the washing-machine, *fig*. 833. *f*, *g* are fluted rollers for the clothes to go between, covered with several folds of flannel to give elasticity to the pressure, and prevent injury to the fabrics. The cylinders have toothed wheels on the end, and are moved round by a small pinion, *h*, turned by a winch The cylinders are capable of being placed at a distance from each other suited to the several articles; but the contrivance for this, as well as the upright stand by which they are supported, are here omitted.

Fig. 835.



6422. *Another wringing apparatus*, *fig*. 835, is described in Loudon's "Cottage Architecture" as useful in small families. The articles to be wrung are taken out of the wash-tub, and being passed over the pin at *a*, the two ends are put through the hole of the twister, *b*, which is turned round by the spokes, *c*. The water drops into the trough, *d*, from which it runs off into a tub or other vessel, through the tube *e*. When small articles are to be wrung, they are put into a coarse hempen bag, which is then treated as above mentioned. This machine does not wear the linen more than common wringing.

CHAPTER X.

WASHING BY STEAM.

6423. Washing by steam has met with little encouragement in England; yet it has been practised many years ago, and has been employed with great success in France. It was first tried by Chaptal, a celebrated French chemist, and the process was improved by Cadet-de-Vaux and by Curandeau, and, lastly, by M. Bourgon de Layne. The process is very simple. The clothes are first soaked in a lye of potash, and then hung in a large vessel kept full of steam by a pipe communicating with a boiler. This vessel for the clothes must be steam-tight; and, on a small scale, a large cask will answer. After remaining a certain time in the steam, generally half an hour, the dirt becomes loosened, and little labour in a subsequent washing is sufficient to detach it by washing with soap. The saving of fuel and labour is thus very great, and the linen is rendered extremely white.

It is stated in "L'Echo du Monde Savant," June 7, 1837, that blankets are washed by these means in Paris for a farthing a pair. We have known washing by steam practised in a tradesman's family in London with perfect success. It should be stated that it will only answer for white articles, for the action of the steam is so powerful as to discharge the colour of dyed things. It is likewise necessary to observe that the linen should be suspended in the steam vessel in such a manner that it shall not come into contact with the suds that drain from it, which, in this case, would produce a bad colour difficult to wash out. Also, it is essential that no iron should be admitted in the apparatus, lest rust should come in contact with the linen. A large copper tea-kettle will produce steam enough for a moderate washing; and to fill with steam the vessel in which the clothes are put, it is necessary to leave an aperture open, at first, by which the common air may be driven out as the steam enters, and which should be shut as soon as the vessel is full of steam; for it is to be observed that the vessel cannot be filled with steam, while, at the same time, it remains full of air; the latter must be driven out, that the steam may occupy its place.

CHAPTER XI.

MARKING LINEN.

6424. *The marking of linen* being connected with the business of the laundress, we shall introduce the subject in this place. Marking has usually been practised with the needle, and still must be for blankets and woollen articles, but linen and cotton can be more conveniently marked with an ink that is indelible by the ordinary processes of washing; observing, however, that this will be discharged wherever the bleaching liquid is used.

6425. *The best marking ink is made in the following manner*, which it is useful to know, as in some places it cannot be purchased or depended upon. Get one drachm of lunar caustic (fused nitrate of silver), which every surgeon keeps; dissolve it in less than half an ounce of pure water (distilled or rain is best), having put into it a drop or two of nitric acid; but this is not essential. This forms the ink; but as it is yet colourless, the writing done with it would not be visible, and it would be too thin. To give it a little colour, add to it a little indigo, or even a drop of common ink; and to give a little thickness, add a very little gum, which by itself will give a greenish colour. To prepare the linen to be written upon, dissolve an ounce of salt tartar (sub-carbonate of potash, the common potash used for washing) in an ounce and a half of water. Wet the linen with this preparation, and let the place dry completely: when the part is dry, rub it with something hard to smoothe the surface, and write with the ink prepared as above. The writing will be indelible. Any one may easily make this ink; but it must be observed that lunar caustic will burn the skin if handled; it should, therefore, be lifted by a pair of pincers or scissors. The ink also makes a black stain upon the skin, which no washing will remove; it must, therefore, be used with neatness and care. If the ink is too pale, there is not lunar caustic enough in it; if there is too much, the ink will be apt to run or blot. Should it not be possible to obtain lunar caustic, the deficiency may be supplied by dissolving a bit of silver, as a small coin, in some aquafortis; the solution is nitrate of silver, nearly the same as lunar caustic, and will answer for marking ink with the addition of a little gum and colour. The vial containing the ink should be kept from the light by wrapping paper round it, or keeping it in a case.

A marking ink is now sold that requires no liquid as a preparation before writing with it. It is said to be indelible, but not being quite certain as to this fact, we cannot at present safely recommend it.

6426. *An indelible ink for printing on linen with types* may be made thus: Dissolve some asphaltum in four times the weight of oil of turpentine; add some lampblack or fine black-lead powder, so as to make an ink of a proper consistence to print with types. Or, take the black residuum after making oxygen gas by manganese and sulphuric acid; mix it with water, and filter it; mix the paste left on the filter with a little dissolved gum tragacanth. The cloth to be marked with must first be wetted with a solution of potash or soda, in the proportion of ten parts water.

CHAPTER XII.

SCOURING, REMOVING STAINS, ETC.

6427. *In England scouring comprehends* such processes for cleaning silks, cloths, woollens, lace, and other articles as do not come within the province of the laundress. The mode of proceeding is more varied and difficult than that of ordinary washing; hence the scourer has become a distinct trade. Those who practise it possess a good deal of knowledge which is not usually attained completely in domestic economy; and when various articles of dress and furniture cannot be cleaned properly at home, they are sent to the scourer, who has not only more skill, but greater conveniences for his business. Nevertheless, as scouring is expensive, a good deal of what is not very difficult may be easily practised with a little attention. We shall in this section treat of scouring, properly so called, where the whole of the cloth is to be cleaned, and likewise of the taking out of spots and stains.

6428. *General Principles.*—Previously to the invention of soap, which affords us so easy a mode of cleaning woven fabrics, various other materials were used. The Romans made use of certain plants and of argillaceous earths; ashes, gall, soda, and urine were likewise employed; and the Persians made use of boles and marly earths. All these materials have still a convenience, and are used in particular cases of scouring, which is, in fact, a variety of washing.

6429. With respect to taking out spots and stains, regard must be had to the nature of the cloth that is stained, and also to that of the matter which produced the spot, since it is desirable to remove the stain without affecting the original colour The most usual substances that produce stains in clothes or furniture are, 1. Fatty substances, as oil, grease, wax, &c.; 2. Resinous matters; 3. Vegetable and animal juices, as wine, fruit, &c.; 4. Iron, ink, &c.

To remove any of these matters, we must find some substance capable of dissolving them without injuring the cloth. Fat, oils, and grease are dissolved by ether, essential oil of turpentine, soap, ox-gall, and solution of alkali; or they may be absorbed by blotting paper, chalk, fullers' earth, &c. The choice of these will depend upon the nature of the cloth that is stained. Soap, or alkali, for instance, will remove grease with ease, but they will also destroy the colours of many dyed stuffs.

When stains are occasioned by acids, alkalies, or any liquids containing these, the colour of the stuff is acted upon and changed. The colour may sometimes be restored by the application of something that would have a neutralizing effect; for an acid, an alkali, and for an alkali, an acid; but this can happen only in case of the acid or alkali having been very weak. The fixed alkalies can unite with oily substances, and, by converting them into soap, render them soluble and easily washed out, but it exercises a powerful action upon wool or silk, so that it cannot be used on them, particularly the latter, except with the greatest care. The volatile alkali, ammonia, has not the same inconvenience as the fixed alkalies. When the oil, or grease, in a spot has been converted into soap by the application of an alkali, this newly-formed soap may be dissolved by spirit of wine. The absorbent earths, such as chalk, fullers' earth, and French chalk, which contains much magnesia, are employed to remove grease, where an alkali would be dangerous. Ox-gall dissolves the grease without injuring the stuffs or affecting the colours generally. To produce the desired effect better, several of these substances are sometimes mixed together to form a material for removing spots; as, for instance, soap, gall, and absorbent earth, and are called *scouring balls.* Sulphuric ether is a powerful solvent for oils and resins, and does not attack the colours, but it is so volatile, that it leaves what it has dissolved too soon. The essential oil of turpentine is, in general, the most convenient agent for combining with and dissolving oil or grease, wax and resins, while, at the same time, it does not affect the stuffs nor the colours; and the disagreeable smell it leaves may be overcome by another essence more agreeable. Some fat substances, and pitch, may be removed by blotting paper, and a hot iron to absorb them. Particular receipts will be given for each of these cases.

6430. *White silk or satin* may be cleaned thus: Dissolve some of the best curd soap in boiling water, and, when the solution is as hot as the hand can bear, pass the silk through it thoroughly, handling it gently, not to injure the texture. If there are any spots, these may be rubbed carefully till they disappear. The article must then be rinsed in lukewarm water, and dried by stretching it out with pins. If satin, the glossy or bright side must be well brushed with a clean clothes-brush, the way of the nap, till it shines; it may then be calendered; or it may be finished by dipping a soft sponge in a little isinglass dissolved in boiling water, and rubbing the wrong side of the satin, which must then be again pinned out, and again brushed and dried. Plain silks do not require brushing.

If the satin is not much soiled, the brightness may be restored by strewing on it some French chalk in powder, and then brushing it off with a hard brush; if once is not sufficient, the process may be repeated. When the silk is large, it may be laid smooth upon a board, and a little soap spread upon the dirtiest parts; then, having made a lather with fine white soap, this may be passed over the silk on one side with a brush, and then upon the other side. It must then be put into hot water, and afterward rinsed in cold water; it must next be dried and smoothed on the right side with an iron not too hot, or calendered.

If the white silks are flowered, the best method is to clean them by sifting on them some crumbs of stale bread, which must be rubbed on with the hands, and then thoroughly shaken and brushed off. If a very little powder blue be mixed with the crumbs, it will be advantageous for some shades of white.

6431. *Black silk is best cleaned* by some ox-gall put into boiling water. The silk must be laid out smooth on a table, and have both sides sponged with the gall liquor; it must then be rinsed out well in clean water. A little gum Arabic, or glue, must be dissolved in water, and passed over the wrong side of the silk with a sponge, when the silk may be stretched out with pins and dried. In many cases it is necessary to unpick the seams of articles of dress, in order to lay each piece flat upon the table.

Gall is a fluid in an animal, likewise termed bile, and is chiefly collected into a receptacle named the gall-bladder, from which it is procured. It is a liquid of a yellowish-green colour, about the consistence of thin oil, and extremely bitter. It contains a good deal of soda; hence its use in removing grease from clothes, &c. When agitated with water, it froths like soap and water; when fresh, its smell is somewhat like musk, but it very soon putrefies and becomes offensive.

6432. *Coloured silks* require a different treatment, on account of the risk of discharging the colours. For common colours, the silk may be immersed and rubbed gently in a solution of soap, as described above, and afterward rinsed in lukewarm water, taking care to be expeditious, lest remaining too long in the soap should affect the colours. More effectually to prevent this accident, the silk should afterward be immediately dipped in water slightly acidulated with oil of vitriol, if the colours are bright yellow, crimson, maroon, or scarlet; orange, fawn, or brown, of any shades, do not require such precaution. Bright scarlet requires to be dipped in water containing a few drops of a solution of muriate of tin. In cleaning silks of various colours, the water should be barely hot enough to extract the dirt, and it is better to give them a second and a third liquor than to use the water too hot. It should be observed that, without considerable skill, the colours of silks are liable to be discharged; and, upon the whole, it is safest to give these to a professed scourer.

6433. *White lace veils* are cleaned by boiling them for a quarter of an hour in a solution of white soap. They must then be gently squeezed till clean, and rinsed in warm water, and afterward in cold water, containing a drop or two of liquid blue. The veil must be starched and cleared by clapping it between the hands, and then dried on a frame, or by pinning out.

6434. *Black lace veils* are cleaned by passing them through some warm water with bullock's gall, and then rinsing in cold water. They are stiffened by dipping them into water that has a little gum or glue dissolved in it, clapped between the hands, and dried as the last.

6435. *Point lace*, if it be not very much soiled, may be cleaned by fixing it in a tent frame and rubbing it gently with crumbs of bread, afterward dusting out the crumbs. If it is necessary to wash it, fix it in the tent frame, make a warm lather of Castile soap, and dipping a soft brush in this, rub the whole gently. Afterward throw over it some clean water in which a little alum is dissolved. The wrong side is then to be gone over with some fine thin starch, and when dry, the same side must be ironed. It is to be finished by opening it with a bodkin, or otherwise it may be cleaned as directed under "Washing."

6436. *Cashmere shawls and Merinoes* may be cleaned by passing them through cold water, having in it some solution of soap in spirits of wine and purified ox-gall, and then through alum-water. They may be stretched and starched as the lace.

6437. *To clean Silk Stockings.*—Wash the stockings in lukewarm water with white soap, to get out the rough dirt; then boil them with soap and water for ten minutes, rinse them in clean water, and wash them again with fine soap, if necessary; if required to have a blue cast, put into the last water a little stone blue in a flannel bag, taking care not to give the stockings too strong a tinge of colour; if required to be of a flesh colour, a little rose pink will do. Dry them, and, to smooth them, put them on wooden legs, two at a time, one over the other, observing that the outsides are face to face; then polish them with a glass, or send them to be calendered or mangled.

6438. *To scour Wool.*—Wool in its natural state is covered with a kind of grease called the yolk, which, as it is found to preserve it from insects or moths, is not removed by scouring till it is to be dyed or spun. The process for scouring wool is this: the wool is put for about a quarter of an hour into a kettle of water, to which some soap or alkali, or, what is better, about a fourth of stale urine, has been added. It is then heated to 140°, occasionally stirred, and, being taken out, is allowed to drain. It is next put into a basket and exposed to a stream of running water, and moved about till the grease is so completely separated that it no longer renders the water turbid. If the wool is intended for dyeing, this process must be very carefully performed. The mode in which the urine acts in scouring is explained thus: urine, left to itself for a few days, is found to contain a portion of the volatile alkali, or ammonia; this combines with the oil in the wool, and forms a soap, which, being soluble in water, is dissolved and carried off. When wool is required to be perfectly white for dyeing, it is sulphurized; and the harsh feel given by this is removed by washing with soap.

6439. *The scouring of blankets* being heavy work, the instrument called a *dolly*, or maid, is sometimes employed to lessen the manual labour in beating and wringing them (see *fig.* 834). Its use is to beat the blankets, counterpanes, and such heavy articles, in the tub with water and soap to clean them. To prepare the water for scouring, cut a pound of mottled or of yellow soap into thin slices, and dissolve it in a gallon of boiling water, adding an ounce of pearlash or of soda. When the soap is quite dissolved, mix the solution with a quantity of cold water, to make it only so hot that the hand can bear it. Put this with the blanket into the scouring tub, which must have a very strong or double bottom, and beat it with the doll, turning it frequently. After it is thoroughly cleaned, the next operation is to wring out the soap and water. This being difficult to do by the hands alone, may be assisted by hanging up the blanket till the two ends meet, and, fixing this to a hook in the wall, pass a short thick stick through the fold; by means of this the blanket can be twisted and wrung out very hard.

In London, blankets are usually sent to the scourers, few town houses having sufficient convenience for this business to be performed at home. But laundresses sometimes undertake them.

6440. *A counterpane* may be scoured in the same manner. If the colour is bad, it will be necessary to boil it in a copper, and in beating it with the dolly to add a little liquid blue.

6441. *Black, blue, and brown wollen cloths* require a different process. The greasy spots must first be plastered over with a paste made with fullers' earth and boiling water, and these places must be dried by the fire or the sun. A little ox-gall must now be mixed with stale urine, adding a little boiling water, still taking care not to reduce the strength too much. Dip a hard brush in this, and brush well the spots which had the fullers' earth, and any other places that may require it. Immerse now the whole cloth in cold water, wash off the dirt, and hang it up to dry. When it is nearly dry, brush the nap of the cloth the right way, and to bring on a gloss, pour a very little olive oil in the hand, and passing the brush over it, brush the cloth over carefully and evenly.

6442. *Cloth of all other colours*, except scarlet, may be cleaned by rubbing the greasy spots with a ball of yellow soap, and when this is nearly dry, brushing off the soap with warm water. If once is not found sufficient, the process may be repeated.

6443. Scarlet cloth requires peculiar care in scouring, as the dye is liable to be discharged. If the cloth is not much soiled, it may be cleaned by washing it in bran water, made by pouring boiling water on bran placed on a hair sieve, adding to the liquor a little white tartar; the process may be repeated, if necessary. If the colour begins to discharge, a drop or two of the solution of muriate of tin must be added to a second liquor of the same kind, and the cloth be kept immersed in it for ten minutes, and then be wrung out and dried. If the scarlet cloth is much soiled, the worst parts must be brushed with soap dissolved in warm water, or the whole must be dipped in strong soap and water, and rubbed quickly; but as soon as the colour begins to give, it must be removed and rinsed out in warm water into which some muriate of tin has been put; after remaining in this for ten minutes, it should be dried in the shade, in a warm room; it may then be cold-pressed.

6444. *In London, in which there are professed scourers*, window-curtains of *moreen* are generally given to them to clean, if the colour is not too faded. They usually charge about sixpence per yard; if watered, about two-pence more.

6445. *Carpets and hearth-rugs may be cleaned in the following manner:* If they are very dirty, they are perhaps best sent to the scourers; but if not, after being well beaten, they are to be laid down, and all the spots of grease removed by laying on them a hot paste of fullers' earth, and next day, when it is dry, brushing it off. The whole of the carpet must now be rubbed over, a piece at a time, with a flannel on which soap has been rubbed, wetted in water that has a little soda dissolved in it, and as soon as a part is thus cleaned, the soap must be removed by another clean flannel, and plenty of clean warm water. Some prefer ox-gall instead of soap, or mixed with the soap, as less likely to injure the colours, using more gall with the water where the spots are worst. Lastly, the carpet must be finished by rubbing with a clean, dry flannel, and dried thoroughly by setting the windows open to remove the smell. If the carpet is very dirty, and not valuable, it may be scoured as a blanket, and beaten with a doll, though this is apt to injure some colours. Professed scourers have a large scouring-board, across which they draw the carpet, to get at it more conveniently; and they rub the dirtiest parts with a piece of soap dipped in boiling water.

6446. *The following receipt for the same purpose* has been given in the "Workwoman's Guide:" Dissolve an ounce and a half of alum in a quart of warm water; also one ounce and a half of fullers' earth in another quart of warm water; put a little of each into a bucket full of soft water, adding a very little gall, and rubbing in some common brown soap. Then wash a small piece of the carpet with a flannel dipped in this mixture, so as to make it rather wet; and, to show the colour, brush it over with soap, which must be well washed off, and the carpet rubbed over with a coarse cloth. Then wash it over with soap and water in which gall, alum, and fullers' earth are mixed, and rub it as dry as possible with a cloth. When the whole carpet is washed over in this manner, piece by piece, it will appear as fresh and bright as a new one. The quantities here given are enough for a large carpet.

Another Way.—Boil some bran in water, and with this wash the carpet with a flannel and brush, using fullers' earth for the worst parts. When dry, the carpet must be well beaten to get out the fullers' earth, then washed over with a weak solution of alum to brighten the colours.

6447. *To clean coach-linings of cloth*, or coarse cloth of any kind, dip a brush in warm gall, and go over the greasy parts ; this will dissolve the grease, and the parts may be rinsed in cold water. Having dried the cloth, take fine sand a little damped, and strew it over ; then beat the sand in with a brush, and brush it off again.

6448. *Clothes powder, for cleaning cloth or cassimer of every kind,* is useful to travellers. It is made by mixing a pound and a half of pipe-clay, an ounce of starch, and two ounces of spirits of wine. Each article should be powdered separately very fine, and the whole mixed together, adding the spirits, a few drops at a time, and breaking the knots ; pack it, when made, in boxes for travelling. An ounce of white pepper added will keep away moths. To use it, sprinkle a small quantity of the powder on the cloth, and rub it in with the hand, then brush the powder out with a clothes-brush. Should there be any spots of grease, put a little of the powder on them with boiling water, and let it lay on till dry, then brush it off.

6449. *Of printed cottons,* some will bear washing in the ordinary way with soap ; others will not, without the colours being injured. This depends upon the processes employed in the printing. When they are washed, it is recommended to add twenty drops of oil of vitriol to the gallon of water in which they are dipped after rinsing, to preserve the colours.

6450. *Chints bed and window furniture,* when not very dirty, may be safely cleaned in the Oriental manner, by using rice water. Boil two pounds of rice in a gallon and a half of water ; when the rice is soft, rub it upon the chints as if it was soap, and wash it in the rice water. Then strain the rice from the water, and wash again till the chints is quite clean. Rinse the cloth, dry, and instead of ironing it, glaze it with a polishing stone, or have it calendered or mangled. The rice water serves instead of starch. If the rods or grooves of the chints be disturbed by this washing, twenty drops of sulphuric acid should be put into the gallon of water before the chints is wrung out, which must be done very gently. It is, of course, necessary to take all chints hangings to pieces, and to separate the fringe bindings and linings, before they are washed. The linings may require to be re-dyed. In London, chints hangings are usually sent to the dyer's.

If the chints is very dirty, it may be scoured with ox-gall and water, which will not injure the colours.

6451. *A method of cleaning silks, stuffs, moreens, printed cottons, or chintses, by the use of potatoes, without injuring the colours,* is described in the "Transactions of the Society of Arts for 1805." Grate raw potatoes, washed and peeled, to a fine pulp ; add water in the proportion of a pint to a pound of potatoes ; pass the liquid through a coarse sieve into a vessel, where it is to remain till the fine white starch subsides to the bottom. Pour off the clear mucilaginous liquor, which is to be used for cleaning. To perform this process, spread the article to be cleaned upon a table, which should be covered with a linen cloth ; dip a sponge in the potato liquor, and apply it till the dirt is removed ; then wash the cloth in clean water several times. The coarse pulp which does not pass the sieve will do to clean worsted curtains, carpets, or other coarse furniture ; and the white starch that subsides may be employed for starching, or instead of arrow-root. Some use the whole of the pulp and water for the scouring ; and others slice the potatoes, and rub them on the stuff as if it was soap.

6452. *To remove spots of Grease from Woollen Cloth, Silk, Cotton, or Linen.*—If the articles will bear washing this will remove it, particularly if the spot be touched with a little alkali ; but if washing cannot be employed, the following methods will be effectual Some absorbing substance may be used, as fullers' earth, or tobacco-pipe clay, of which the first is the best. These earths, melted, must be laid upon the spots, and as the water evaporates the oil will be absorbed, and leave the fibres of cloth ; then, when dry, the earth may be brushed out. A little sulphuric ether may sometimes be necessary to remove the stain completely, and this, again, may be washed out with spirits of wine ; or the following compositions, wetted, may be laid on the cloth. Take an ounce of pipe clay, and grind it with twelve drops of turpentine and twelve of spirits of wine. When dry, the composition must be rubbed and brushed off, when the stains will disappear.

Another Method.—Rub a little magnesia, moistened, on the spot. When dry, brush it off, and the stain will have disappeared.

Grease spots in cloth may also be removed by using soap and water and a nail brush, and afterward wiping off the lather with a wet towel. French chalk may also be used for the same purpose, thus : Cover the spots with scraped French chalk ; place these parts on a water plate containing boiling water, or on the face of a warm iron. This will melt the grease, and the French chalk will absorb it, and the whole may then be removed by brushing. If once is not sufficient, repeat the process ; or the French chalk may be mixed with lavender water, or with turpentine, so as to make a paste, which is to be put upon the stain ; over this lay a piece of blotting-paper, and run it over with a hot iron : then brush off the chalk.

6453. *An excellent method of removing spots of grease from silk or cotton dresses* without hurting the colour is the following : Grate raw potatoes into water, so as to form a pulp ; pass the liquid through a sieve into another vessel of water, and let the potato subside. Pour the clear liquor from the top, which may be bottled for use. Dip a sponge or a small brush in this, and wet the spot till it disappears ; then wash it in clean water. Be very careful not to wet more than the spot, as there is danger of discharging the colour. Spirits of turpentine is, perhaps, the safest thing for this purpose; apply this with a bit of sponge, and rub it with a clean linen rag; the turpentine will dissolve the grease, and the rag will absorb it. A little essence of lemons will correct the smell of the turpentine.

6454. *Scouring drops*, which are made of equal quantities of oil of turpentine and essence of lemon, are sold for taking out stains and grease from silk. They are rubbed on with a bit of flannel, and generally answer perfectly well.

6455. *Scouring balls, for taking spots of grease from cloth or silk*, are likewise convenient. They are made thus: Take pipe-clay, two pounds; fullers' earth and whiting, each four ounces; ox-gall, a quarter of a pint. Powder the whole, and mix the gall with these, stirring and bruising them, so as to compose a stiff paste, which is to be made into the form of rolls, balls, or any other convenient shape. To use them, rub the ball over the soiled part, until it is well covered; then rub it briskly between the hands, and brush out the dust with a clothes-brush: if once is not enough, repeat the operation several times. Any part that is very greasy may be treated by scraping a little of the composition and putting it on with hot water, and when dry, brushing it off. If required to be quite white, the fullers' earth may be omitted, and whiting used in its stead; they do not injure any coloured cloth; or they may be made by mixing eight ounces of white soap, an ounce of oil of turpentine, two ounces of ox-gall, one drachm of lemon-juice, and eight ounces of starch powder.

6456. *Rolls may also be made for removing grease from silk* as follows: Mix an ounce of pounded French chalk with five ounces of pipe clay, and add to this two ounces of spirits of wine. Form this paste into rolls of the size of one's finger. When dry, they may be applied to silk or stuffs to remove grease, in the same way as the balls above described were to woollen cloth; and the stuff must be afterward washed with cold water.

6457. *To remove Oil or Grease from Boards.*—Moisten fullers' earth with hot water, and let it stand till it is cold; then spread a thick plaster of this over the spots: let it remain on all night; next day scour the place with hot water. If necessary, repeat the process.

6458. *To remove spots of wax* from clothes, moisten them repeatedly with strong spirits of wine; this will so far dissolve the wax that it will become dry and brittle, and may then be brushed off; or a few drops of rectified turpentine may be employed as still more effectual; and the turpentine may be washed out with soap and water.

6459. *Balls for cleaning chamois leather* are made by pounding and mixing together one pound of Bath brick, four ounces pumice-stone, two pounds pipe clay, and half a pint of ox-gall. If a yellow colour is required, add sufficient yellow ochre. They are used as the balls last described.

6460. *To take out Spots of Oil Paint from Clothes.*—The paint may be removed before it becomes dry and hard, by brushing the part with soap and water, or more effectually by turpentine; but after the paint has become dry and hard, soap will not remove it. The spot should then be touched with turpentine applied with a pointed stick; this should remain for some time, till the turpentine has dissolved the hardened oil and loosened the paint. When the place is dry, it may be rubbed between the fingers, and the colour will crumble off in loose powder. The smell of the turpentine will go off in a day or two, but may be removed sooner by laying a piece of brown paper on it, and applying a hot iron, or by spirits of wine.

6461. Pitch or tar must be removed by spirits of turpentine, either from cloth or from the hands.

6462. *Recent stains of ink* may be nearly removed if, before the ink is dry, the places be washed with plenty of water after a sponge has been used, to take up as much of the ink as possible; if this does not succeed, rub the part with lemon juice, tartaric acid, or purified wood vinegar, and after that wash it with soap and water.

6463. *To remove Spots or Stains of Ink which have dried, and Iron Moulds.*—The black colour of ink is owing to red oxyde of iron united to a principle existing in all barks, called gallic acid; and iron moulds are the red stains of iron, owing to the red oxyde of iron which is left by itself, from ink, or from contact with rust of iron. Whatever dissolves the iron will destroy the iron mould; acids have this effect, but if they are too strong, they likewise corrode the linen. Certain weak acids, which have a strong affinity for iron, are selected for this purpose, the best of which is the citric acid, or the acid found naturally in the citron, in limes, in lemons, and other fruits. On account of its having been procured plentifully from lemons, it is sometimes called *salt of lemons*, or crystallized lemon juice. For a more particular account of it, we refer the reader to our description of the lemon among "Fruits," Chap. IX., Book VII.

Another acid which has the same effect, and which is now more used, from being cheaper, is the *oxalic acid*, which, it is proper to know, is a deadly poison. This acid exists naturally in wood sorrel; though in this plant it does not exist pure, but combined with potash, forming oxalate of potash, which is also poisonous. The leaves of wood sorrel, which contain in their grain this oxalate of potash, when bruised and rubbed upon iron moulds, removes them; but as a more convenient mode, this salt has been extracted from sorrel and is sold for this purpose, under the very improper name of salt of lemons.

6464. *The method of taking out iron moulds with salt of lemons*, whether the genuine or the fictitious (the salt of sorrel or oxalate of potash), is this: A small quantity of the salt is pounded and applied on the spot; and then some hot water is dropped on it, and rubbed in, upon a pewter plate placed upon a stove, or on a water plate containing boiling water; the acid dissolves the iron in the iron mould or the ink, and a little warm water washes all out. If one is not enough it must be done over again. The rationale of this effect is, that the oxalic acid has a greater affinity for iron, whether in the ink or in the state of iron mould. It unites, therefore, to the iron, leaving the potash, and forming an oxalate of iron, which salt is colourless, and being soluble, is easily washed away. The method of making the salt of sorrel from the juice of the plant has been described in our account of "Sorrel," Chap. IX., Book VII. If the stains are of long standing, and difficult to remove, the spots may be wetted for five minutes with sulphuret of potash or muriate of tin, and after this is washed out, applying the citric acid.

Iron moulds may likewise be removed by the bleaching liquid to be described.

6465. *Stains from vegetable substances, as fruit, wine, &c.*, may be removed by simple washing, if that can be done before the stain is dry; but after that the colouring matter adheres with more force, and is sometimes difficult to remove. If the stain be recent, it may be destroyed sometimes by rubbing on a little alkali, as soda or pearlash; but a mixture of ammonia and spirits of wine is safer; the spots should be soaked in it some time. Some faint stains left may be destroyed by moistening the cloth and holding the spot, at a due distance, over the fumes of a brimstone match.

Some recommend putting salt upon the part as soon as the accident has happened; and probably the stain may come out in the washing. Rubbing on the stained part immediately soap and whiting is also recommended; after which it must be well bleached in the air. Some stains may be removed by sour butter-milk.

6466. *If the fruit stains have been long in*, rub the part on each side with yellow soap, then put on thick starch in cold water and rub it well in; hang the linen in the air, exposed to the sun for three or four days, and, if that is not sufficient, repeat the process.

6467. *The most effectual thing for removing stains of all kinds, except those from grease, is the bleaching liquid.* This is sold for the purpose under that name, but as the price is considerable, we shall show how it may be procured at a cheaper rate. The powder called chloride of lime (for the nature of which, see "Bleaching") is sold, and may be bought for 6*d*. a pound. To make a solution in water, which constitutes the bleaching liquid, put four ounces into a wide-mouthed quart bottle, add to it a little water, and stir this together with a stick; then fill the bottle nearly full with water, and let the whole stand together corked for about a fortnight, that the chloride may dissolve. During this time, some gas will be disengaged, and to prevent this driving out the cork, twice a day it will be well to take out the cork for an instant only; and it is to be noticed that the gas has an extremely offensive, suffocating smell, and that it must by no means be suffered to get into the lungs, or it will cause excessive coughing; though when diffused through the apartment in such small quantity it is not hurtful. At the end of the fortnight the clear solution is to be poured off, and kept in a well-corked bottle, with paper wrapped round the bottle, in a dark place, for light or air injures its properties. This solution, or bleaching liquid, when diluted with water, will remove any stains from linen by keeping the part some time wetted with it; but it has no effect upon grease or oil.

6468. *If neither the bleaching liquid nor the chloride of lime can be procured*, chlorine itself may be formed thus; and it will have the same effect: Into a large tumbler put one drachm of black oxyde of manganese finely powdered; this may be had at most of the druggists'; add to it three drachms of common salt. Pour upon this mixture two drachms of oil of vitriol; a thick greenish vapour will immediately appear, which is the chlorine gas, set loose from the salt; and it is this gas that has the peculiar property of destroying colours, and, consequently, of removing stains, as is explained under "Bleaching." The fabric that has been stained must now be wetted, and held tight over the top of the tumbler, that it may come in contact with the gas, which will very soon cause the stain to disappear. But this can only answer for textures that are white; for if coloured ones, it will remove the colour, together with the stain, in which the remedy would be as bad as the evil. It is necessary to observe that, whenever the bleaching liquid or the chlorine gas is applied, the linen must be *immediately* very well washed and rinsed afterward; since if this should be neglected, its texture would be rotted or much weakened; but if employed with proper precautions, they are as safe as soda or pearlash. The bleaching liquid is safer than the chlorine gas.

6469. *An extemporaneous bleaching liquid* may be thus made: Put a few grains of the chlorate of potash (a salt kept by most chemists and druggists) into a tea-spoonful of common salt, and dilute it with water.

6470. *To remove Mildew from Linen.*—Moisten a piece of soap, and rub it on the parts affected. Then rub over the parts with whiting; lay the linen on the grass, and from time to time, as it becomes dry, wet it a little.

6471. *To restore the nap* in places where clothes have been worn threadbare, a process may be occasionally resorted to which is employed by dealers in old clothes. They soak the cloth in cold water for half an hour, and then, having laid it upon a smooth board, they raise the nap by rubbing it with a thistle called a teazle, used by manufacturers of cloth. The nap is then brushed in one direction to lay it.

6472. *To raise the Pile of Velvet when pressed down.*—Warm a smoothing-iron moderately, and cover it with a wet cloth, and hold it under the velvet; the steam or vapour rising from the heated cloth will penetrate through the velvet, and enable a rush whisk to raise the pile.

6473. *To sulphur Silks, Woollens, Straw Bonnets,* &c.—The fumes of sulphur, consisting of the sulphureous acid gas, have a powerful effect in destroying colour; and are, therefore, much employed in whitening various substances. The way of managing it is as follows: Provide a large box or cask to hang the clothes in, and on the bottom of the box place a small chafing-dish with some lighted charcoal; upon this strew some brimstone, and cover up the box close, leaving the things to hang for several hours.

6474. *To clean white, brown, or fawn-coloured Feathers.*—Dissolve some fine white soap in boiling soft water, and add a small bit of pearlash. When the water is just cold enough for the hand to bear it, pass the feathers several times through it, squeezing them gently with the hand. Repeat the same process with a weaker solution of soap, and then rinse the feathers in cold water, beating across the left hand for about ten minutes, to expel the water; when they are nearly dry, draw each fibre or flue over the edge of a small blunt knife, turning it round in the direction you want the curl to go; then, if the feather is to be flat, put it between the leaves of a book to press it.

6475. *Black feathers* may be cleaned with water and some gall, proceeding as with the last.

6476. *Wash-leather gloves*, as their name implies, may be easily washed with soap and water; when nearly dry, the fingers should be stretched with a piece of wood.

6477. *White and coloured kid gloves* are more difficult to clean; but it is said they may be cleaned perfectly by laying them on a clean towel, rubbing them with a piece of flannel dipped in a hot, strong lather of white soap, till the dirt is removed, using as little water as possible. Hang them up at a distance from the fire to dry gradually, and after they are quite dry, pull out the shrivels and stretch them on the hand.

BOOK XXIII.

CARRIAGES.

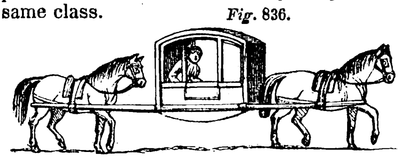
CHAPTER I.

HISTORY OF CARRIAGES.

6478. No nation entirely in a savage state is possessed of any vehicle such as we denominate *a carriage;* and mankind must have advanced somewhat considerably in civilization before they subjected animals so far as to domesticate them for the purpose of drawing wheel-carriages. The Esquimaux have trained dogs to draw their sledges, and the North American Indians use horses for riding, an art introduced by the Spaniards. Besides these, asses, mules, lamas, camels, dromedaries, elephants, and even the bull and cow, have been used in various countries for draught, though the origin of their substitution for human power cannot be traced. Of these, the horse, the ass, and the mule are found the most generally useful; the camel and dromedary are preferred by the Arabian only when he crosses the sandy desert, on account of their being able to subsist long without drink. Among the Indians of Peru the lama is the common beast of burden; and in other countries, as Iceland, the horse is the sole means of conveyance from place to place, and to carry provisions and merchandise.

In crossing steep and rocky mountains, impracticable for carriages, or even for horses or mules, such as parts of the Andes of America, travellers are carried in a chair on men's backs; in China, one of the best modes of travelling is in a sedan, carried by two men on elastic poles, connected at the ends; and the same method is used in some parts of Brazil. In India, the palanquin is a more luxurious kind of conveyance of the same class.

Fig. 836.

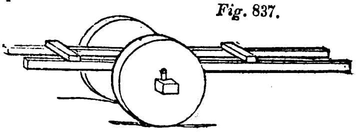


6479. *The ancient litter, fig.* 836, was a kind of vehicle borne by men upon shafts, in the manner of the palanquin. It was much used among the Romans; and Pliny calls it the traveller's chamber, the name *lectica* having probably been derived from *lectus*, a bed, there being usually a pillow and a quilt within. In the time of Tiberius, these were in common use, as we learn from Seneca. The litter was also sometimes conveyed by horses; and the horse litter, which was introduced into Rome from Bithynia, was first brought to this country by the Normans; it is still used by the pope on certain state occasions, and also by travellers in the mountain passes in Sicily, Spain, and Portugal. For several reigns succeeding the Norman conquest, these were the only carriages employed in England for travelling by opulent persons; and this vehicle was used as a conveyance even long after the introduction of coaches, being the easiest, and giving least fatigue of any then known. The mother of Charles I.'s queen entered London in a litter after having travelled from Warwick in a coach.

6480. *Previous to the invention of wheels, the sledge* was no doubt long in use. The facility with which a log of wood can be dragged would suggest the idea; and in northern countries the sledge is constantly employed, in the present day, when the ground is covered with frozen snow. In Madeira, the heavy pipes of wine are drawn on sledges from the mountain vineyards to the coast, and a person accompanies them to wet the bare rocks with a mop, to diminish the friction. A similar instance is the sledge loaded with barrels employed by the London brewers, and drawn by a single horse. In Wales, sledges are used to draw hay and corn; but in all sledges on dry ground the friction is considerable.

6481. *Wheel carriages are of great antiquity*, being mentioned in the history of Joseph when among the Egyptians; and drawings from ancient representations of Egyptian chariots have lately been published. Indeed, the discovery of the wheel could not be long after the practice of moving logs or trunks of trees by means of the lever. Heavy stones were likewise moved, in ancient times, upon rollers.

Fig. 837.



The first wheels were probably solid cylinders (*fig.* 837), which would afterward be lightened by connecting together by a beam or axle two slices cut off a tree; and two poles joined by cross-pieces laid upon this axle would form the simplest carriage. The next improvement would be rounding the axle (*fig.* 838, *a*) and making the solid wheels revolve upon it; and a frame of wood-work, with a handle to draw it by, was probably the first wheel carriage. Nearly such a vehicle may still be seen in the hands of the modern mason. The antique car used in war by the Egyptians and Greeks was equally simple; the wheels were small, but perforated to give them lightness (*b*, *fig.* 838), the warrior standing in the carriage. A box, or basket, placed upon the axle, makes the rude cart; and the construction of the wheels in the present mode, of naves, spokes, and felloes, is another advance towards perfection, which not only admits of their being of larger size, but causes them to be more durable, by a metal band all round the circumference.

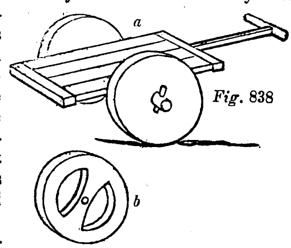


Fig. 838

But two-wheeled carriages would be found inconvenient for moving heavy loads, because part of the load must be supported by the power employed for the draught, whether men or animals. This would give rise to the use of four wheels, by which the whole weight would be on the carriage, and the power of draught only required; with this view, at first, no doubt, all the wheels were of equal size, like those on our railroads, and such was, probably, long the construction of four-wheeled carriages.

6482. *Though Beckmann, in his History of Inventions, has taken considerable pains to prove that covered carriages* for travelling and pleasure, under different forms and denominations, were used among the principal nations of antiquity, yet the earliest mention of them in modern Europe is towards the end of the thirteenth century. During the feudal times, it was the fashion for the lord to appear on his courser, and the fine dames sat gracefully upon their palfreys; but when Charles of Anjou entered Normandy, his queen appeared in a *caretta*, highly ornamented with velvet and gold. The French *charette* was the same kind of ornamented and covered cart; it is mentioned by Chaucer as having been introduced into England; and probably it had no springs. Various contrivances of this kind appear to have been employed, either for invalids or as a luxury, although the accounts of them are extremely imperfect. Hungary is the reputed birthplace of the proper coach, and, according to some, received its appellation from *Kotsee*, a Hungarian village, where it was first invented. In 1294, Philip the Fair forbade the use of these vehicles to citizens' wives; and in the reign of Edward III. of England, although they were not uncommon, it was long considered as effeminate to ride in a coach. Various kinds of vehicles no longer known were, however, used formerly in this country by the middle classes; and at tournaments they were objects of great display.

6483. *About the beginning of the sixteenth century coaches became extremely numerous* among the nobility on the Continent, and frequently consisted of a carriage having pillars supporting a canopy with curtains, to which, ultimately, glass succeeded. Stowe informs us that coaches were not used in England till 1555, when the first was made for the Earl of Rutland; and in 1564 one was constructed for Queen Mary. Queen Elizabeth had been on the throne seven years before she had a coach, but she used frequently to travel in one during her progresses; before that time, she used frequently to ride behind her lord-chamberlain on horseback. Since that time coaches have been in constant use.

6484. Mr. Adam, in his interesting work on Wheel Carriages, has described a vehicle contrived in France in the reign of Louis XIII., and brought into general use in Paris. It was named a *brouette*, or *roulette*, and was in the form of a sedan chair, placed or suspended between two large wheels, in such a manner that the bottom of the body was within a foot of the ground, and it was drawn by two men. This mode of hanging the carriage may have partly suggested the form of our present hackney cabs.

6485. About 1624, *sedan chairs* were introduced into England by Sir S. Duncombe, who was a great traveller, and had seen them at Sedan; these were long a rival to coaches.

6486. *The addition of springs to carriages*, with a view to prevent the jolting which occurs in passing over rough roads, is, comparatively, a late improvement. Before steel springs were invented for this purpose, the bodies of the four-wheeled carriages of Europe for travelling were suspended by long ropes or thongs placed beneath, which were fixed to the frame with wheels; and the seats were suspended on straps, somewhat in the manner in which we still see occasionally light butchers' carts in the country parts of England. In countries where the roads are very bad, springs can scarcely be used, being liable to break, and repairing them on the spot being generally impossible; but the inconvenience of the necessarily long leathern straps by which the bodies were hung would naturally lead, in time, to interposing some kind of spring between the body and the carriage to break the concussion, and elastic wood was first resorted to. This was applied in various ways, until the superiority of springs made of steel became evident, and the improvements in roads permitted their adoption.

CHAPTER II.

CONSTRUCTION OF FOUR-WHEELED CARRIAGES.

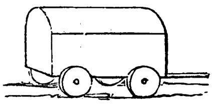
6487. *The construction of modern carriages is far from being simple or obvious to persons in general* who have not paid particular attention to them; indeed, we believe that few persons will be found, even among those who keep carriages, who have correct ideas respecting their construction and mode of action; as, for example, in what manner a four-wheeled vehicle is enabled to turn. On this account, and likewise because this interesting subject has not hitherto been treated of satisfactorily in any popular work, we have considered it desirable to explain the leading principles on which wheel carriages in general are constructed, a branch of knowledge highly useful to all who have to choose such vehicles for their own use; and we shall likewise point out the distinctions between the various carriages at present in fashion, but confining ourselves to those used for pleasure and convenience, and drawn by horses, omitting steam-carriages and all vehicles for transporting goods, as carts, wagons, &c.

6488. *Less than half a century ago the variety of carriages was very limited;* but these have multiplied so much of late years, that an enumeration, or even a distinct classification of them, has become difficult. Besides our native constructions, a few foreign kinds have been introduced, which have been submitted to the alterations of our coachmakers to adapt them the better to English habits. As it is now the custom much to consult the particular wishes and tastes of the possessors, coach-builders have departed from the trammels of ancient forms, and are continually producing new varieties, which cannot be easily classed; and the former names having been still, in a great measure, retained, with some modification, great confusion has taken place in the nomenclature of carriages. Among those which have been so remarkably altered, the phaetons may be cited as an example, and carriages termed phaetons are exceedingly unlike each other. This is endeavoured to be corrected by some addition to the name, as cab phaeton, britzschka phaeton, &c.; but it would be impossible to lay down any rule by which an inexperienced person could name or class the different carriages now in use. In some cases the new carriage has been named after the inventor, as the Tilbury and Stanhope.

6489. *Carriages are divided into four-wheeled and two-wheeled*, each of which forms a class that requires to be considered separately; and although the latter is the simplest, yet we prefer commencing with the first, as containing the greatest number of parts, many of which are common to both classes.

6490. *The most simple kind of four-wheeled carriage* is that which was probably of the original construction, a large open box, or a covered chamber placed upon two fixed axels, having wheels on each end, in a similar manner to some of those first used on the railroads (*fig.* 839). But the construction at present of carriages for pleasure, which are drawn by horses, is much more complicated; and to explain the origin and nature of their structure requires that we should enter into some previous details. When four-wheeled carriages were first used in the simple form we have mentioned, it would be found that they would go perfectly well upon straight roads, or where there was very little bend; but that it would be difficult to make them turn in a confined space, because, while turning, both axles being fixed, the fore wheels would partly drag along the ground, instead of revolving like the hind weels. This inconvenience is now obviated by a very ingenious contrivance, which is adopted in all four-wheeled vehicles.

Fig. 839.



6491. *Although, in common language, the term carriage is applied to the whole vehicle,* yet, among coach-makers, it is more limited in its application; according to them, the vehicle consists of two parts, the *body* and the *carriage;* the first being the receptacle for the passengers, and the second the system of frame-work with the wheels, to which the body is fixed or suspended. The carriage part is also divided into two, called the *upper* and *under carriage*, these being separate and distinct framings. The upper carriage or framing remains either attached to the body, *a a* (see *fig.* 840, which represents the under side), or, at least, always remains in the same relative position with respect to it, and it contains the hind axle, with its two wheels, *b b*. But the under carriage or framing, which contains the axle with the fore wheels, *c c*, is so contrived that it is moveable on a centre, *d*, into oblique positions, the use of which is, that, being by its moveable property always at right angles to the direction of the road, represented by the dotted lines, its wheels can revolve instead of dragging along the ground, as they must have done if fixed to the body like the hind ones. Thus, though both axles are parallel while moving forward in a straight line, they are no longer so while the carriage is turning. The fore wheels may be considered as the conductor of the carriage, and their axle is turned by means of a long, horizontal lever attached to it, called the *pole*, passing between the horses. This turning of the fore axle is termed "*locking*."

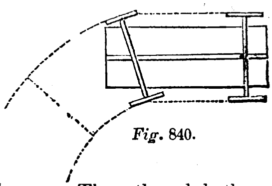


Fig. 840.

If the body be considered as a large open box, having the hind axle fixed on the under side, and the fore axle turning on a pin in its centre, we shall have the construction of the ordinary four-wheeled carts, and perhaps of the most ancient carriages. But the introduction of the present manner of hanging the body by straps or braces, to lessen the concussion from rough roads, caused the carriage part to be detached from the body, and the hind and fore axles, with their wheels, to be connected together, not by the body, but by a separate long piece of wood or iron, *d e*, called the *perch* of the carriage. The under carriage turns upon a pin, called the *perch bolt*, passing through it and the perch, thus connecting them together, while the perch is fixed immoveably to the hind axle. The two axles with the perch now become the proper carriage part, and, if detached from the body, may be drawn together alone by the horses, as may be frequently seen when repairs or alterations are being made, and in breaks for horses. This construction, however, of an upper and an under carriage, though productive of so much advantage in turning, has given rise also to some imperfections. It is obvious that if the body be as long as the distance between the axles, when the fore axle is turned into an oblique position, it will come into contact with it, and be prevented from moving farther round, except the body be placed so high that all the wheels may pass beneath it; but this great elevation of the centre of gravity would be unsafe and inconvenient, and has led to making the fore wheels smaller than the hind ones, that they alone may pass beneath the body in turning; or that the body should be modified so that the fore wheels shall not interfere with it, which is sometimes effected by cutting away a portion of the front under part, called by the coach-makers, technically, a "step piece." These considerations have been the occasion of the custom that has long been universal, of making the fore and hind wheels of carriages of different sizes; and some have erroneously imagined that a mechanical advantage has been thus obtained; whereas, on the contrary, the fore wheels, being smaller than the hind ones, lose somewhat of leverage, and, besides being obliged to make more revolutions in the same time than the hind ones, have increased friction, and wear out sooner; but, notwithstanding these defects, the great accommodation in turning has caused the practice to be continued.

6492. *Having now given the simplest idea of the principles by which a modern four-wheeled carriage is enabled to turn easily,* and which is essential to its perfection, we shall proceed to describe the actual structure of the carriage of a coach, as this will enable the reader to understand more clearly that of any other travelling wheel vehicle.

6493. *Figs.* 841, 842, 843, 844, represent the plans and elevation of the carriage part of a coach. *Fig.* 841 is the plan of the carriage part, in which the upper carriage is drawn in full lines, and the under carriage in dotted lines. For the convenience of reference, the same letters are attached to the corresponding parts in all the figures 841, 842, 843, 844.

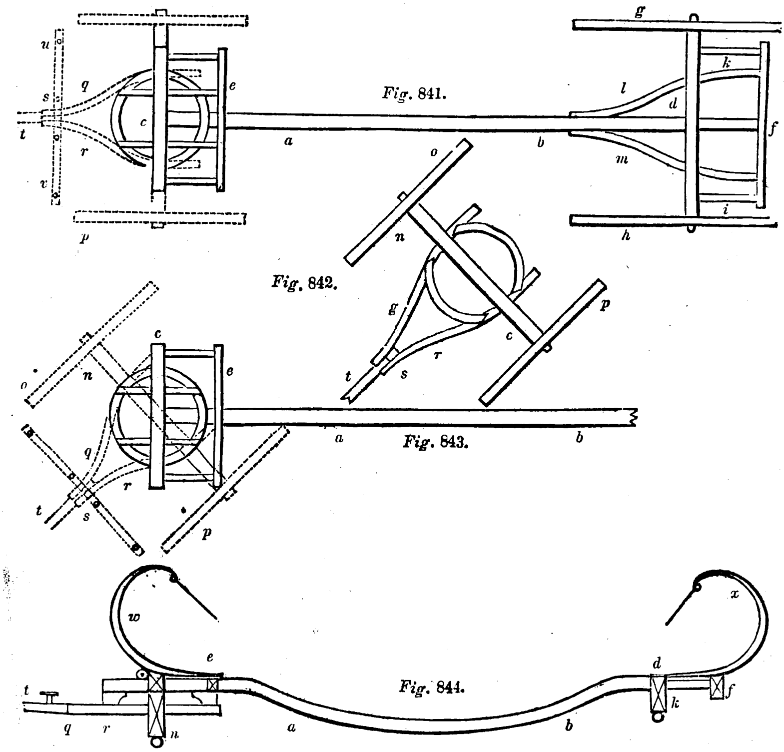


Fig. 841. *Fig.* 842. *Fig.* 843. *Fig.* 844.

To begin with the plan of the upper carriage: *a b* is the *perch*, which, as seen in the elevation, *fig.* 844, is of the curved kind. It is framed into a cross-piece, *c*, called the *fore transom*, in the fore part, and into another cross-piece, *d*, called the *hind axle bed*, which is a strong piece of wood, in the under side of which the hind axle of iron is bedded, carrying the hind wheels, *g* and *h*, *fig.* 841. To complete the description of the hind part of the carriage, we may point out another cross-piece, *f*, called the *hind transom*, or *hind spring bar*, connected with the hind axle bed, *d*, by short pieces, *i* and *k*, *fig.* 841, called *nunters*. Two curved-spreading pieces, *l* and *m*, called *wings*, cross these, and are fixed to the perch. In the fore part of the upper carriage, besides the fore transom *c*, already mentioned, there is another cross-piece, *e*, called the *horn bar*, connected with the fore transom by short pieces. To comprehend the under carriage, the reader must imagine a very strong piece of timber lying beneath the fore transom and the perch, the ends of which are seen projecting in dotted lines beyond, carrying the fore wheels *o* and *p*, *fig.* 841, but which appears distinctly in *fig.* 844, where it is marked *n*, and also in an oblique position, *n*, *figs.* 842 and 843, which represent the fore axle in the act of turning. An iron pin, called the *perch bolt*, passes down through the fore transom and the fore axle bed, thus connecting together the under and upper carriages, and enabling the fore axle to turn on it as a centre, as is represented in *figs.* 842 and 843, which is the contrivance to make the carriage turn already spoken of. To render the nature of the under carriage more evident, it is represented not only in the dotted lines in *figs.* 841 and 843, but by itself, and without the upper one, in *fig.* 842.

To enable the horses to turn the fore axle *c*, two curved pieces, *q* and *r*, called *futchels*, are framed into the fore axle bed, and are united together at *s*, called the *chops of the futchel*, between which the pole, *t*, that passes between the horses, is inserted: *u* and *v*, *fig.* 841, is the *splinter bar*, fixed upon the futchels, to the roller bolts of which the traces are attached, to draw the carriage by.

If the reader will now refer to *fig.* 845, he will see a perspective view of the fore part of the upper and under carriage, in which the names of the different timbers are written on them to render the subject clearer. *Fig.* 846 represents a view of the framing of the fore part of the carriage by itself. In *figs.* 845 and 846 the place of the perch bolt is marked by a small circle, *x*, in the middle of the upper side of the fore transom and of the fore axle bed, it being this pin that connects the under with the upper carriage, as above stated, and by which one turns on the other.

It remains now to explain the circles seen in *figs.* 841, 842, 843, 844, 845. To keep

Fig 845.

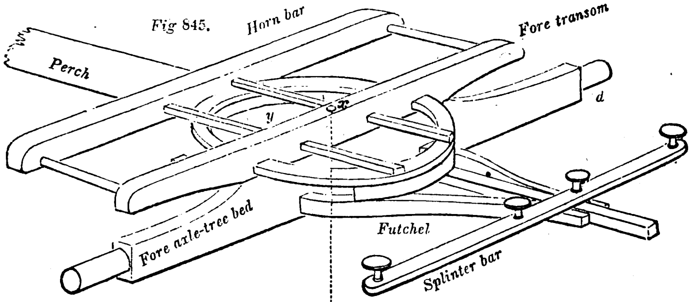
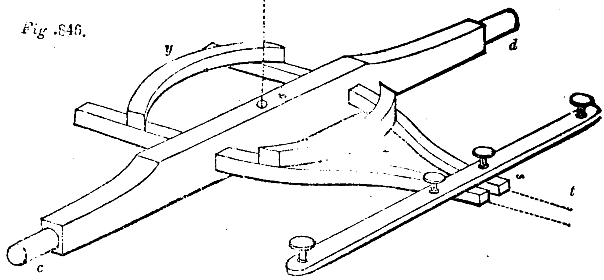


Fig. 846.



the upper and under carriages more steady, in turning them, than if there was only the perch bolt to depend upon, and to give a greater bearing to the upper one, a circle of iron, or, rather, an annular plate, called the *wheel plate*, is fixed on the under side of the fore transom, and, of course, between it and the fore axle bed; and, to bring its bearing to the futchels, short pieces of wood, being portions of circles, are placed under it at *y* and *z*, *fig.* 846, of which *y*, *fig.* 846, is called the *sway bar*, and *z* the *felloe piece*. The edge only of the wheel plate can be seen as a thick black line in *figs.* 845 and 846, because the upper side of the plate is protected by a circle of wood. It may be observed that this wheel plate, being attached only to the fore transom, which is a part of the upper carriage, remains always fixed, the under carriage turning against it. *c* and *d*, *figs.* 845 and 846, are the axle-tree arms on which the wheels revolve. Having thus explained so minutely the various pieces of the fore part of the upper and under carriages on *figs.* 845 and 846, it will be unnecessary to go over the ground again by a reference to the wheel plate in *figs.* 841, 842, 843, 844. In *fig.* 844 the springs are represented, *w* and *x*, from which the carriage is suspended, as in the complete representation of a coach, *fig.* 853. The construction we have just described may be seen in almost every private and hackney coach; and the reader who wishes to have a perfectly clear idea of the subject will do well to follow our description by an actual examination of one of these carriages; but it must be stated that, to render the wood-cuts simpler and more easy to be understood, we have purposely omitted all the ornaments with which the various timbers are usually decorated.

6494. *Springs of Carriages.*—Having now explained the construction of the carriage part of a coach, and other four-wheeled vehicles of the first class, the next subject that demands our attention is the manner in which the *body*, or place for the passengers, is connected with it. The most ancient wheel carriages were without springs or any other method of lessening the jarring produced by rapid motion over rough roads, which, in the antique cars, as represented in bas-reliefs, appeared to be so considerable, that the drivers were obliged to stand upright to enjoy the benefit derived from the elasticity of their muscles. The simplest, and probably the first method of affording ease, was to suspend the seat by straps or lashings. The next improvement would be the separation of the sitting part from the frame carrying the wheels and axles, and the supporting of the former by long ropes or straps stretched beneath it, and fixed to uprights rising from the frame: a construction borrowed, doubtless, from the horse-litter. The four-wheeled carriages of Europe, used for state purposes, were constructed upon this plan; and their great weight and slow movement prevented any violent concussion. Many of the stage-coaches of France are suspended on the same principle, as well as many of the carriages in Canada. In countries where the roads are very bad, the use of springs is scarcely admissible, as they are then very liable to be broken. In these cases, considerable weight is useful to prevent the vibration from side to side. Elastic substances, to prevent the concussion, are an improvement on suspension only. Wooden springs were first used, suggested, no doubt, by the elasticity of the bow; and some of these were in use not long since. Steel was next employed for a spring, and at first it consisted of one piece only, tapering; but afterward several laminæ of steel plates bound together, as at present, were found to be better, as being less liable to be broken.

6495. *The method of connecting the body with the carriage part forms one of the most important distinctions in carriages*, and much of the ease of the passengers depends upon the particular manner of effecting it. It is either now suspended by *strong leathern braces attached to springs rising from the carriage part*, in the manner of the coach, *fig.* 853, or, without any suspending traces, it is placed *upon the carriage part, springs of some kind intervening between this and the axles*, as in the phaeton, *fig.* 857.

In the carriages that have the bodies suspended by braces and springs there are sometimes, likewise, other springs beneath the carriage part, resting on the axles. In the latter case the vehicles are termed *under-spring carriages;* and these are the easiest of all for the passengers.

6496. *It is necessary that we give a technical description of the various kinds of springs now constantly employed to diminish the jarring or jolting occasioned by obstacles on roads.*

6497. *Single elbow springs, fig.* 847, are nearly straight, being only very slightly curved, and consisting of several plates of steel laid upon each other, and each shorter than the others, so that the whole tapers from one end to the other, the largest plate being the thickest. The several plates are kept together by hoops or clips.

Fig. 847.

6498. *The double elbow spring, fig.* 848, is the single elbow spring repeated right and left. Examples of it may be seen in the modern phaeton, Tilbury, Dennet, Stanhope, and in most two-wheeled carriages, where it is fixed across the axle at right angles. It is also used in the omnibus and stage-coach.

Fig. 848.

When the weight leans upon the spring by means of curved pieces of iron, called *loops, fig.* 849, which are connected with the springs by shackles, *b, b*, it is called the *grasshopper spring*, and is used in the Dennet and light carts. The longer the springs are, the more elastic and easy is the motion.

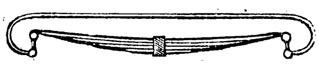


Fig. 849.

6499. *Double curved springs, called S springs*, were formerly the principal springs to which the bodies of four-wheeled carriages were hung by suspension braces; see *fig.* 853, in the coach; but they are now scarcely ever used, being superseded by the spring described next.

6500. *C springs, fig.* 850, are now universally employed for suspending the bodies of carriages with perches, as may be seen in the cuts of the coach, *fig.* 853, chariot, *fig*, 855, &c. One great advantage of this form over the S spring is, that the leathern brace is stretched round the back of it, and can be tightened by means of a small iron axle and notched wheel called a jack, *a:* this is rendered necessary occasionally, because the weight of the body gradually stretches the braces, causing the body to sink down nearer to the ground. Accidents from breaking rarely occur in C springs, though they are frequent in double elbow and elliptic springs. The C springs, also, from their long braces, yield a universal motion before, behind, downward, and sideways, and therefore are the easiest for the rider, though not for the horse; whereas elbow and elliptic springs are confined to vertical action, which is less easy.

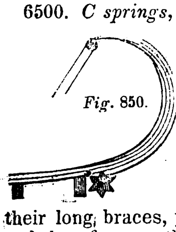


Fig. 850.

6501. *Elliptic springs, fig.* 851, are those most commonly now used in modern light carriages without perches. They consist of two curved springs placed on each other with the concave surfaces opposite, and connected together at the ends, forming nearly the figure of an ellipsis. They are placed on the axle-trees at right angles, and the weight of the body bears upon the upper spring. Examples of these may be seen in all the four-wheeled carriages without perches. They are less easy than the C springs with braces; but, through the great improvement of roads and pavements, they are not much inferior in this respect. They are easier than the double elbow.

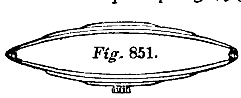


Fig. 851.

6502. *When under springs are used* in under-spring carriages, mentioned above, the most usual one is a curved spring like the lower part of the elliptical; but, instead of another curved spring being placed above this, there is a curved iron, *fig.* 852, simply called a *dumb stay*, because in this case so much elasticity is not required.

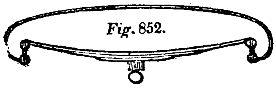


Fig. 852.

6503. *Combinations of several of the above springs* are employed in various carriages, and receive different appellations by coach-makers. Thus, when four elliptic springs are used in a four-wheeled carriage, the whole is termed the *nut-cracker springs*. *Telegraph springs* are a combination of eight springs, when used in four-wheeled carriages. Two of these are placed longitudinally on the frame-work of the body, and two transverse ones are suspended from it by shackles; on the latter the weight rests, and thus the body is placed two removes from the concussion. The Stanhope is suspended on four of these springs: from the small space they occupy, they are constantly used in stage-coaches; but they are not very easy without a great weight on them.

6504. The springs of carriages are made of a peculiar kind of coarse steel prepared expressly, and having little carbon, that they may be less brittle. Forging coach-springs is a peculiar branch of business. Though springs are kept painted, yet they are liable to decay by the rain, forcing its way between the plates, rusting the inner surfaces. Mr. Adams recommends tinning each plate before putting them together. Mr. Adams likewise observes that a difficulty arises in adjusting the elasticity of springs to the weight of the carriage; for if springs are calculated for a certain weight, say six persons, and only three enter the carriage, the springs will be found too hard, and with more weight the carriage would be easier. Even when properly adjusted, light carriages are not so easy to ride in as heavy ones, because the concussion on a rough road takes more effect on a light carriage, in causing it to rebound, than it does on a heavy one.

CHAPTER III.

DESCRIPTION OF THE FOUR-WHEELED CARRIAGES WITH PERCHES.

The following representations of carriages are all drawn accurately to the same scale, which is placed below the wood-cut of the coach.

6505. *The coach, fig.* 853, is the principal carriage in use. It is properly a four-wheeled carriage, with two seats within, and capable of holding four or six persons. There are several varieties, but the *town coach* is the most complete. Of this the carriage has been already described. The *body* is now always suspended by braces and C springs, the braces passing over the springs so as to be tightened by winding round a *jack* placed at the bottom. This is a great improvement on the S springs, *fig.* 854, used not many years back, and which could not, from their form, be so tightened. The body is attached to the braces by curved irons, called *body loops*. Some coaches have the coachman's seat covered by a rich hammer-cloth, supported upon the horn of the loop by means of branch iron-work, and others have a *Salisbury boot*, like that of the chariot, *fig.* 855. The *platform* behind for the footmen is best suspended from the body, or from the C springs, which, in that case, ought to be very strong; when placed merely upon the carriage, the jarring is intolerable. Some coaches, besides the C springs, have also under springs, as in the chariot, *fig.* 855, and these are

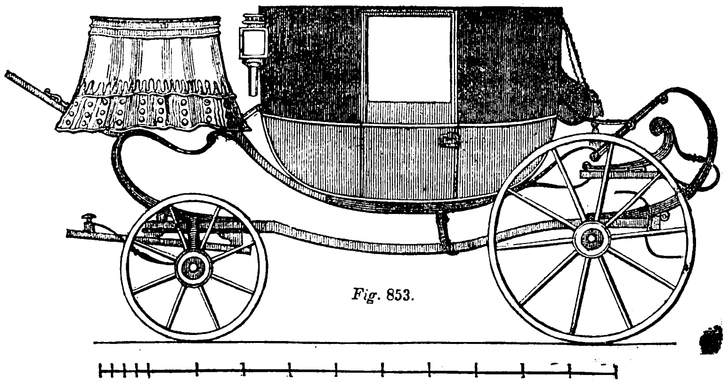


Fig. 853.

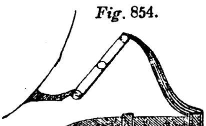


Fig. 854.

by much the easiest. When there are under springs, the footman's platform is generally placed upon them, though the jarring is still very considerable. Coaches have the great advantage of affording the most comfortable accommodation to a family in all weathers ; but having no convenient lookout in front, they are not so agreeable on some other occasions as other vehicles which have been substituted for them; they are, however, upon the whole, the most complete of all carriages.

6506. *Crane-necked carriages* are so called from a particular form of perch, which obviates the difficulty which we have dwelt upon respecting the limit in turning the fore wheels. The crane neck is formed by removing the perch of wood, and substituting two long bars of iron arched upward in front, as in the phaeton, *fig.* 857, somewhat in form of the neck of a crane, by which means the fore wheels can pass underneath in turning. This answers the desired end, and adds much to the strength of the vehicle, but likewise much to its weight. This contrivance is not modern; and as coaches were formerly kept only by the rich, who could afford to keep abundance of horses, the difficulty of draught was not regarded as of much consequence ; at present it is almost entirely confined to state equipages, all of which are so built, on account of its elegance and convenience in turning; but the description of these does not come within our limits.

6507. *Travelling coaches* are now seldom used, lighter vehicles being found more convenient. When an ordinary coach is used for travelling, it is fitted up in a particular manner. The hammer-cloth is taken off, and, instead of the Salisbury boot, another, of a square form, is introduced, capable of holding trunks. It may be interesting to notice that formerly, instead of the present boot made of boards covered with leather, one made simply of stiff leather was made to hold the luggage, called a *budget*, whence the term so well known to politicians. A similar one is placed behind, or a seat for servants, supported on the springs. Two flat boxes covered with leather, called *imperials*, are sometimes placed upon the roof of the body, and even a contrivance beneath the body, called a *well*. *Venetian blinds* are added to the windows; a *chain* and *drag-staff* are added for going down hill, and a *tool-budget* should never be omitted.

6508. *The landau* is a coach having the upper part to throw open occasionally in fine weather. This is effected by means of jointed metal levers, called *irons*, on the upper quarters, as in the pilentum landau, *fig.* 870. When the carriage is required to be open, the two quarters separate in a joint in the top, and each folds back. These carriages, which are hung and fitted up in every respect like a coach, are extremely convenient, as they answer the purpose of an open and close carriage, without the expense of keeping two, and accommodate many persons without the care of driving, as in other open carriages. The bodies not being assisted by the connecting strength of the upper framing, it becomes necessary to make the lower parts of stronger materials, and even to have much iron-work, which somewhat increases the weight; also, the upper quarters, with the joints, are obliged to be covered with the leather, which, though well blacked, has not the same good appearance as that of coaches with fixed roofs, and, after much use, looks indifferently. It appears, nevertheless, to be a kind of carriage, upon the whole, well suited to our uncertain climate, and if built light, without a perch, and with elliptic springs only, is found extremely useful. They are sometimes made narrow, to be drawn by one horse.

6509. *The landaulet* is a chariot having the head to open, in the same manner as the landau: there is, of course, only one seat. The same observations may apply to it as to the latter carriage.

6510. *The barouche* is constructed like the lower part of a coach, with a perch, and two seats in the body, and hung on C springs; but it is essentially an open carriage, having no roof, and only sometimes a jointed head, to put occasionally on the hinder part. The driver's seat is in front, and there is seldom a place behind for the footman, who sits on the box with the driver. It was formerly a very fashionable carriage, and is extremely agreeable in fine weather, and convenient for a party, but it is not calculated for bad weather. The head may be closed in by a glass frame, like the britzschka, but this is inconvenient; and this carriage is now much superseded by the britzschka, which answers several purposes.

The barouche, together with the phaeton, britzschka, and some others, come under the denomination of *open carriages*, as the coach and chariot are *close carriages*.

6511. *The barouchet* is to a barouche what a landaulet is to a landau, an open carriage with a head, and in form like the lower part of a chariot.

6512. *The sociable* was a carriage formerly in use, constructed like the barouche, but with sides of worked cane.

6513. *The chariot* differs from the coach in having only one seat, and it is, in fact, like a coach with the fore part cut off, whence the French appellation, a *coupé*. It is hung in the same manner as the coach, with C springs, and has, as well as the coach, what the coach-makers call a compass perch; sometimes, also, it has under springs, as *fig.* 855. The Salisbury boot, as in the wood-cut, and hammer-cloth, are the same as in the coach. It is considered as the most elegant for a dress or court carriage, but is

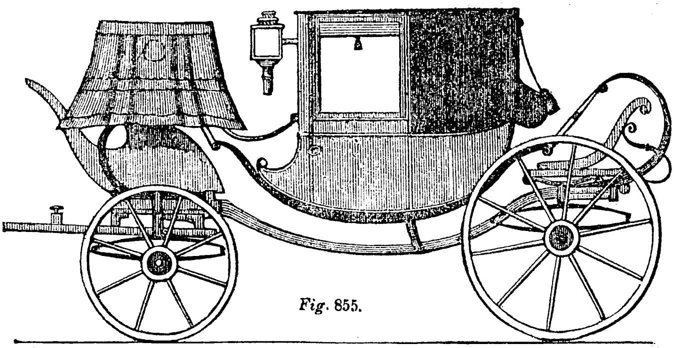


Fig. 855.

not any lighter than a coach, though more agreeable to the eye, and affording a view in front. The very best work of every kind is executed in this carriage, and good taste is exercised in the painting, varnishing, and other decorations in a chaste and not gaudy style.

6514. *Travelling or posting Chariot, fig.* 856.—When the chariot is intended for trav-

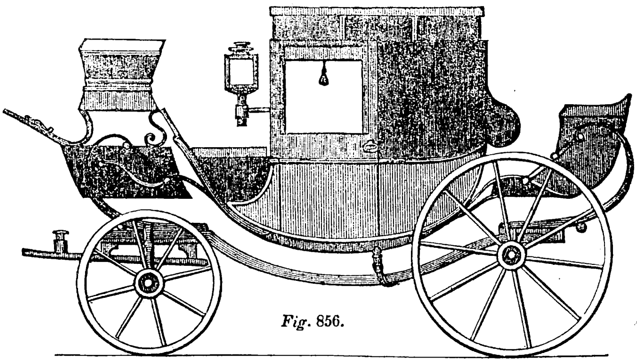


Fig. 856.

elling it is built somewhat stronger, the hammer-cloth is removed, and a driving-seat placed there. Families who travel with post-horses sometimes have their own carriages, which, among other conveniences, prevents the luggage from being shifted. The ordinary chariot is sometimes converted into the travelling one, by removing the coach-box, and supplying its place by a trunk-boot, the coachman riding one of the horses as postillion. A compass perch is used; and some have a crane neck, which admits of the fore wheel turning in less room in narrow streets; or sometimes a *swan* neck, which consists of a single perch instead of a double one, the arched part only being of iron. Another trunk-boot is placed behind, with a seat for servants: on the roof is placed a large square box, called an *imperial*, and sometimes there is also a case below the body, called a *well*. All these are covered with water-proof black leather, and they are well secured by leather straps and buckles. There are likewise Venetian blinds to the windows, and a sword-case, drag, and chain. So many conveniences are useful, because it is not uncommon, in some countries, to be obliged to carry portable tables and stools, beds and beddings, together with some cooking and other utensils. For persons who wish to lie at full length, the front panel can be taken out, and a boot added at the bottom of the body to stretch the legs and feet into; this is termed a *dormeuse*. A chain, shoe, and staff are likewise necessary on a journey. The chain is to lock one of the wheels, to check the velocity in going down a hill. The shoe is to put under the wheel, and the staff is to stop the carriage, to give a rest to the horses on ascending a hill. The chain is fixed to the middle of the perch, and is covered with leather, to prevent it from rattling. A box with some necessary tools should never be omitted in case of an accident, such as a wrench, hammer, chisel, saw, pincers, a few bolts, nuts, and screws, &c.

6515. *A light travelling chariot* may be put upon elliptic springs without a perch; but particular care should be taken that the body is well secured by iron plates, as in that case these alone will connect the fore with the hind carriage. This will not be so easy a vehicle as when hung with C springs, X braces, and will require very smooth roads.

6516. *The post-chaise* is of the same general form as the travelling chariot, but, being intended for quick travelling, is built light; and, to render it still lighter, there is no coach-box, the driver sitting on one of the horses.

6517. *The phaeton of the end of last century* was a very lofty, open, four-wheeled carriage, with a jointed head, *fig.* 857; it had a very showy appearance, but, from its preposterous height, was far from being safe, whence probably its appellation from the fabled car of the son of Apollo. It was for some time much in fashion, and was a favourite driving carriage of George IV. when Prince of Wales, and also of Sir John Lad, and other whips of the time. There were several varieties, of greater or less elevation, and, consequently, hazard to the driver; but we give, in *fig.* 858, a representation of the crane-necked phaeton, with iron perches, from Fulton's work "On Carriages," with a view to show the absurdity of the taste of those days, and the improvement that has taken place since in carriage building. It was considered, from its comparative lightness and elevation above the dust of the roads, to be an improvement on former vehicles, and safer than those with two wheels; but this lofty construction has now gone entirely out of use, in consequence of the numerous accidents, often fatal, which occurred.

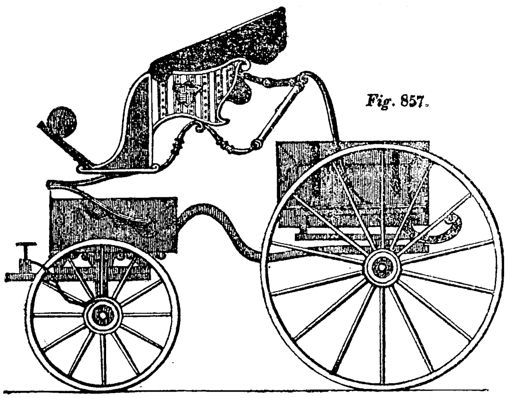


Fig. 857.

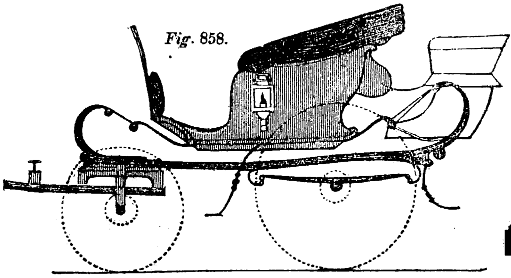


Fig. 858.

Fig. 858 represents a *perch phaeton*, not long since made; somewhat after the old fashion, but much reduced in height.

6518. *The modern phaeton, fig.* 859, bears scarcely any resemblance to the fashionable vehicle of former times, but is one of the simplest forms of four-wheeled carriages in ordinary use. "It is," says Adams, "literally a long box and locker for luggage, usually painted black, with an arm-chair and hood in front, and a bench behind; an arch in the locker is usually contrived to permit the fore wheel to pass beneath, and thus allow it to be much higher." The body rests on four cross springs, whose ends are suspended from four side springs placed across the axles. These springs are connected at the ends by links called *shackles*, as in the ordinary stagecoaches, which, if not properly constructed, are apt to occasion a jingling noise. Some have substituted leathern braces instead of them. By those who like to drive themselves, the body with the driving-head is placed in front, as in the wood-cut; and the phaeton is generally double bodied, that is, having another seat behind: but the seats may shift their places, in order that a servant may drive in bad weather. Though convenient for town use, or for travelling, being light, with rather large wheels, yet it is not very graceful, and is now much superseded by the britzschka.

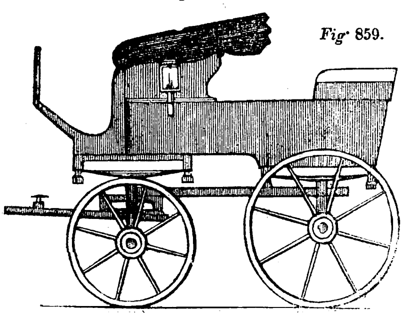


Fig. 859.

6519. *The under-spring phaeton* is suspended on C springs, and has likewise double elbow mail, or elliptic springs.

6520. *The shooting phaeton* is fitted up with a receptacle in the body to carry dogs, game, &c.

6521. *The britzschka* is a carriage lately introduced from Germany, and, on account of its great convenience, has become extremely common. *Figure* 860 represents the original German britzschka. The body is so long that the traveller may recline at full length and sleep, a convenience not possessed by other carriages. It has a perch with C springs: the head is sometimes fixed as in the wood-cut, but is sometimes, also, moveable: for cold weather it is closed in front by an ingeniously-contrived shutter, with panes of glass, which folds up in a recess, and which, when let down, fills the whole front, closing with a tight joint. The wheels are rather low, and the driver sometimes sits in the body of the carriage, or he may have a seat in front. The part of the body not sheltered by the head is covered by a moveable wooden flap, which folds back in several pieces.

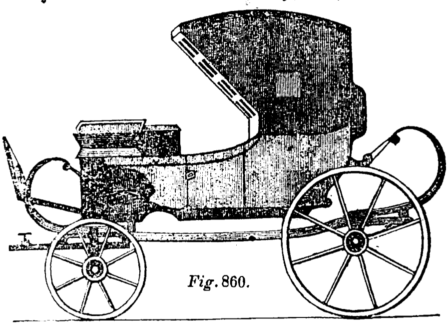


Fig. 860.

6522. *The britzschkas made in England* have nearly the same form, *fig.* 861, but are

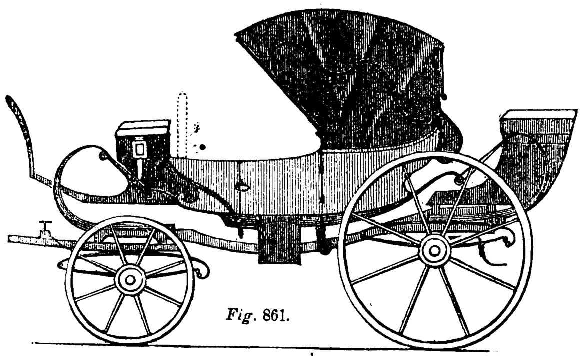


Fig. 861.

more convenient. The head is always a moveable calash, and there is a place for the driver in front, and a seat for servants behind. Though in wet weather, when the head and glass frame are up, and the knee-flap down, the body will hold but two persons, yet in fine weather two more can be accommodated, by raising the knee-flap, which folds back, so that part of it, padded on the lower side, stands upright, as in the dotted line *a*, and serves for a back to those who are on an additional seat: some of these britzschkas are also made with additional under springs, or put upon elliptic springs. For travelling, sometimes the driver's seat in front is removed, to give room for more trunks, the driver sitting on one of the horses.

6523. *The vis-a-vis* was a carriage formerly fashionable, though now not in use. It was, as the French name implies, a narrow coach, in which only two persons could sit face to face. The advantage of it was that, on account of its small size, the passengers could not be jolted against each other, and, being confined, it was warmer than larger carriages.

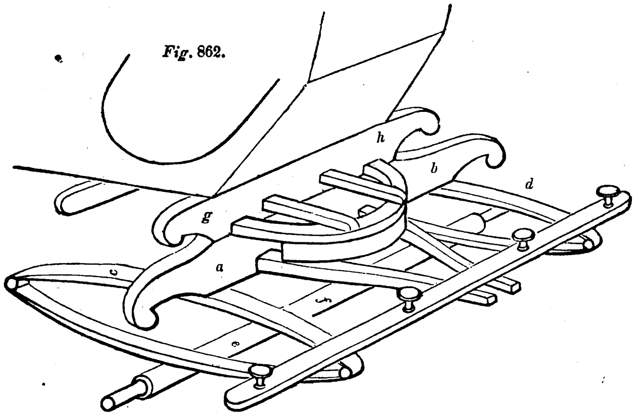
6524. *The sulky* was a name given to a carriage used formerly, built light, with one seat, in the form of a chariot, but, like the vis-a-vis, with the seat so contracted that one person only could sit on it; and it was so called from the proprietor's desire of riding alone.

CHAPTER IV.

FOUR-WHEELED CARRIAGES WITHOUT PERCHES.

6525. Within these few years a numerous class of carriages has appeared without perches, having the driver's seat attached to the body, which rests upon the axles, with elliptic springs intervening, see *fig.* 862: they are usually termed "elliptic spring carriages" One material advantage attending the omission of the perch is, that the

Fig. 862.



body can be brought near to the ground, thus lowering the centre of gravity of the vehicle, and rendering it safer and less liable to be overset; it also affords greater convenience of ingress and egress. These carriages are particularly suited to the infirm, and ladies who find it difficult to mount the high steps of an ordinary coach. They are also less expensive to build, and, being lighter than perch carriages, do not require such strong horses; but they are not quite so easy for the rider as perch carriages with suspension braces and C springs, although the improvement of the roads by Macadamizing has rendered them little inferior when the springs are well made.

By comparing the construction of the fore part of the carriage of one of these, in *fig.* 862, with that of perch carriages, in *fig.* 845, the difference will be readily perceived. In the elliptic spring carriage, the fore transom, *a b*, instead of resting upon a fore axletree bed, as in *fig.* 845, bears upon the elliptic springs *c* and *d*; and these rest upon the iron axle *e f*, without any bed of wood. The bar *g h* is fixed to the bottom of the body of the carriage, and a bolt similar to the perch bolt passes through this bar and the fore transom, *a b*, on which the carriage turns, the wheel plate and futchels being the same as in the perch carriage; *g h*, therefore, belongs to the upper, and *a b* to the under carriage, the principle of turning being the same in the carriages without perches as in those which have them. These four-wheeled carriages on elliptic springs, and without perches, are now so numerous, that it is impossible to go into the streets of any of our principal cities or towns without seeing some of them; and they are best examined in the objects themselves after the clew which has just been given.

6526. It has been stated that when the wheel of a carriage comes in contact with any impediment, it is most essential that the whole of the impetus or momentum which the carriage has already obtained in moving should be brought into full action; and, consequently, that no elasticity should intervene between the wheel and the load in the direction of the progressive motion, that is, longitudinally. But carriages hung upon C springs admit of a very considerable longitudinal movement in the body of the carriage, and, on that account, they are the most heavy to draw. Cabriolets hung in this manner require heavy, powerful horses to drag them, whereas vehicles with grasshopper and elliptic springs have no elastic motion in a longitudinal direction, but only an up-and-down motion; they are, therefore, much easier to pull, and may be drawn by lighter horses. Carriages suspended on C springs are the easiest for the passenger, though not for the horses; because with them there is not only a longitudinal, but likewise a side motion, as well as a perpendicular one, which causes the jolting from passing over stones or other obstacles to be less felt than with grasshopper or elliptic springs. Now, however, from the great improvement in our roads, carriages on elliptic springs are nearly as easy to the rider as those on C springs, and, being much lighter for the horses, are much in fashion. The more elasticity, or, in other words, the more action there is in the latter springs, the more effect will they produce in diminishing the draught: with a C spring a contrary effect is produced. The greater the elasticity, also, the more will springs lessen the sudden shocks to the load. Some are of opinion that post-chaises, which are now hung on C springs, may afford all the ease that is required by placing them on well-constructed grasshopper springs, and with considerable advantage to the horses.

Much of the forms and construction of carriages depend upon the roads, since it is requisite to suit them to the condition of the latter. The late improvements on roads have had a considerable effect upon modern carriages, which are now built much lighter than formerly, when greater strength was required to resist the concussions caused by obstacles.

6527. *Phaetons are now very generally made without a perch*, and placed upon elliptic springs. *Figure* 863 is one of this kind, in which the body is nearly the same as in the phaeton with a perch.

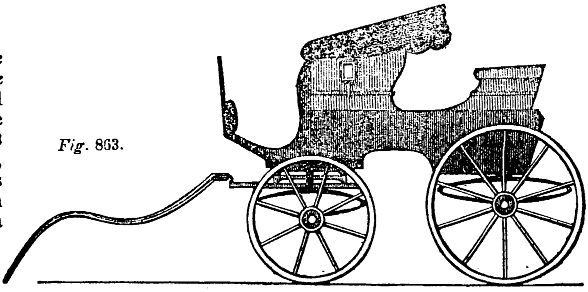


Fig. 863.

Fig. 864 is a variety called a *Stanhope phaeton*.

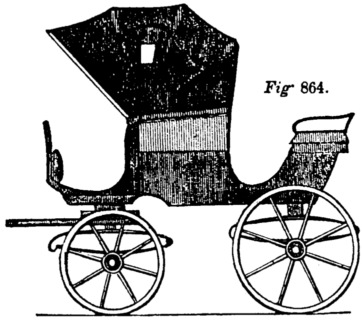


Fig. 864.

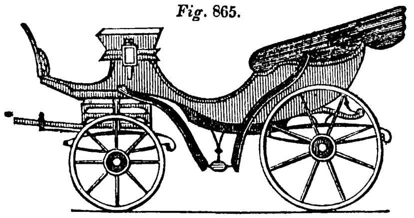


Fig. 865.

6528. *A pony phaeton* is a small, light phaeton with low wheels, intended for parks, where ladies can drive themselves ; but a boy may ride as postillion on one of the ponies

6529. The cab phaetons, *figs*. 865, 866, are other examples of the varieties of this kind of carriage that have appeared of late. These are sometimes hung on C springs with a perch ; and sometimes the upper part of the body is of cane.

6530. *Fig*. 867 is a cab phaeton with a hard seat.

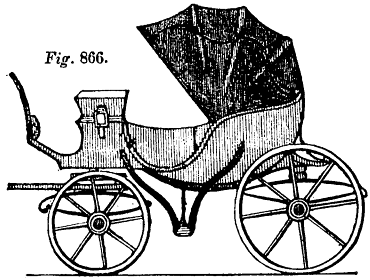


Fig. 866.

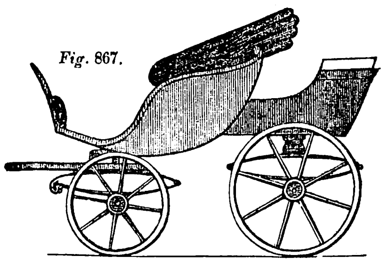


Fig. 867.

6531. *The pilentum, fig*. 868, invented by Mr. Davies, coach-builder, of Wigmore-street, London, is one of the most characteristic of carriages without a perch. It is a four-wheeled carriage, the fore and hind parts of the body resting upon the elliptic springs that are placed upon the iron axles. The central part of the body, with the door, is brought down very low, affording easy access; and the box and driving seat, instead of being detached from the body, form one mass with it. Leather splashers are placed on each side of the

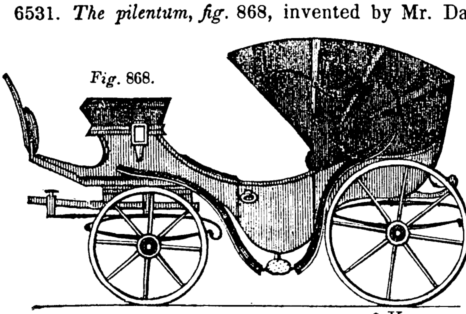


Fig. 868.

door to defend the passengers from the dirt of the wheels. This carriage has usually a head to throw up, and may be open, or furnished with a glass and frame in the manner of the britzschka.

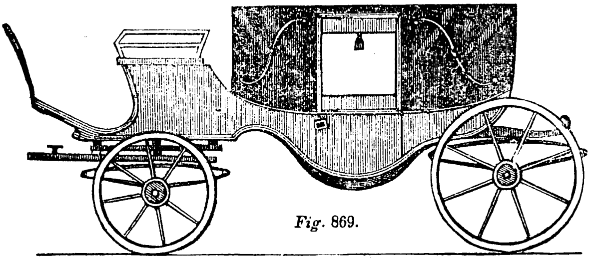


Fig. 869.

6532. *The pilentum landau, figure* 869, is another carriage by Mr. Davies, on the same principle, on elliptic springs, and the centre of the body brought low.

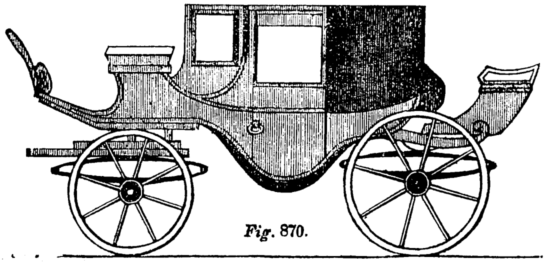


Fig. 870.

6533. *Fig.* 870 is the construction called a *Clarence.*

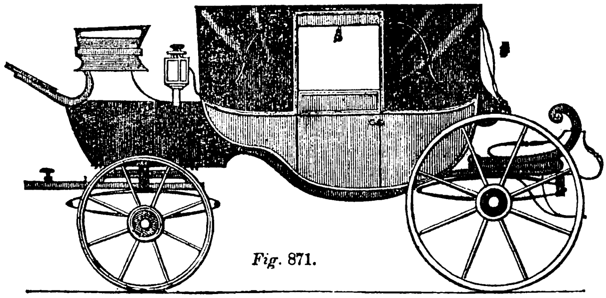


Fig. 871.

6534. *Fig.* 871 is a landau on elliptic springs.

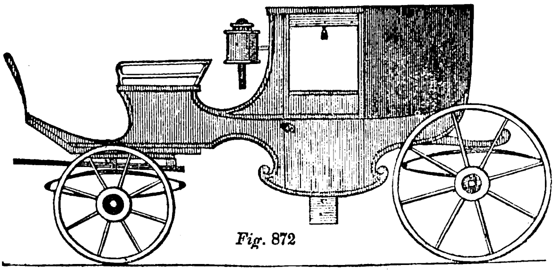
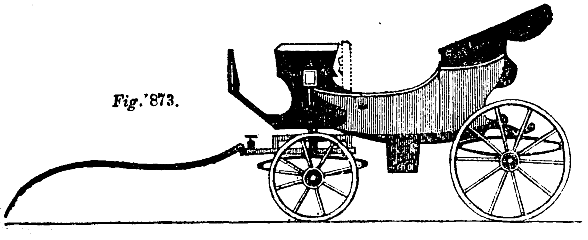


Fig. 872

6535. *The sovereign chariot, fig.* 872, by Mr. Davies, exhibits another instance of the adaptation of the principles we have mentioned.

Fig. 873.



6536. *The demi-britzschka, fig.* 873, is a small four-wheeled carriage in the form of the britzschka, but without a perch, and placed on elliptic springs. By lifting up the knee-flap, it will accommodate four persons in fine weather. It has a German shutter for bad weather, when it can only accommodate two persons.

6537. *The Pelham, fig.* 874, is another of Mr. Davies's carriages, having some of the qualities of the britzschka.

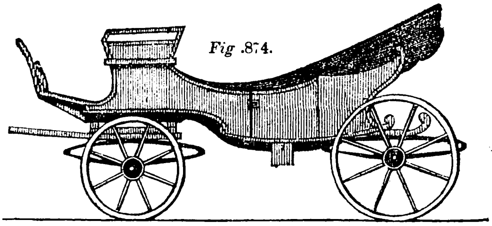
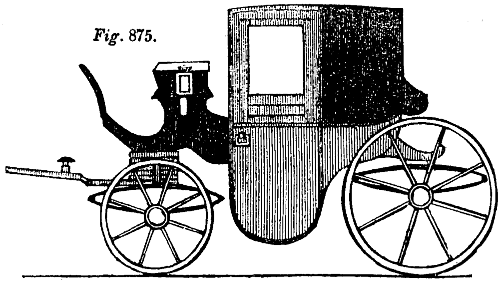


Fig. 874.

6538. *Fig.* 875 is a small light carriage, having the body brought very near the ground, extremely convenient for invalids. Its form is borrowed from one of the street cabs, but it is larger and more elegant.

Fig. 875.



6539. *Of hackney cabs, fig.* 876 is an example of the usual construction, which is found very compact and convenient.

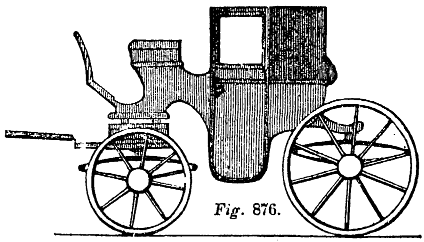


Fig. 876.

Fig. 877 is another example, in the form of a small chariot.

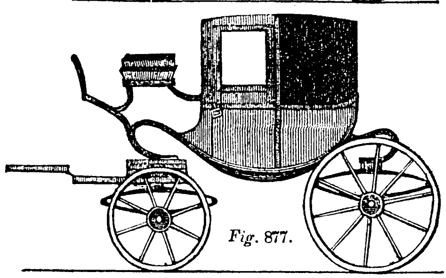


Fig. 877.

6540. *The droitzschka*, or, as it is commonly called, *drosky*, is a Russian carriage, *fig.* 878, being the most common vehicle for hire in the streets of Petersburgh and Moscow. It is described by Mr. Barrow as a very low four-wheeled carriage, the body of which is near the ground; it is, in fact, a narrow bench on wheels, at the hinder part of which is a small back, about as high as the middle of a man's body, and against which he leans, sitting straddling across the bench, with his legs straight down on each side, as he would sit on horseback. If a second person be in the drosky, he sits on the same bench sideways, with nothing to rest his back against. In front of all is the driver, with his legs also across it, and separated from the person next to him by a small iron bar about six inches in height. The form of the droskies kept by private gentlemen is the same, but they are more ornamental: they have padded seats and backs, and splashing-leathers to keep off the dirt from the wheels. Mr.

Fig. 878.

Barrow found these vehicles both unpleasant and dangerous, from the jolting and the difficulty of the rider keeping himself on the bench, which serves as a seat. A carriage bearing the same name is now built in this country; but Mr. Adams observes that, "instead of its being similar to the Russian, it is rather a modification of the elliptic spring britzschka, by placing the passenger's seat nearly at the level of the hind axle, and sinking the central part of the body below the level of the axle for the legs." The Russian vehicle, however, appears to have suggested the great improvement of bringing the body of some of our new vehicles so low; and this may be seen well exemplified in our common four-wheeled hackney cabs.

6541. *The equirotal carriage* is an invention of Mr. Adams, an eminent coach-builder. Considering the defects occasioned by having the fore and hind wheels of different sizes, he makes all his wheels of the same size; hence the name given to his carriages. By this construction, he equalizes the friction of the wheels; and to enable them to turn readily, without adopting the usual methods, he separates the fore wheels, with the driving seat, from the body of the carriage with the hind wheels, by vertical hinges, which causes the driver to turn with the fore part of the carriage, thus having more command of the horses; whereas, in the usual construction, in which the driver remains in the same position while his horses are turning, he is sometimes almost dragged off. These principles, which are solid and just, are applied by the inventor to all sorts of four-wheeled vehicles, from the coach to the wagon.

CHAPTER V.

TWO-WHEELED CARRIAGES.

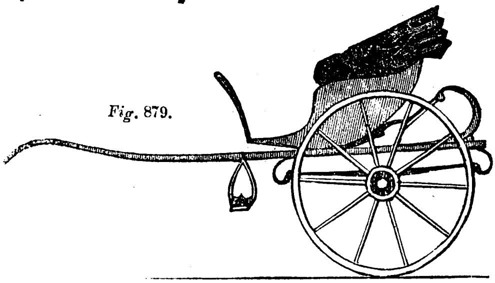
6542. The simplest two-wheeled vehicle is the common cart; this, made lighter and more elegant, and put on some kind of springs, constitutes the spring-cart, the buggy, and chair. With the body suspended, and put upon good springs, it has been improved into the one-horse chaise. The gig, the cabriolet, the Dennet, the Tilbury, and Stanhope are all varieties or improvements upon this. For lightness and simplicity, two-wheeled carriages are preferable; their comparative less cost, their being drawn by one horse, and consequently their economy, are the principal reasons for their being used. But they are not so agreeable to ride in as phaetons, owing to their unpleasant motion; neither are they so safe as four-wheeled carriages, because if the shafts give way the body falls to the ground with the passengers, who are precipitated forward with great violence: they are also more difficult to turn than those carriages that have two axles, one of them moveable. Those which are entirely open, without any kind of head, though light and well calculated for rapid travelling with a single horse, are inconvenient in rainy and cold weather; and the head, when it is up, is apt to be much affected by strong wind, and is not a complete security from the rain. Nevertheless, with all these and other drawbacks, they possess advantages sufficient to be very generally in use. Of two-wheeled carriages, some are suspended by braces and C springs, and others have the bodies placed upon springs beneath the shafts; occasionally, also, under springs can be used.

6543. *The shafts* are the long side framings of two-wheeled carriages which extend on each side of the horse, and answer the same purpose as a pole in a four-wheeled carriage, to draw and turn the vehicle by. As a considerable portion of the weight rests upon the shafts, it is essential that they are sufficiently strong, since in breaking the body must fall forward and throw out the sitters; but it is likewise proper that they shall have elasticity as well as the toughness requisite to render very great thickness not necessary. Ash is found, upon the whole, to be the best material for shafts, and they are strengthened by iron plates on the under side. Lance wood, obtained from the West Indies, has been much employed for shafts, on account of its great elasticity, which enables it to be much lighter than those of ash; but though valuable on account of its elasticity, it is a brittle wood; and being less to be depended upon than ash, it is much less used. It is strengthened by whalebone on the bottom, its elasticity preventing the use of iron.

6544. *Celerity of motion being one of the most desirable qualities in two-wheeled carriages*, the great art is to build as light as possible, yet so as to be sufficiently strong. Ash is the timber usually employed; the form depends much upon fashion. Very light carriages are never so easy to ride in as heavy ones, even when the springs are proportionally adjusted, for the concussion of a rough road takes more effect on a light carriage than it does on a heavy one. Gigs, and other two-wheeled carriages to be used in the country, should have their axles sufficiently long for the wheels to fall into the cart-ruts, and additional strength is required.

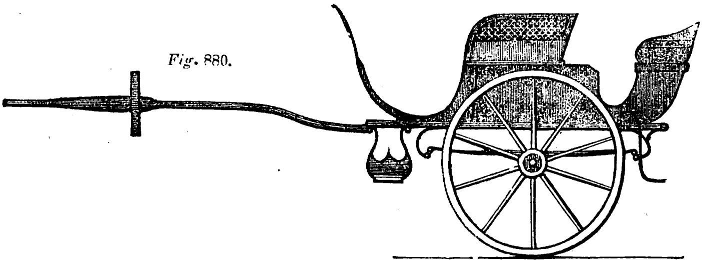
6545. *Cabriolet, fig.* 879.—"This," Mr. Adams observes, "is, in reality, a regeneration of the old one-horse chaise in a more elegant form, which has been borrowed, together with its name, from the French; and, as is common in most such cases, it has been improved upon. The form of its body, which is its characteristic feature, resembles that of the nautilus shell, and it has a head to raise up in bad weather, with curtains to draw in front, or it may be closed in by a German shutter. The knee-flap, instead of being a piece of flexible leather, as in the apron of the old one-horse chaise, is stretched tightly across a frame, which answers better." Though an elegant vehicle, it is not very safe when moving at a rapid rate. The body is hung on C springs, and braces behind, and it has a double elbow, or grasshopper spring beneath, resting on the axle; besides these, there are two small brackets affixed beneath the shafts, to take two straight springs which are bolted to the body. It is a convenient carriage for a single man to ride about town in, as it affords shelter from the weather, and, as the owner can drive it, it saves the inconvenience and expense attending on a close carriage with servants. A boy, however, may be carried behind, cut off from communication with the riders, and who may take charge of the vehicle. Its weight requires powerful horses, and to run a cabriolet about town all day two are required; and if day after day, three will be necessary.

Fig. 879.



6546. *The curricle, fig.* 880, differs from other two-wheeled carriages chiefly in being

Fig. 880.



drawn by two horses abreast instead of one; and it is the only two-wheeled carriage where two horses are employed. It has no shafts, and the body is suspended in a similar manner to the cabriolet. A pole is inserted into the front cross-bar of the carriage frame, and passes between the horses; from this a metal bar is suspended, resting on the horses' backs (represented in the wood-cut as turned upright); this, and the pole sustaining the weight of the carriage and passengers, is the same manner of yoking as that of the classic car. It fatigues the horses less than a four-wheeled carriage, but, as the safety of the vehicle depends entirely upon the strength of the pole, there is great risk in case of the horses becoming restiff. It is seldom made of a graceful form, though it might be so by a person of taste; but it has been almost wholly disused of late, perhaps on account of its want of safety. Any one-horse vehicle may be easily converted into a curricle by substituting a pole for shafts; but the curricle is usually made expressly with some peculiarities. *Fig.* 880 is a curricle, in form resembling a Stanhope, with a seat behind.

6547. *A tandem* is not, as some suppose, a particular kind of carriage; but the term (probably from the Latin *tandem*, at length) is applied only to the manner of placing two horses to draw any two-wheeled carriage in a team, or one before the other. When the roads are very bad and heavy, it is sometimes necessary to add one horse in this way to relieve the other, and promote speed. This method, however, can only be used by those who are expert in driving, unless the fore horse is rode by a postillion. As this may be often useful, it is convenient for every one-horse carriage to have a loop at the point of each shaft for the leading horse to be fixed to.

6548. *A gig* is a one-horse chaise without a head, or an open railed chair, made of a light construction for quick travelling, sometimes suspended by braces and springs behind, and having in addition some other springs between the body and axle; and some gigs have only the latter springs. Gigs are made of a great variety of forms well known, and with various accommodations for luggage. The name gig includes the Dennet, Tilbury, and Stanhope, which are gigs of particular constructions and modes of hanging. They have always a space beneath for holding a portmanteau or other luggage.

6549. *The Dennet, fig.* 881, is a light two-wheeled carriage, said to be so named from

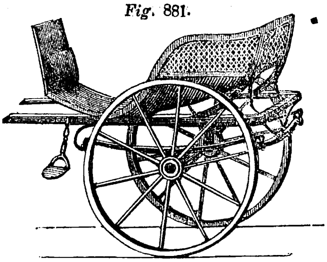


Fig. 881.

the Misses Dennet, two celebrated dancers. It is a gig made of various forms, but hung by a combination of three springs, two of them being placed across the axle at right angles, and the third suspended from them behind with shackles. The body may be with or without a jointed hood, and either of cane or close. The Dennet springs are very commonly used in light carts.

6550. *The Tilbury, fig.* 882, derives its appellation from a coach-builder of that name. It was for many years very fashionable, but it is neither sightly nor convenient, and though apparently light, it is in reality very heavy, from the quantity of iron-work: it is now little used. To support the body, it has an iron gibbet, *a*, fixed

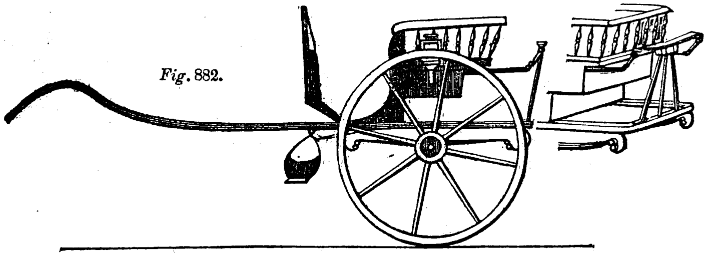


Fig. 882.

on the hinder part of the carriage, to which the body is suspended by leathern braces; and it has grasshopper springs fixed to the body beneath the shafts; likewise, in front there are two single elbow springs attached to the body, serving to suspend it by a short leathern brace. It has a small hose below the seat for luggage, and a cloth board in front.

6551. *The Stanhope, fig.* 883, resembles the Tilbury in the body, but has more room below for luggage. The origin of this carriage has been communicated to us by an eminent coach-maker well acquainted with the circumstances; Mr. Tilbury, who contrived the carriage that bears his name, was requested by Lord Stanhope to construct for him some novel kind of light carriage that should be called after him. Tilbury accordingly adapted to his own new carriage the springs that had just before been applied by Elliot to the mail, making some alterations. The springs of the Stanhope are accordingly the mail springs of that day. These consist of two springs fixed longitudinally on the side frame-work, and two transverse ones suspended from it by shackles; on the latter the weight rests. By this means the body is placed two removes from the concussion, but the shafts, and, of course, the horse, are exposed to the whole of it. This combination of springs is not easy without a great weight on them. Sometimes the upper part of the Stanhope is formed of cane-work, which gives it a lighter appearance, and now more frequently the body of the Stanhope is hung on the springs of the Tilbury.

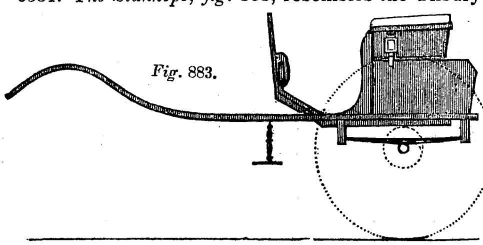


Fig. 883.

6552. *A whiskey, or chair*, is a small chair, not hung by braces, but placed on the shafts, having springs of some kind interposed between them and the axles. The most usual springs for this purpose are the double elbow. The body may be made with panels, or worked with cane. It is made very low and very light. In other respects it resembles the gig, and is the cheapest kind of spring carriage.

A kind of very low chair is sometimes made on two or four wheels, with or without springs, for a park; useful for invalids.

6553. *Buggy* is a name which has sometimes been given to a smaller one-horse chaise; sometimes it is so small as to contain only one person.

6554. *The jaunting car, fig.* 884, is a common travelling vehicle in Ireland, and is cheap, safe, and convenient, though not elegant. They are much employed as stage conveyances, and are likewise kept of a handsomer construction by private individuals. *Fig.* 884 represents one of the latter in a plain style, and calculated for six persons, drawn by one horse; the wheels are low, and the feet of the passengers come within a

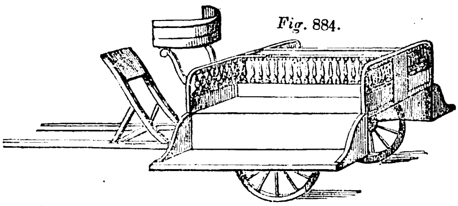


Fig. 884.

foot of the ground. Between both the seats is a space called the well, for luggage. Besides this, there are several other constructions. In some the wheels are outside, and the passengers sit face to face, instead of back to back, as in this figure; and these have sometimes the addition of upright standards and canopies for defence in case of rain, forming an economical summer carriage, extremely agreeable. The best kind are put upon springs. In the common country car, which is smaller, there is no separate driving seat, but the driver sits on the same seat with the passengers, or often runs before. Another modification, called "Bianconi's jaunting car," is on a larger scale, carrying four or five passengers on each side, has four wheels, and is drawn by two horses.

CHAPTER VI.

VARIOUS DETAILS RESPECTING THE PARTS OF A CARRIAGE.

6555. *The body* of a carriage is composed of a frame-work of ash, filled in with panels of soft, straight-grained mahogany, usually Honduras. The roof in close carriages is made of deal well blocked underneath, and covered externally with hides stretched and dried on, being afterward blacked. In some carriages the coach box and boot are connected with the body; in others they are detached and supported by the carriage part. At the back of the body there is a projection called the *sword case;* but in light carriages this is often omitted. In open carriages a *jointed hood or head,* covered with leather, is sometimes attached, and this is either permanently fixed, or made to take away if required. The most complete method of excluding the rain was described in the "Britzschka."

To give the body greater depth inside, without injuring the symmetry of the exterior, two pieces of wood, called *rockers* (because shaped like the rockers of a child's cradle), are fixed on the bottom angles, and to these the floor-boards are nailed. These pieces being painted black, are scarcely seen on the outside. The bodies of open four-wheeled carriages, as a barouche or a britzschka, must be made stronger, with iron plates at the bottom, than those of a close carriage, which requires none.

The variety in the forms of bodies is considerable, and chiefly characterizes the kind of vehicles. Open bodies have this advantage, that three persons can sit with tolerable ease on the same length of seat as would accommodate only two in a close carriage. A full-sized seat for a close body to contain three persons is about four feet two inches; that of an open body, three feet five or six inches; the seat in a close carriage for two persons is three feet five or six inches; in an open body, two feet eight or ten inches. The width across the seat is never regular, but generally from fourteen to eighteen inches; the height of the seat is usually fourteen inches. The height inside the body varies; from the top of the seat to the roof from three feet six inches to three feet nine inches, or more.

6556. *The doors* are framed double to admit of the glasses sliding down between the two thicknesses; in the best carriages the hinges do not appear on the outside. It is important that the doors should fit well; should they stick a little by swelling at first with the wet, it is best not to be in haste to have them reduced, as they will probably shrink in warm weather so as to be too little. The windows are of plate glass, for strength as well as appearance. The glasses are enclosed in frames of wainscot, covered with cloth or velvet. The door handles are of brass or of plated metal, generally plain, but sometimes richly chased in dress carriages.

6557. *Venetian blinds,* for excluding the sun in hot weather, and yet admitting the air, are added; and shutters of mahogany in panels, for shutting up the windows and excluding dust, are necessary when the carriages are not in use.

6558. *The steps* are made of iron to fold up double or treble, according to the height, and fill recesses in the insides of the doors when they are closed. They are covered with carpet or morocco. When fixed outside, care should be taken to place them conveniently, as they are often unsightly and in the way. When they are small and fixed, they are called *treads.*

6559. *The lining of the insides* of carriages was formerly always of light-coloured cloth, but now various kinds of silks are likewise used, and sometimes morocco. In summer this is occasionally covered with chints. The lining is ornamented with coach lace, fringe, tassels, &c.

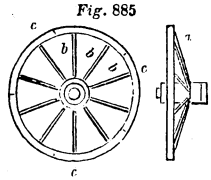
6560. *The seats inside* are strained over with cane or girth web, and upon this are laid cushings stuffed with horse-hair. Under the seats are placed portable boxes for holding things.

6561. *The floor* is covered with a carpet fitted in.

6562. *Pockets* are fixed to the insides of the doors, and also in front in chariots.

6563. *The wheels of a carriage* consist of the nave, spokes, and felloes. The *nave* is the short block of wood, nearly cylindrical, forming the centre of the wheel, *a*, *fig.* 885, and pierced by a hole for the axle to pass through. It is usually made of elm, but fustic has lately been used as a superior material. The *spokes* are the arms, *b b*, of oak, extending from the nave to the external rim, the several pieces of which are called *felloes* or *fellies*, which are made of ash or beech, and are hooped round and protected with iron, called the *tire*. This iron is either in several pieces, called *strakes*, or in one piece, put on heated; the last is the best way, as the iron, by shrinking in cooling, compresses the wheel, and binds it very tight; all carriage wheels are now made in this manner, which is termed *hoop-tire*, or *bond-tire*. Wheels are constructed in a form said to be *dished;* that is, the nave is not in the same plane with the rim or felloes, but falls back, so that the spokes form a very flat cone, as may be easily seen by viewing a wheel on the edge, as *d*, *fig.* 885. This is done for strength, and to throw off the mud and prevent it from clogging; it requires very skilful workmen to make good wheels; if bad, they often break down; and yet the men must be trusted for the work, for frequently no eye can detect bad workmanship. Wheels have been made wholly of iron, but though these answer in some cases for railroads, the elasticity of wood is found to be preferable in ordinary carriages and roads. The height of wheels varies.

Fig. 885



Mr. Adams observes, that, on a level ground, a horse will draw a vehicle with the greatest facility when the centre of the wheel is a trifle lower than the point of draught, viz., the point where the traces are affixed to the collar; but this in practice would be found inconvenient, inasmuch as you would be unable to enter the vehicle save from behind, and, moreover, the height of the axle would necessitate a corresponding and inconvenient height in the seat. For this reason, the total height of the wheels of two-wheeled vehicles is usually made to vary from three feet to four feet six inches. It must be borne in mind that a low wheel on a very level road, a railroad, for example, may be more efficient than a higher wheel on a rough and uneven road. But on the same road, and with an equal load, the high wheel is that which requires the smallest amount of power to turn it. The number of spokes varies according to the size of the wheel; there are two to each felloe; hind wheels have usually from seven to ten, fore wheels from seven to nine. An extensive manufactory has lately been established in Pimlico, London, for making wheels by machinery; and it is said that the wheels produced there are of a very superior quality.

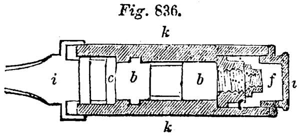
6564. *The axles* of carriages were formerly made all of wood, whence the old name axle-tree, but they now always consist of iron; the best are formed of several flat bars welded together, about two inches or two and a quarter in diameter for a coach; for light carriages an inch and a half. In common axles, the wheel is prevented from coming off by a pin, called the *linch-pin*, passing through the end of the *axle-tree arm*, the name of the part that the wheel turns upon; but as many serious accidents have happened through the linch-pin falling and the wheel coming off, an improved method of securing the latter is now practised, by means of a box, called the *axle-tree box*, which is contrived to answer the double purpose of keeping on the wheel, and to hold oil, grease, or some lubricating substance for lessening the friction. When iron axles were first used, it was the custom to drive a strong and broad iron hoop into the nave to prevent its being worn, and this plan is still used in heavy carts. The projecting seam formed in putting it together helps to secure it from turning on the nave. The commonest axle boxes now used for carriages are somewhat of a conical form, of plate iron, with a seam, as above, driven into the nave. At the upper part of the axle-tree arm the axle is left square, and against this a broad iron washer is driven or put to hold fast by shrinking; against this the axle-tree box works.

6565. To secure the wheel from coming off, an iron collar, called the *axle-tree nut*, is placed on the small or outer end of the arm, and through this and the axle arm the linch-pin passes. To hold the lubricating grease better, the inside of the box is sunk into hollows.

To prevent friction in wooden axles, soap or black-lead are the best materials; for common, coarse axles, a thick, unctuous grease is the best adapted; but for iron axles, which are accurately made and fitted to the boxes, there is no lubricating substance equal to oil of the purest kind, and freed from mucilage or gelatin, according as it may be of vegetable or animal production.

6566. Various patents have been taken out for axle boxes, but the most esteemed is Collinge's. This possesses the advantages of being very durable, giving a steady and silent motion to the wheels, and retaining the oil to prosecute a journey of 2000 miles without requiring to be replenished. *i* (*fig.* 886) is the axle-tree arm, made as perfectly cylindrical as possible, and of a peculiarly hard surface, the middle reduced in diameter so as to form a recess to contain the oil necessary to feed the axle-trees at the two bearings, *b b*, having a shoulder, *c*, against which the wheel-box, *k k*, takes its bearings; the adjoining collar is grooved for a washer to preserve the oil, and to prevent noise in its use, with a rim on the collar of the axle-tree. The end *f* is double-screwed, to receive two nuts for securing the wheels; one screw turns the way of the wheel, the other the reverse, and is meant as an additional security. *l* is a cap which covers the nut and receives the waste oil: it is made of brass, and screwed on. In order to ensure greater durability and greater freedom from friction, these axles and their boxes are always case-hardened, and the rubbing surfaces highly polished. These axles, excellent as they are, however, Mr. Adams observes, are not without their defects. Should, by any carelessness, the surface be suffered to be without oil, they fit so close that they would become hot by friction, and stick fast; likewise, should the smallest quantity of grit get in, it would cut into the metal and prevent motion. A patent has been taken out by Mr. Mason, which, according to Mr. Adams, remedies these defects. It is sometimes objected to Collinge's axles that, if any accident happens to them, such as a wheel sticking fast in the country, or on the Continent, their complication renders it a difficult matter to put them to rights. But this objection, observes Adams, is not of much force; for, if necessary, common boxes for grease may be applied to them as easily as to any others.

Fig. 836.



6567. *The pole* is applied when the carriage is put to use. It is fixed in the chops of the futchels, and secured by an iron pin. At the front end of the pole is a double staple, to which leathern straps called pole-pieces are attached, to hold the horses in proper position, and to prevent the carriage from overrunning them when descending a hill.

6568. *The coach-box* always forms part of a coach and a chariot, and also occasionally of some other carriages. The objection to it is, that it obstructs the view of the country from the front windows in travelling, and it is then frequently removed; but it is less fatiguing for the driver than when he rides one of the horses, and is also easier for the horse. The obstruction to the view is of less consequence in town. There are several kinds: the standard, the Salisbury, the travelling coach-box, and the chaise coach-box. The first two will be mentioned under "Boot;" the travelling coach-box, sometimes called a *dickey-box*, has a low iron rail round for the security of the driver; and the last resembles nearly a small chaise, in case the owner wishes to drive himself. The coachman's seat is stuffed with straw, and is covered with baize; it is made higher at the ends than in the middle, to give a more secure seat. This is covered by the hammer-cloth.

6569. *The hammer-cloth* is a constant appendage to the town coach and chariot. It is made of strong cloth stiffened with tarpauling, and is contrived to hang in large folds. The top and bottom are ornamented with bands of lace, and the bottom has, besides, a deep fringe. Some have a crest on the side.

6570. *The boot* is a box covered with black leather, placed on the fore part of the upper carriage for the purpose of carrying luggage. Boots are of various forms. Some are square, called platform boots, for holding trunks, &c., and then the coach-box is supported over it by upright standards of wood or iron; but that called the Salisbury boot is very generally used for town coaches; horns project upward from it, to serve as a support for the coach-box, and the coachman's foot-board is also a part of it. Formerly a kind of boot called the *budget* was very common in travelling-carriages for luggage. A boot behind, with a seat for two servants, is called a *rumble*.

6571. *Dashing or splashing frames* are fixed to the fore part of open carriages to keep off the dirt splashed up: they are made of leather strained upon iron frames (*fig.* 882) in the Tilbury. A curved sort has lately been introduced on each side of the body steps, to keep off the dirt from the wheels, borrowed, apparently, from the droitzschka. It is shown in the pilentum (*fig.* 866).

6572. *Lamps.*—In carriages, the term lamp is applied to the case or lantern that holds the light, whether that be given by a candle or oil. The simplest are wax candles contained in tubes, through a hole in the upper part of which the wick passes, the candle being pressed upward by a spiral spring as fast as it is consumed. In dress carriages, the lamps are circular and ornamental, and contain wax candles, though the light is inferior to that of oil. Lamps for travelling are square, with shutters for day to protect the glass: they burn oil with flat wicks, and reflectors of silvered metal are usually added. Means have not yet been contrived for using successfully Argand's lamps, as they are liable to be extinguished by gusts of wind, and the motion of the carriage causes the oil to overflow.

6573. *The iron* used in carriages requires to be of the toughest quality; the best is that kind called *king and queen*, which is prepared from fragments of old wrought iron collected and welded together. There is a large manufactory of it at Rotherhithe.

The irons are extremely numerous, and much of the strength of the carriage depends upon plates properly applied to the various parts. The springs have been already mentioned. The body loops, or iron brackets, bolted to the bottom of the body, one at each corner, to fix the suspension braces to, require to be very sound and strong.

6574. *On the quality of the leather* depends, frequently, the safety of the carriage; the *suspension braces* are made of several straps sewed together firmly. Besides these, there are *collar braces*, which go from the perch to each side of the body, to prevent it from turning over, and breaking the springs by a reverse action in case of violent concussion. There is also a *check brace* from the spring-beds to the body, to prevent it from swinging too far fore and aft.

6575. *Chaise heads*, used to most open carriages, are formed of hoops connected together by long iron joints, and covered with leather blacked and made water-proof. The fronts are round or square, with curtains to close it occasionally.

6576. *The painting and varnishing* of carriages are carefully performed. The body receives six or seven coats of oil paint; these, when dry, are rubbed smooth with pumice-stone and water, and two more coats are added; after that, it receives five or six coats of copal varnish, which, when thoroughly dry, is highly polished. This varnish is the hardest and least liable to be scratched. Adjusting the colours properly demands considerable taste. It is customary to confine the colours to the lower half of the carriage, except some stripes round the door and window; the remaining upper quarter is made black, a practice not ornamental, and which appears to have been continued from the time when it was the custom to cover all the upper part of the body with blacked leather. Heraldic bearings on the panels used always to be painted in their proper colours; now they are frequently painted in relief in nearly the same colour as the grounds. The carriage part and wheels receive several coats of oil paint, and are ornamented with stripes of various colours, to give a light appearance; they are then varnished with common varnish.

6577. *Carving* in ordinary carriages is sparingly employed, as it tends to harbour dirt, and impedes the process of cleaning; the timbers of the carriage are ornamented with a few sunk mouldings and small scrolls, to take off the plain appearance which they would have if left square. In state carriages more is introduced.

6578. *Carriage-building* is subdivided into numerous branches, and employs many distinct trades, only a part of which is engaged in the factories, as body-makers, carriage-makers, wheelwrights, axle tree-makers, smiths and spring-makers, curriers, brace and harness-makers, carvers, painters, japanners, lamp-makers, trunk-makers, blind-makers, lace-makers, ivory-workers, platers, chasers, embroiderers. Besides these, there are the manufacturers of cloth, glass, and other materials. In these various branches there are many skilful workmen, particularly the smiths and wheelwrights, some of whom receive high wages, and work by the piece; but few of them are in constant employment all the year. It is remarkable that the workmen consider themselves as of very different grades in point of rank, and the body-makers and wheelwrights stand at the head. It is generally admitted that the carriages built in England excel all others in point of lightness, strength, and goodness of workmanship; but we have been indebted to our neighbours for several hints in point of form.

6579. *In travelling*, several circumstances respecting carriages require to be attended to. If the axles of the vehicle are of the commonest kind, they will require to be looked at frequently, and have fresh grease every seventy or eighty miles. Collinge's patent axles will run from three to four thousand miles without fresh oil; but when they are to be fresh oiled, it is best to get a coach-builder to do it, except the servant has been taught and understands it perfectly. If the wheel runs dry, the axle gets damaged, and perhaps may break suddenly. The wheel-plate also requires greasing, and perhaps new leather to the transom. The suspending braces should likewise be examined, as the safety of the carriage depends upon them. Persons who suffer from the jolting of a carriage may sit on an additional loose cushion stuffed with horse-hair and wire springs, or on an India rubber one filled with air by means of a stop-cock.

6580. Though sometimes the same carriage is used for town and for travelling, and a town chariot may be converted into a posting one, yet there are some objections to this. Mr. Adams observes that "the springs adapted to a light weight easily are not adapted to carry a heavy weight, and *vice versâ*; and a carriage must lose much of its beauty when used for travelling. These disadvantages have prevented some from keeping carriages, and have obliged a few to keep two carriages. But another motive has perhaps been still more forcible. In travelling with a carriage rapidly, it is necessary to go with post-horses, or to travel by very easy stages with a single pair. Few persons like to travel slowly, and fewer still to leave their horses behind them, and be deprived of their use; and as the habits of those who keep carriages are mostly migratory at particular periods of the year, they would rather cease to keep horses and carriages than be confined to one spot. The desirable thing is to have one pleasure carriage perfect in all its parts, and to be able to convey it, servants, horses, baggage, and all, at a rapid pace, from one point to another, without injury to the carriage or horse; and to have the perfect use of it at any required spot with as much facility as though the owner had not left his home. This railroads will, in time, accomplish, as the carriage can be put on a platform, and conveyed with the steam vehicles, as well as the horses."

6581. *To preserve carriages* much care is required; and consideration should be paid to the various materials of which they are composed, which are as delicate as those of furniture. The coach-house should have a boarded floor, laid hollow, for the circulation of air beneath, and be extremely dry and well ventilated. It should not be placed, as is often the case, adjoining to stables, in the vicinity of dung-heaps, cess-pools, or open drains, as the gases disengaged from these places have a very injurious effect upon the paint and varnish. The wood-work is apt to swell with damp and shrink with heat, and, though it is well painted, yet the moisture will, in some degree, find its way in. If it be exposed in too dry situations, the panels will shrink, and perhaps crack; the wheels also require to be frequently wetted to prevent shrinking, particularly in summer. The iron-work is liable to rust with damp, which at last forces off the paint: the plated and brass-work tarnishes and suffers from the same cause. It is better to rub these dry every day than to suffer them to contract tarnish, which requires to be got off with whiting or plate powder. Leather requires frequent oiling to preserve its tenacity, which is particularly essential in those parts where great strength is required. Certain leathers, as heads and knee-flaps, where they are used merely to keep out the rain, are sometimes blacked or japanned, which answers for a time, so long as they do not crack; this saves a great deal of trouble in oiling, and has a good appearance. The cloths and linings of the inside should be kept free from damp, which will occasion them to rot from mildew, and the sun's rays will destroy their colours; but, above all, it is necessary, by frequent brushing and other precautions, to keep them from moths. To preserve hammer-cloths from rain, water-proof India rubber cloth covers are now used; and this has the advantage of keeping away moths, but the disagreeable odour prevents its being used inside.

After the carriage has been out, whether in the sun and dust or rain, it should be carefully washed and dried. It should, if possible, be cleaned before the dirt dries on it, and it should be well sluiced with plenty of water to prevent any sand from remaining, which might scratch the varnish in rubbing. Sea water should never be used. Great care in cleaning goes much towards the preservation of a carriage. The varnish of the body is very apt to be stained by the various substances in roads: the stains should be got rid of as soon as possible by rubbing with a baize or soft leather, and a little sweet oil, drying the place off with flour; or if the stains should be difficult to get off, a little rotten-stone or Tripoli, with oil, will assist. If the panels appear to begin to shrink, it will be proper to see that they are confined in their grooves, otherwise they may crack, which is a defect difficult to remedy; but this may happen without the framing giving way in the least. The wear of a carriage depends very much upon the coachman's driving, and looking after it when in the coach-house. He should have a knowledge of the construction of carriages, in order that he may know when any part is out of order, that the proper remedy may be applied in time. Driving very hard over the stones exposes the carriage to many accidents, and the springs and axle-trees are the parts most liable to give way: the wheels also suffer much. The shaking of the carriage frequently loosens the bolts and nuts; this should be attended to in time by the coachman, who, if he is skilful, may tighten them himself without always sending for the coachmaker; it is prudent, however, to try these once a fortnight, if the carriage has been in constant use. Rattling is a sure sign of something loose that requires to be tightened. When iron works against iron, rattling often takes place, and sometimes a piece of leather put between will stop it. Squeaking may be stopped by a little oil. Repairs, in general, form a considerable part of the expense of a carriage; on an average, the wheels require to be renewed every five or six years, or oftener if they are much used.

6582. *To have the use of a carriage* several methods have been resorted to. The most satisfactory mode is to have it built to order, as then it may be made to suit exactly the convenience and taste of those who require it. If the carriage is completely paid for at once, the owner takes upon himself all the trouble of keeping it in repair; but the carriage-builder will also let it upon lease for a term of years, generally four or five, engaging to keep it in repair all the time, excluding accidents: the occupier has thus the same advantages as with a ready-furnished house. When the term expires the carriage reverts to the builder. A third method is to purchase a carriage ready built; in this manner one may be often procured at a cheaper rate, but great judgment is necessary in the purchase. Few persons are judges of the qualities of a carriage so as to detect their faults; and, indeed, from the way in which they are sometimes got up on speculation, it is extremely difficult to discover the defects, except by a trial of some time. On this account, the safest mode is to pay a higher price, and trust the reputation of the builder. Carriages may likewise be hired for various periods, as by the week, month, or year.

6583. Some gentlemen who have carriages of their own job their horses, or hire them by the season or by the year. Careful job masters will stipulate for the employment of their own coachmen, but not always; it is for several reasons objectionable in a quiet family. It is important that every groom or coachman should be a competent judge of the working of a horse, that he may be able to inform his master whether he is properly served. A pair of carriage horses should be well matched; when this is neglected, one of them is obliged to do more duty than the other, and wears himself out; and it is likewise necessary that the carriage should not be too heavy in draught for the horses, or the horses too light for the carriage. Though carriages are in general made lighter now than formerly, yet some of the light kind have a great deal of iron about them. The fitting of the harness to the horses is likewise important to attend to.

BOOK XXIV.

OF STABLES, AND THE MANAGEMENT OF HORSES.

CHAPTER I.

CONSTRUCTION OF STABLES.

6584. Great improvements have been made lately in the construction of stables, since the nature of the horse has been so much studied by veterinary surgeons, and the importance of ventilation and good air has been understood, together with many particulars for the prevention of diseases of the feet and other parts. Formerly, horses were too often lodged in low, confined, and dark stables, where the air was of the worst description, in consequence of which diseases were engendered, the origin of which was unsuspected.

6585. *The situation of the stable* should be at some distance from the mansion, and it is best, if possible, to have a southern aspect to shelter them from the cold winds. It is desirable that the surface of the ground should be sloping, for the convenience of drainage, and that the soil should be dry, a damp situation being particularly injurious to the health of horses. It is essential that proper drains should be executed by the builder.

6586. *Stables should be sufficiently large* for the number of horses; but it is not judicious to have many horses in one stable, since the change of temperature occasioned by taking out some of them may render it too cold for those that remain. When there are many horses, it is best to divide the stable into several parts. For valuable horses, it is recommended that one stable should not have above six or seven stalls, or perhaps not above four or five. One empty stall is useful, that two may be occasionally thrown into one, in case of a horse being sick. For a pair of carriage horses, the stable should have three stalls. When there are many horses, the stalls are sometimes arranged in a double row, with a passage between, to occupy less space; but a single row, or a single-headed stable, is best; where it is double-headed, the horses are apt to hurt each other by kicking.

6587. *The walls* must necessarily be of the materials used in the country; but brick is the best, being the warmest and driest, if properly laid. The inside is usually plastered, or, at least, whitewashed. It should be boarded to the height of four or five feet, plaster being apt to break away; and all the stalls should be boarded at the head about three feet above the manger.

6588. *The width of the door* is usually three feet six inches, but this is too narrow for taking the horses out; four feet is better. The height of the door should be at least eight feet. Sometimes the door is usefully divided into two halves, one above the other. The bolts should be of wood, which is better than iron.

6589. *The floor of the stable* should be laid with materials that are durable, and of a certain degree of toughness, so as to prevent the slipping of the horses feet. Flagstones are not proper, except they are grooved or furrowed. Common bricks are not hard enough; but Dutch clinkers, laid edgeways, make an excellent, perhaps the best paving, being narrow and extremely hard. Basalt, called also whinstone, is employed in some parts of the country where it occurs, and is unexceptionable when squared to proper shapes. The asphalte forms a hard and even paving; it has been tried experimentally at the Veterinary College, and found to answer; it has also a very neat appearance.

To carry off the urine of the horses, the whole of the paving should be laid with a slope towards a channel or gutter running the whole length of the stable. But some object to the floor of the stall having this slope, as it is supposed to strain the back sinews of the horse, and they prefer making a grating in the centre of the stall (section, *fig.* 889), towards which the floor has a slight inclination, and a short drain from this should communicate with an underground drain, thus preventing the urine from remaining in the stable. Instead of an iron grating, some use a square piece of stone or oak with holes in it; this must be made to take up to clean the drain. If the floor of the stall is made to slope, the slant should not be above an inch in a yard. There must be proper traps to the drains to prevent any smells from rising, or cold air or rats ascending. The drain should lead to a manure tank. In stables where there is no contrivance to carry off the water, part is soaked up by the litter, part sinks into the floor, and the remainder evaporates and mingles with the air, rendering it damp and foul. Where the situation of the stable is a perfect flat, it is proper to raise the floor above the level of the surface, so as to get sufficient inclination for the drains and secure perfect dryness; the approach to the door may be a very gentle ascent.

6590. *The ventilation of the stable* is the next thing of importance we shall consider, since, if this is not provided for in the construction of the building, it is not easy to effect it properly afterward. Before the subject of physiology was rendered popular, and the nature of respiration understood, by which the necessity of pure air for health is rendered evident, people never thought of admitting fresh air into a stable, as they had no notion of its use. In fact, they did all they could to exclude it, by closing up every aperture by which a breath of fresh air might find admission. The horse was confined in a sort of hot-house, the air of which was so offensive that it was with difficulty the grooms could bear it. The bad effect of hot stables is now pretty generally understood, but still many do not know the difference between common air simply heated and air heated and mixed with other noxious gases. Those persons confound a hot stable with a foul one, whereas one might exist without the other, although the two qualities of being overheated and being foul with noxious air are generally united.

We would recommend the reader to study what we have said on the subject of ventilation; he will then perceive that the atmosphere which we breathe, when deprived of its vital principle through the act of respiration, whether of men or horses, is unfit for the support of life, becoming noxious, and, in fact, a poison, which, when mingled with the rest of the air, renders it unwholesome. It is necessary, therefore, to get rid of this foul air, so that it shall not be respired again, and to introduce fresh air that possesses the property so essential to life. But merely heating the air, without breathing it, does not deprive it of this vital principle, and air may therefore be warmed to a considerable degree without being at all unfit to be breathed. As, however, the foul air that comes from the lungs is always warm, this expired air is one of the chief causes of the high temperature of stables in which horses are confined, and in this case air so warmed is rendered unwholesome. It is as necessary that horses should breathe pure air as human beings, and that the gas which is ejected from their lungs should pass out of the stable, while, at the same time, an equal quantity of pure air is introduced into it. Fortunately, this noxious air, being lighter than the cold air, rises at first to the ceiling, and when proper apertures are made there for its escape, it will find its way out, while cool and fresh air will force its way into the stable at the lower part to supply its place.

6591. *The air of stables is not only deteriorated by the breathing of the animals, but it is farther contaminated* by emanations from the body, as well as by the noxious ammoniacal vapours arising from the urine and dung. This may be easily perceived on entering the stable in the morning, when not only an oppressive, but a pungent ammoniacal smell is perceived, resembling that of hartshorn, of which, indeed, the urine of the horse contains a large quantity. These vapours are hurtful to the lungs of the horse, and still more particularly to its eyes, and are no doubt the source, frequently, of blindness and many of his diseases. The grooms, likewise, are known to suffer in their health from the ammoniacal vapours in the stables.

6592. *The most effectual mode of managing the ventilation of a stable* is by having large trunks or tubes of board, about a foot square, to pass through the ceiling and roof into the open air, having their tops covered in such a way that the heated air can go out but no rain come in. If it is impossible to send them out through the middle of the ceiling, they may be carried out just beneath it through the wall; and it will be best if there be a tube to each stall, as at *a* in the section, *fig.* 889; or windows with luffer-boards, to be opened or shut as may be required, may be placed at convenient situations.

It is to be observed that no air can go out except an equal quantity be admitted to supply its place, as the stable must at all times be equally full of air; therefore, apertures for the admission of fresh air should be made somewhere at the lower part of the stable, where the draught will be least prejudicial. In a small stable, the bottom of the door will do for this, if a board be placed below the aperture in it, slanting so as to direct the current of air that enters upward, instead of its coming horizontally, which might strike upon the legs of the horses. In larger stables, where more fresh air is required, numerous small apertures are better than one large, placed in such manner that the air cannot reach the horse as cold currents, which may be injurious to him; they should be so contrived that the air admitted may soon mix with the rest.

6593. It is customary in the morning to open all the doors and windows to ventilate the stable when it has been shut up all night; but this, though often useful and proper when the horses are out, is not enough; for means should be provided by which a continual slow change of air may be going on, and which should act of itself, without any attention from the groom or his assistants, and yet that the change should not be so great as to render the stable cold. When the ceiling of the stable is flat, its height should be nine feet for four horses; and if there are more, it should be higher, as much as twelve or fourteen for large stables. The smallest ought not to be less than eight feet high. If too lofty it will be cold; when too low, currents are occasioned by the ventilation.

In a late number of the "Journal of the Agricultural Society," a method is described of correcting the bad effects of the ammoniacal vapours mentioned above as so injurious. If a mixture of powdered gypsum, wetted, and sulphuric acid (oil of vitriol) be strewed on the floor of the stables, the acid will neutralize the ammonia, and, to use the words of the grooms, "the stables will be sweetened." It has been supposed that the gypsum produced part of this effect, but it does not appear that any portion of the ammonia is absorbed by it, and that it merely acts as a convenient surface for the acid; for a mixture of sawdust and sulphuric acid answers the same purpose. One part of sawdust will absorb three parts of the acid solution, which should consist of one part by measure of acid and fifteen of water. Instead of strewing the mixture on the floor, where it will get mixed with the straw and injure the horses' feet, it is better to place it in trays distributed in various parts of the floor. The acid should not remain unchanged longer than three or four days, when it will be found neutralized.

6594. *The temperature of the stable* is a circumstance that requires particularly to be attended to. Grooms, in general, have a predilection for warm stables. Well-bred horses require a warm and genial temperature in the stables, supposing, of course, the air to be pure, to maintain that beautiful appearance of a glossy coat so indicative of condition, and so essential to the beauty of the animal. But although it has this effect, a very glossy coat in winter is not desirable; nature has a tendency to proportion the degree of fineness of the coat to the season, making it a little rougher in winter than in summer. The glossiness of the coat should be more the result of careful grooming than of the warmth of the stable. The bad effect of hot stables is evident from the diseases frequently occasioned by taking horses out into the open air, particularly in cold weather, when the temperature is 30° or 40° below that of the stable. This is often the cause of rheumatism, catarrh, or inflammation of the lungs, when horses are kept standing long in the cold, notwithstanding that exercise keeps them warm for a time. It is also generally known that a sudden return to hot stables is nearly as dangerous as the change from a heated atmosphere to a cold and biting air. It is true that the horse is an animal now in a highly artificial state, requiring to be treated with a degree of care beyond that of any other domesticated quadruped; but it is only the race-horse, and those with much of their blood, and particularly while in training, that require an extraordinary degree of warmth, since they belong to a race that came originally from a warm country; neither ought they to be kept too warm after they have been so long accustomed to our climate. No horse in the stable should sweat under his clothing; by so doing, he is rendered highly sensible to external impressions from alteration of temperature, producing a morbid sensibility of skin, and, consequently, a greater susceptibility to many diseases; it also proves a relaxant.

The heat of a well-regulated stable in summer should not vary from between 60° and 65°; nor in winter much from 50°. Some have even found the advantage of accustoming horses to a cooler atmosphere by keeping them much in the open air. It is essential, as we have already stated, that grooms should learn to distinguish between merely *heated* and *foul* air; at present they confound these under the name of *close*. But, as we have stated, air may be warm without being in the least unwholesome, and may be cold, and yet very foul, the wholesomeness for respiration not depending upon the temperature, but upon the gases which compose it and the noxious vapours with which it may be contaminated. The temperature should be ascertained by a thermometer kept in the stable.

As an argument against the practice of keeping stables too warm, it is stated that in Berwickshire it is not uncommon to keep horses all winter in hammels or small sheds in open straw-yards, where they are exposed to the freest circulation of air, and that they have no grease, swelled legs, coughs, or inflammations, or other diseases probably brought on by the use of hot stables. Horses, however, to be treated in this manner, should be brought up to it, for it would not be safe to try the experiment on a horse long accustomed to a warm stable.

6595. *The light of stables* has been much neglected. Many have not even a glazed window, as it has been supposed that horses had no use for light, and even that they thrive best in the dark; but this is now known to be an error; besides, a certain degree of light is necessary to enable the owner to see whether the stable is kept properly clean and in order. Some stable-keepers prefer darkness, to conceal their want of cleanliness, or to make the horse look lively when brought into the light; but this is injurious to his eyes. However, too much light prevents his sleeping.

6596. *Windows should be placed high up in the stable*, that the light may not come into the horses' eyes; and the glass should be in imitation of ground glass, to keep out the direct rays of the sun. When opened in summer, a net should be kept across the opening, as that keeps out the flies, so annoying to horses.

6597. Whitewashing or lime-whiting the walls and ceiling of the stable is very proper on account of cleanliness; but, except the stable is rather dark, it is best not to make the walls quite white, but with a tinge of brownish-yellow or stone colour, this being less glaring for the horses' eyes.

6598. *For night, the best lights are candles, or lamps in lanterns.* The gas lights, which are sometimes employed to burn continually in stables, are extremely prejudicial, as they consume much of the vital part of the air, and sometimes suffer the carbonated hydrogen to escape unburned, which is exceedingly injurious.

6599. *Stalls.*—All good stables are divided into stalls, one for each horse, and these are separated from each other by wooden partitions (see plan of a four-stall stable, *fig.* 887, and the view of the interior, *fig.* 888). If horses are placed together, they are apt to do each other mischief, or are in some way inconvenient to the other. In some stables they are separated only by wooden bars; but these are not enough, for one will sometimes rob the other of his food, or do him harm by biting or other annoyance. Good stalls require to be six feet wide in general, and should be eight or nine feet in depth; that is, the partition should be of this length to prevent one horse interfering with another; the height of the partition should be seven feet at the head and five at the heels. Ponies will do with stalls five feet wide, but large dray horses require six feet six inches. When the stall is too broad, the horse will stand across it; when too narrow, he cannot lie down, which is a necessary position for his repose after having been hard worked. It ruins a horse's legs and feet not to allow him to stretch his

Fig. 887.

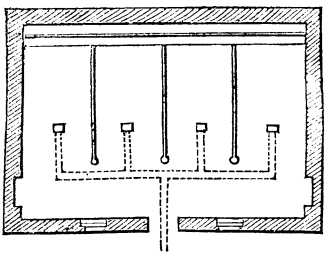
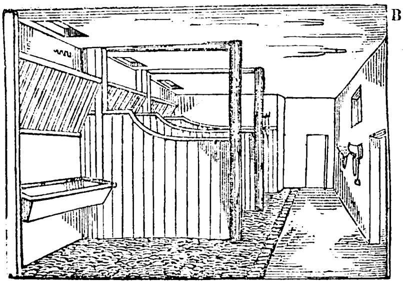
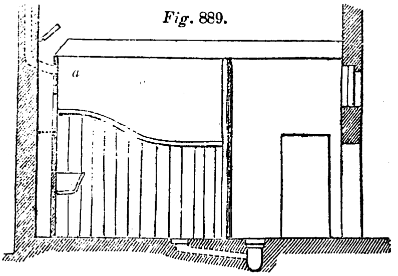


Fig. 888.



limbs in the stall. Of the paving of the stall we have already made mention. The stall posts are uprights at the bottom of the stall to stay the partition (see *fig*. 889); they should be round or octagonal, not square; sometimes they only rise a little above the partition, and sometimes they extend to the ceiling, which is firmest. Each side of this post should have a ring for pillar reins, which are used when the horse is required to stand reversed in his stall, as he is occasionally when being cleaned. The top of the partition is generally covered with iron.

Fig. 889.

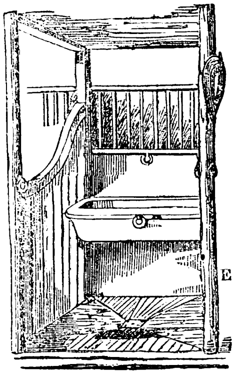


In some stables there are, besides the stalls, some compartments much wider, called boxes, for such horses to be in that are ill, or which require much rest. When horses are worked daily, it is proper to hang the harness of each on pegs in the wall opposite, to lose as little time as possible in putting or keeping in the harness-room that which is used only occasionally.

6600. *Hay-racks* are usually made of wood, but they are now beginning to be made of cast iron, which, though more expensive at first, are much more durable, and are more easily kept clean. The front of the rack usually slopes forward, as in *fig*. 888, that the horse may draw the hay more easily from it, and that it be more easily filled. But there are some objections to this form, and dust and seeds of the hay sometimes fall into the horse's eyes, and on this account some prefer having the bars or spars (as they are called) perpendicular, as in *fig*. 890; but this requires greater depth of the stall, because a partition must be run up at a little distance from the wall, as in the section, *fig*. 889, and the hay is thrown into the space between, either from the hayloft above, or from an opening just under the ceiling of the stable. In this space, below the rack, there is a bottom with bars closer to let the seeds and dust fall through, which are collected by a door below.

The spars should be round, two feet and a half high, an inch and a quarter thick, and two inches and a quarter apart. Each rack should have a ring at bottom for securing the horse's head: when tied to the spars, he is apt to bend or break them. Some have made the spars turn round on a pivot to facilitate the coming out of the hay. The racks are also sometimes placed in the corner of the stall, forming the quarter of a circle, which gives more room.

Fig. 890.



The usual mode of filling the hay-rack is from the hayloft over the stable, as it is generally in towns, by means of an aperture in the ceiling just over the rack, *fig*. 889. These apertures have been objected to; it has been said that the foul vapours from the stable rise up from them and contaminate the hay, and that the dust and seed of the hay fall down upon the head, mane, and ears of the horse, and, in consequence, it is recommended to abolish these apertures, and to keep the hay in another manner. But the rising of the foul air can be prevented by close trap-doors, and the dust may be avoided by a canvass sheet, to be used whenever the hay is put down. Any other mode of carrying in the hay would occasion much trouble, and in case of having perpendicular racks, as in *fig*. 890, no dust could occur. In towns, where space is so valuable, no place could be found for the hayloft so convenient as over the stable.

6601. *The manger* is the trough in which the horse's corn is put. It is usually made of wood and fixed, see *fig.* 888, but is sometimes also of cast iron and moveable, as in *fig.* 891; these have the advantage of being not only more durable, but of being likewise sweeter and cleaner, particularly where boiled or moist food is used, in which case wood imbibes the moisture and gives out a musty smell. Wooden mangers are made as long as the stall is wide, but iron mangers need not be so long; about three feet is sufficient length; they are generally nine or ten inches deep, but a foot would be better; and they should be twelve inches wide at the top, and nine inches at the bottom, inside. If the manger is too small, the horse is apt to scatter and throw his food out in turning it over. There should be no sharp corners to it for the horse to hurt himself against. Wooden mangers would be better if made moveable, so that they might be taken and scoured occasionally; but they should be securely fixed by draw-bolts. The top of the manger ought to stand from three feet to three feet six inches from the ground; if too high, the horse cannot eat comfortably, and if too low, he is apt to get his foot into it. It would be well to put sloping boards from the front edge of the manger to the wall, to prevent the horse cutting his knees against the corners. In the case where the rack is perpendicular, and there is a partition detached from the wall, as in *fig.* 889, the manger might be a drawer to slide back into the empty space. A small sheet-iron japanned drawer by the side of this might be made to serve as a water-trough, to move out on a pivot into the corner of the manger; but this must be made to lift out to be cleaned, or some other contrivance may be adopted for holding water in cases where it is desirable that the horse should always have it in his stall.

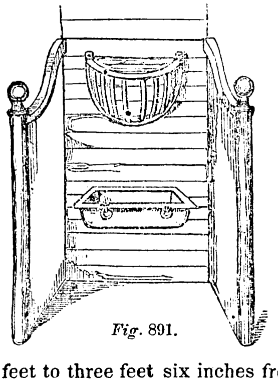


Fig. 891.

There are mostly two rings placed, one on each side of the manger or stall, for the reins of the horse's halter to run through, and a logger is fixed to the ends of these sufficient to poise them perpendicularly, but not so heavy as to tire the horse or to hinder him from eating.

6602. *Besides the daily cleaning out of the stable*, it should be thoroughly purified once or twice a year, by all the wood-work being scrubbed with soap and water, and the walls and ceiling whitewashed or limewhited; but opportunities for this should be taken when the horses are out for some time.

6603. *The hayloft* in towns is generally over the stable, chiefly for the convenience of supplying the racks easily: in the country it is often in another situation. Where there is no plastered ceiling to the stable, the joints of the flooring boards should be ploughed and tongued, and otherwise made quite tight, to prevent any noxious effluvia coming through from the stable. If the apertures for supplying the hay-racks in the stable have also close-fitting covers, this situation of the hayloft above the stable may not be objectionable; but in the country, where the hay can be cut from the stack every twenty-four hours, a separate hayloft is scarcely necessary. When there is one, it should contain nothing but the horse's food, and should be provided with means for ventilation. In large establishments, an adjoining room, for cutting hay or straw, bruising corn, and measuring, weighing, and mixing, will be found necessary.

6604. *A granary*, in a large establishment, or a *corn chest* with divisions for different kinds of grain in a small one, may be placed in any convenient situation that can be found. If above the stable, the grain can be supplied to the manger by a wooden tube.

6605. *Boiler-house.*—In a small establishment the boiler may be placed in a corner of the yard, but where there is much preparation of mashes, &c., sometimes a room on purpose is necessary to perform the various operations in, and for keeping all the implements belonging to the stable.

6606. *Water.*—At some places in the country there is a pond for watering the horses, but this water, though it may do to wash the carriage, or for the ducks and geese, is not fit for the horses to drink, being both dirty and stagnant, and, in cold weather, too cold. Water for drinking should be of the best quality, and should be kept near the stable.

6607. *Stable-yard.*—In towns, where the stables and coach-house are in lanes called mews, there is no place to groom the horses and wash the carriage but the mews itself; but in the country, where space is not so valuable, there is usually a stable-yard for this purpose, where all the wet work should be done. It may be well, likewise, to have a shed at one side of the yard, where the horses can be groomed in cold or wet weather, and where they can be moved about occasionally.

6608. *Stable appointments* are generally known. The *Dutch collar* and *neck strap* are necessary for every horse in the stall. *Muzzles* are also sometimes useful, to prevent a greedy horse from taking food from his neighbours or biting. *Dressing cloths* are of leather, hair, woollen, or linen. Combs, brushes, scissors, foot-baths, and stable pails are always required.

6609. *Harness-room.*—Though in confined places the harness is usually hung up in the stable or in the coach-house, yet, where it is possible, and where there is much harness, it is best to have a place on purpose. The stable is an unfit place, being damp and apt to spoil the harness, which requires to be kept very dry and clean. The harness-room should be well aired, and have a fire-place, be provided with proper pegs to hang the various articles of harness on, and it is a good plan to have a curtain to draw over them, to slide with rings upon a rod, to keep off the dust, which saves much trouble and time in cleaning; the walls behind where the harness is hung being boarded, and not plastered only: there should be, also, stools and shelves for saddles and various other articles, and cupboards for brushes, brooms, sponges, cloths, bandages, and such things as are in constant use: nothing of this kind should be suffered to lie about in the stable, but be so arranged as to be always at hand. It may also have a chest for keeping corn, and likewise a boiler for heating water.

6610. *Room for the Coachman or Groom.*—Where there are valuable horses it is proper that some one should sleep near, to be ready in case of accident in the night, but this must vary according to the nature of the establishment.

6611. *Furniture of the coach-house or stable:*

Coach mops,	Curry-combs,	Dung-baskets and boxes,
Jacks for wheels,	Inside brushes,	Stable shovels and forks,
Horse brushes,	Birch and heath brushes,	Rugs for gigs, carriages, &c.,
Spoke brushes,	Mane and trimming combs,	Corn sieves,
Quarter brushes,	Scissors and pickers,	Quartern measures,
Water brushes,	Oil-cans and brushes,	Whipcord,
Crest and bit brushes,	Harness brushes,	Horse blocks,
Dandy horse brushes for dirt,	Leathers for carriages,	Stable pails.

CHAPTER II.

ON HORSES AND THEIR MANAGEMENT.

6612. In the following pages we shall confine our observations to carriage and ordinary saddle horses, omitting racers, hunters, and farmers' horses as not coming within the scope of this work; and we shall devote our attention chiefly to those circumstances of proper management which are necessary to keep horses in health in the stable and at work, without entering into the treatment of diseases, which we leave to veterinary practice. We shall, in short, endeavour to select all those facts which it is proper that every one possessing horses should be acquainted with, but intending this rather as a check upon the pretended knowledge of those who may have the immediate care of horses; for no written directions can completely supply the practical skill of an experienced groom, to whom, however, the sole management should not be implicitly trusted, where it can be avoided. With this view, the most able writers on the subject have been consulted, and the various details have been compared with the opinions of several experienced persons.

SECT. I.—GENERAL REMARKS ON THE VARIOUS BREEDS OF HORSES.

6613. The horse, no doubt, existed originally in a wild state, as it does now in South America and Tartary, but at what period it was subjected to the dominion of man cannot be determined. All the civilized nations of the ancient world of whom we have any historical records not only possessed this animal in a domesticated state, but set a high value upon it, bestowing great pains in training and improving its various breeds or races. The origin of those breeds is likewise unknown, but they were most probably produced by the circumstances of variety in climate, food, and shelter, during a long succession of ages, assisted afterward by the effects of domestication in different countries. Climate has great influence upon the forms of animals, and, in general, a species is found indigenous to each country whose form best fits it for supporting its existence there. Thus, in the arid plains of the East, where herbage is scarce, the horse is found to possess a form which enables it to transport itself with great rapidity from one spot to another, without permitting his weight to cause it to sink in the sandy deserts. In wild countries, on the contrary, his size is diminutive, but his compactness and strength, as well as his coarse, shaggy coat, enable him to resist the severity of the weather. In temperate climes, where these causes do not operate, and where vegetation affords, by its luxuriance, more nutriment, we no longer see him equally small or slender, but, with great capacity still for progression, possessed of more beautiful proportions, with superior muscular power; varying considerably in his qualities, which are adapted to the purposes of war, hunting, parade, the saddle, and draught.

6614. The indigenous horse of every country has been modified by cultivation, and the native breeds have at one time or other been more or less mixed with other varieties with a view to improvement. What is meant by purity of blood is the result of limiting the propagation of particular races, and preventing other races from mixing with them. The native races of some countries are distinguished and esteemed above others for their peculiar qualities: thus the fleetest horses *are found in Arabia*, where they possess a spirit and courage united to docility excelling that of any others, and where they are brought up with an unexampled degree of care.

6615. *The Barb*, the *horse of Barbary*, is superior to the Arabian in point of form, and is remarkable for his free and graceful action, but is rather lower, and has not quite the speed and spirit of the Arabian: he has contributed much to the excellence of the Spanish and other European horses. Several varieties, having considerable resemblance to these, are met with in Tartary, Turkistan, and Persia; but the native breeds of India and China are much inferior. It is remarkable that horses were unknown in America before its discovery by the Spaniards, and that the wild horses, so numerous in the Pampas, are merely the descendants of some that got loose and escaped from the Spanish army.

6616. In Europe *the horses of Turkey* are descended chiefly from the Arab, crossed by the Persian and other bloods; they have contributed much to the improvement of our English breed. The German horses are, in general, large, heavy, and slow; but the Hungarian are an exception, partaking more of Eastern blood. The Dutch and Flemish horses are large, strong, and beautifully formed: we are indebted to them for some of the best blood of our draught horses. France contains, like England, numerous breeds of horses; but they are in general inferior to ours, though much attention has lately been paid to them by importing other breeds. The best French horses are bred in Limousin and Normandy, and from the latter district comes a strong variety, excellent for the cavalry, road, or carriage.

6617. *The earliest record of the horse in Great Britain* we find in the Commentaries of Julius Cæsar on his invasion of this island, in which he described the war-chariots of the Britons as being drawn by numerous horses. What was their original character is not mentioned; but probably they were subsequently somewhat changed by the introduction of Roman horses, which were themselves compounds from various countries. It appears that English horses were much esteemed even in the Anglo-Saxon times, but received a cross from those of William of Normandy. So early as the reign of Henry II. the value of the Arabian and Turkish horses was understood; and every successive monarch has bestowed much attention in improving the nature of an animal so useful and so great a favourite as the horse. Every variety of Eastern as well as European blood of a superior kind has been ingrafted on ours; and the advantage of this method is evinced in the high esteem in which English horses are now held all over the Continent.

6618. *Horses may be divided into draught and saddle horses.* Although our object in the present work is to confine ourselves to those that are employed for what may be called domestic use, namely, saddle or riding and carriage horses, yet a short account of the various other kinds of English horses may not be irrelevant. Saddle horses may be reduced to the race-horse, the hunter, the hackney riding or road horse, the Galloway, and the pony. Draught horses are the heavy draught horse or dray horse, wagon, coach, chariot, and gig horses.

6619. *The English race-horse* possesses his most valuable qualities of great speed in consequence of his descent from the Arabian, Persian, or Barb. The term of *thorough-bred* has reference to his origin, but it is not perfectly definite: it is generally supposed to mean that both sire and dam can be traced to Eastern parentage; but it may be considered doubtful whether many of our race-horses can be proved to belong strictly to this class. The "Stud Book," which is the chief authority for the pedigree of horses, traces all the most famous racers to some Eastern origin; or it traces them back to a certain extent, ending with a known racer the origin of whom is lost in obscurity; but it is supposed by some that several of our best racers are derived from our native horses improved by judicious crossing. A horse is said to have *blood* when in his pedigree it can be shown that he has derived his origin in any degree from a thorough-bred horse. If he has been produced by a racer and a common mare, he is called *half-bred*. Horse-races were very early among the English sports, and though at first pursued without any direct view to the improvement of the animal, they have ultimately proved useful by drawing the attention of the wealthy classes to the subject, and by preserving the purity of blood, or practising judicious crossing. By the most nutritious food and duly-apportioned exercise during his training for the courses, not only his speed, but his bodily powers, have been increased, and a breed of horses has been produced unrivalled in the world for symmetry of form, swiftness of progression, and durability under exercise. The Darby Arabian was the parent of our best racing stock. He was purchased by Mr. Darby at Aleppo, and was bred in the plains of Palmyra. His immediate descendant was the Flying Childers, so called from his breeder Mr. Childers, of Devonshire: the fleetness of this horse was so great that he moved over a space equal to 83½ feet in a second; some say a mile in a minute. After him, Eclipse, Highflyer, Matchem, Hambletonian, and others have contributed to keep up the reputation of the English racer, which has been known to beat some of the best of the Arabian breed on their native ground.

6620. *The hunter* is produced from a thorough-bred, or horse of entire blood, as it is called, and a mare of good quality; or sometimes from a mare of blood and an English horse of the best kind. This variety of the horse is, therefore, a combination of the speed of the Arabian with the strength and durability of the native animal, and the English breed is now much esteemed in every country of Europe. The real hunter is kept in the stable, and is attended with great care: the principle of training, or preparing him for his work, which is an affair of considerable time and difficulty, is the same with that of the racer, viz., to get rid of all the superfluous fat and flesh without too much lowering the animal; and particularly to bring him, by dint of exercise, into good wind, and accustom him to the full trial of his powers, without overstraining or injuring him. Occasionally it happens that a farmer's horse, worked in the day, with a feed or two of corn, and turned out at night, with an open stable or shed to run into if it pleases, is nearly as active and enduring, for one day's sport, as those which are carefully trained and confined to the stable during the hunting season; yet, if tried for a day or two, he will infallibly show an inferiority in wind and bearing fatigue, though he will much better resist the severity of cold weather than the pampered and stabled animal. It is a remarkable fact that both the racer and hunter fully share the enthusiasm of the rider. Without whip or spur, he will generally exert his energies to the utmost to beat his opponent; and several instances are mentioned where his natural ardour has been evinced in the struggle; even when, after hard work in racing, he has been turned into the park to enjoy himself for life, he has been known to feel an irresistible desire of joining in the chase on hearing the distant cry of the hounds.

6621. *The old English hackney*, now little known, was the origin, with improvement, of our best saddle horses, whether for the road or farmer. He has been frequently considered as indigenous, although it is most probable that the breed has sprung from a judicious culture of the small native horse with Norman, German, or Flemish, and thus improved in size and strength for the purpose of carrying hacks, for which the horse was formerly employed extensively.

6622. *The improved hackney*, *road-horse*, or *roadster*, besides the advantage of being, in all probability, partly descended from some of the best horses of the Continent, has also frequently some of the blood of the racer, but less of that than the hunter; and the proportion he should have will depend upon the kind of work he is to perform. A very good road-horse is even more difficult to meet with than even a hunter, for which there are several reasons. The price of a hackney, or horse of all work, is so low, that he who is so fortunate as to possess a good one will not part with him on account of his real utility and the little chance of procuring another equal to him, for it is by mere accident alone that he is to be obtained. He must likewise be free from certain faults that may be overlooked in the hunter. The latter may start; may be awkward in his walk, or even in his trot; he may have thrushes or corns; but if he can go at a good slapping pace, and has wind at bottom, we can put up with him or prize him; but the hackney, if he be worth having, must have good fore legs and good hinder ones too. As safety is required in the hackney as well as speed, great pains are taken to breed him so as to have the fore parts high and well placed, whereas in the hunter the hind parts are rather of most importance. The hackney must be perfectly sound on his feet; even-tempered; no starter; quiet in whatever situation he may be placed; not heavy in hand; and never disposed to stumble. The Irish road-horse is an improved variety of the English; and it is said that most of the common road-horses used in England are of the Irish breed. *Cobs* are a thick, compact variety of hackney breed, about fourteen hands, in great request for elderly and heavy persons to ride, or to drive in low phaetons.

6623. *The large black horse* is a noble animal that furnishes those grand teams we see in the coal wagons, and also in the flour and other heavy carts and wagons about London, where the immense weight of the animal's body assists his accompanying strength to move the heaviest loads. He is mostly bred in the midland counties of England, chiefly in Lincolnshire; but the present system of farming requiring horses of less bulk and more activity, better adapted for travelling, and more capable of enduring fatigue, he is confined chiefly to the above uses. This heavy breed is supposed to be derived from the old English black cart, improved by crossing with Dutch and Friesland mares. The largest of them are used as *dray-horses*. The next in size are employed as *wagon-horses;* and a smaller variety, with more blood, constituting a considerable part of our *cavalry*, is likewise devoted to undertakers' work.

6624. *The Cleveland or Yorkshire bays* have long been celebrated as one of the best breeds in the island for draught; but they are said to have degenerated of late. They are reared to a great extent in Yorkshire, the farmers of which county are remarkable for their knowledge in everything that relates to horses. In activity and hardiness they have, perhaps, no superior. Some capital hunters have been produced from the mares and full-bred stallions; but the chief object latterly has been to breed coach-horses and others for heavy draught, and these are of considerable strength. They appear to have been the origin of our best kind of heavy coach-horses.

6625. *The Suffolk punch* is a horse much esteemed for agricultural labour, being strong and active, but without any superiority of shape.

6626. *The Clydesdale horse* has long been in repute in Scotland and the north of England, and, for the farmer, is probably equal to any other in Britain, being docile and steady. The origin of this breed is uncertain; and they have not got this name from having been bred only in Clydesdale and Lanark, for they are reared in many other parts of the west and south of Scotland. They are rather larger than the Suffolk punches, and their colour is black, brown, or gray, with a white spot on the forehead. They are remarkably true pullers, and are seldom restiff.

6627. *The coach-horse* cannot be called a particular breed; but the origin of the superior kind is the Cleveland bay, confined principally to Yorkshire and Durham, but now difficult to meet with in either county. The coach-horse most in repute, with his arched crest and high action, is the produce of a Cleveland mare and a three fourth or thorough-bred horse of sufficient substance and height. From the thorough-bred of sufficient height, but not of so much substance, we obtain the four-in-hand and superior curricle horse. From the half-bred we derive the common carriage horse and the poster. Yorkshire is considered as the chief breeding county in England for coach-horses, hunters, and hackneys. The English coach-horse is now very different from what he was fifty years ago. We no longer see those clumsy black family horses, over-fat, straining at first starting, yet scarcely equal to six miles an hour, and knocking up with one day's hard work. Rapid travelling is now so much the fashion that the modern coach-horse is, with improved strength and action, frequently like tall, strong, overgrown hunters. Yet, though their speed is increased, they still have not the endurance that could be wished, and a pair of poor post-horses will often beat them at the end of the second day. It is remarked that no country produces finer horses than England, yet in no other country is there such a destruction of the animal from the rage for fast travelling.

6628. *Galloways.*—The true Galloway is a beautiful variety of horse, so called from that province in Scotland from which it came originally. It is a bright bay or brown, with black legs; but this breed has now become rare, from being neglected, on account of its unfitness for agriculture. The term Galloway, however, is now applied to any horse of the same size, which is between that of the pony and the pack, and such horses are much in request for drawing low chaises, for which the original breed is very valuable, being flat and very sure-footed.

6629. *Ponies* are the smallest of our breeds, not above thirteen hands, and they vary in different districts. The Welsh pony is a beautiful little animal, will live on almost any fare, and is never tired out. The Highland horses are very similar, being small, but remarkably hardy and enduring; and as they appear to be the same with those of Norway, it seems not improbable that they might have come originally from Scandinavia. They are seldom above twelve hands high, and sometimes only nine. They are extremely well formed, but inferior to the Galloway.

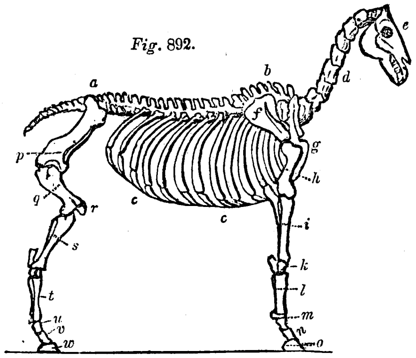
6630. *The Shetland pony*, called *Sheltie*, an inhabitant of the Shetland Islands, is a distinct breed, and the most diminutive of our horses, being sometimes not seven and a half hands high, and rarely exceeding nine and a half. He is a most hardy animal in his native place, subsisting on what he can pick up in that barren country without any sheltered habitation, and often, even in winter, obliged to find his own food by scraping off the snow, or resorting to the shore to eat sea-weeds, his body covered with long hair, and his mane and tail rough and shaggy. His strength is immense, and one will carry a man and his wife for miles to church on a Sunday. He is well formed, and perfectly docile. When transported into England, and submitted to the process of the curry-comb and the care of the groom, he becomes one of the most beautiful of the species, and may sometimes be seen harnessed to a low gig or chair in some of our parks. Several of them are now running in Windsor Park.

SECT. II.—NAMES OF THE EXTERNAL PARTS OF A HORSE.

6631. For want of knowing accurately the names of the various parts of a horse, mistakes are often made in giving or receiving directions, or in conversing about them, by those who have not been much used to horses. In order to understand these clearly, it is necessary to have some knowledge of the bones, and we therefore give a wood-cut of the skeleton, and another of the external figure of the animal, both to the same scale. To show the utility of the former, the reader may try to understand the horse without it, and he will then perceive the use of adding this farther elucidation; but we shall commence with the skeleton, *fig.* 892.

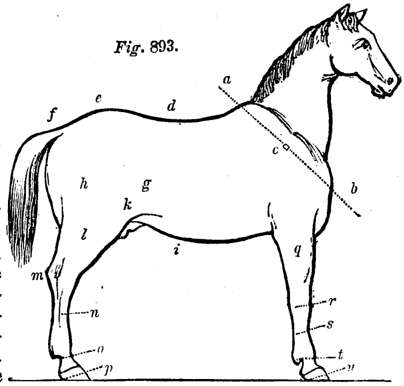
6632. *In the skeleton we may observe: a b* the *spine*, or back bone, composed of a number of joints or vertebræ, of which there are eighteen in the back, called dorsal vertebræ; six at the loins, termed lumbar vertebræ; five at the pelvis, or haunch, called sacral vertebræ; and from eight to thirteen caudal vertebræ, forming the tail. At *b* are several processes or projections from the vertebræ, just above the shoulder, which form what is termed the *withers*. It is to be observed that similar processes, though not so long, project from all the vertebræ, and that it is those which appear as a sharp ridge on the back of a lean horse. *c c* are the ribs, which are attached to the vertebræ of the skin, and in front to the sternum, or breast bone, *g*. *d* are the vertebræ forming the neck, and named cervical vertebræ; these are by farriers called rack bones. *e* is the scull. *f* is the scapula, or shoulder-blade. *h* is the humerus, or arm bone, so concealed by strong muscles as to be overlooked by the general observer; and in consequence the next bone, *i*, is commonly called the arm bone, which is anatomically the radius. *i* is the fore arm of horsemen, but the radius of anatomists. *k* is the knee, but answering to our carpus or wrist: the knee joint is formed of seven small bones. *l* is the cannon or shank bone, forming what is generally termed the leg; but it is to be observed that anatomists, in comparing the structure with that of the human body, consider this single bone as in the place of our metacarpal bones, or those of the palm of the hand, as if all our metacarpal bones were united into one. *m* is the upper pastern bone; *n* the smaller pastern bone. *o* is the coffin bone. These bones of the foot will be afterward described more at large. *p* is the haunch, consisting of three portions, the ilium, ischium, and the pubis. *q* is the femur of anatomists: this articulates with the pelvis, and its strong head is called the whirl bone. *r* is the patella, a small bone, called by farriers the stifle. *s* is the thigh bone of horsemen, but the tibia or leg bone of anatomists. *t* is the leg bone of horsemen, but the fibula of anatomists. *u* is the upper or larger hind pastern. *v* is the lower or smaller hind pastern. *w* is the hind coffin bone.

Fig. 892.



6633. *The following are the names of the external parts of the horse, fig.* 893. The whole is divided into the head, neck, trunk, and extremities. The head and neck are, in general, sufficiently well known; but we may observe that the line of the face is sometimes nearly straight, but occasionally a little arched. *a* is the withers; *a b*, the line of the shoulders extending from the withers to the breast, *b*, in front. It is by the muscles of the shoulders chiefly that the horse draws, and by which the action of the fore limbs is effected. The shoulder is formed by two bones, the shoulder-blade and humerus or arm, which are covered and concealed by large muscles; *c* is the centre of action of the shoulders. The humerus is the bone which, among anatomists, corresponds to our own, and it articulates with the shoulder-blade (see *fig.* 892), although among horsemen the bone below it is called the arm. *d* is the back, which extends from the withers to the loins. *e* is the loins, at the hinder part of the saddle, when that is on. *f* is the croup, extending from the loins to the setting on of the tail. The flank, *g*, is the part between the ribs and haunches. *h* is the situation of the whirl bone of the farrier, at the hip joint, formed by the articulation of the pelvis bone with the true thigh bone of anatomists (see *fig.* 892), concealed by muscles, and only to be understood by reference to the skeleton. *i* is the belly. *k* is the stifle. *l* is the part called the thigh by horsemen. *m* is the hock, or the articulation of the thigh bone of horsemen with their leg bone; *n*, the leg of horsemen; *o*, the pastern; *p*, the hoof. In the fore extremities there are *q*, the thigh of horsemen; *r*, the knee; *s*, the fore leg; *t*, the fore pastern; *u*, the fore hoof.

Fig. 893.



Sect. III.—VARIOUS QUALITIES IN A HORSE.

6634. *The height of a horse is measured by hands*, each hand being equal to four inches. The height of hunters and hackneys varies from fifteen to seventeen hands, but is never below the former; most usually between fifteen and sixteen, which makes them about five feet high from the point of the shoulder to the ground. Cobs are from fourteen to fourteen hands and two inches; Galloways are from thirteen to fourteen; ponies are not above thirteen hands; Welsh ponies sometimes not above twelve.

6635 *Horses are usually broken and trained* at four and a half or five years old, but not before; at five they are, in general, considered fit for full work. A horse is generally reckoned in his prime when from seven to ten years of age.

6636. Horses are not injured, but rather strengthened by plenty of work, provided it be not too hard, and that they are well fed; but they should not be much worked too soon, and before they have arrived at their adult state, as this is apt to bring on premature old age. Few horses last more than twelve or fourteen years with constant work; and during that time it must be expected that they are unfit for work from sickness.

6637. *The extent of the horse's life* seldom reaches much above twenty-five years, though with good usage they will live to thirty, and even to forty years. When very old they suffer much from decay of their teeth.

6638. *A horse's age is judged of chiefly by his teeth.* The horse, as is well known, has six incisive or nipping teeth in the front of his mouth, in the upper and under jaw; four canine teeth, called also tushes, and six molars, or grinding teeth, in each jaw above and below. The mare is without tushes, and has but thirty-six teeth, while the horse has forty.

The foal has six grinding teeth in each jaw at its birth, without front teeth; the tenth or twelfth day after two of the front teeth appear above and below, and in fourteen or fifteen days more the two intermediate come out, and the corner ones three months after.

6639. Various changes take place till the horse is two or three years old, when the front teeth fall out and give place to the permanent ones. At four years the horse has six molar teeth, and at five the tushes appear. Beyond nine or ten years the age of the horse cannot be ascertained with any certainty by his teeth, and previously to that time it requires persons of much experience to speak with decision on the age of a horse by his teeth. Breeders and dealers are known to practise various tricks with the teeth for the purpose of deception.

6640. *What are usually termed the paces of a horse* is his manner of moving. The ordinary paces are walking, trotting, galloping, and cantering; these are improved in the training.

6641. *To walk well* is a valuable property in a saddle horse, particularly to timid riders and to ladies. When a horse is tired by trotting a great distance, it may be a great relief to finish the journey by walking. The greatest speed in the walk of a horse is about six miles an hour, but five is the common pace.

6642. *Trotting* is either slow or quick. It is exceedingly difficult to mark the action of the horse's legs in trotting. The feet are lifted diagonally in the moderate trot; in the running trot, which is a rough pace, all the feet are in the air nearly at the same time. The speed of a horse in trotting may be improved by training, and it is of great importance in light carriages. Twelve miles an hour is reckoned a moderately quick trot; and fourteen miles in harness is good trotting. Eight or nine miles an hour is usual. This must, of course, vary with the description of work performed. The carriage of the horse's head is to be marked, both for grace and safety; it should neither be held too high nor too low; and there is sometimes a fault in his striking the hind with the fore foot.

6643. *Of the gallop* there are three varieties, that of full speed, the hand gallop, and the canter; the gallop at full speed is always preceded by the slower one, and at last is a succession of leaps. The greatest speed in galloping at the races has been a mile a minute.

6644. *The canter* is not a natural pace, but an artificial one, usually taught to ladies' horses, on account of the greater ease in the motion to the rider. In it all the legs are never in the air together, one of them always touching the ground.

6645. *Safety in horses is essential;* those which are apt to stumble are on all accounts to be rejected. Some horses that are safe in one pace will stumble in another: much depends upon good training, but much also on the rider. Horses that have been accustomed to mountainous countries and rough roads are generally safer and less liable to stumble than others. Some horses are apt to strike the ground too much with the toe, instead of lifting their feet clearly over obstacles, and should the fore part of their shoe touch a small stone, they may stumble, and even fall. In purchasing a horse, it is proper, therefore, to examine the front of their shoes and see if they indicate any marks of "tripping."

6646. *To decide respecting the action of a saddle horse*, the kind of work for which he is wanted must be considered. If it is for a lady, the canter is the most important pace; if for the road, then the trot is of most consequence: few excel in all the paces.

What is called *grand action* in horses is not desirable in those for the saddle, nor in those used for light carriages, or where speed is required, but is requisite only in horses for state carriages, and perhaps for the coach, the landau, the barouche, or cabriolet.

6647. *The colours of horses* are laid much stress on by many persons, and long experience has shown that certain tints are usually accompanied by certain qualities of person or disposition. As a general rule, dark-coloured horses are the best, but black form an exception, as they are extremely variable. Light shades appear unfavourable to strength and durability. *Bay* is a prevailing tint, and is generally admired; it admits of many shades; there are bright bays, dark and dappled bays; the latter is esteemed for beauty; brown bay is valued for service, and consists of bay and black in variable proportions: all bays have black manes and tails. *Brown* horses are highly prized; the dark varieties have sometimes beautiful tan markings. *Chestnut* is also a good colour, but is said to be less depended upon than some others. The *sorrel* is a variety of the chestnut, but not a favourite one. *Dun* is a colour that has several varieties, the mane and tail sometimes lighter and sometimes darker than the body, with frequently a black list along the back: they appear to be of all qualities. *White* horses are not in much estimation, neither is it a very common colour for young horses; but some become white through age. *Black* is a very usual colour, and seems to be an original tint. The tempers of black horses vary extremely, being either sluggish or too fiery. It is seldom that a horse entirely black is seen; there is usually some spot of white in the forehead, or a few white hairs on the breast. The *roan* is a mixture with white hairs. *Gray* horses are of many shades, compounded of black and white; there are the iron grays and dappled grays. Various other names for mixtures are enumerated, scarcely possible to define.

SECT. IV.—FOOD OF THE HORSE.

6648. The substances on which the horse is capable of subsisting, and on which he is actually fed in various parts of the world, are more various than might be generally supposed. Among these are enumerated, not only herbage, green and dried, with grain and pulse, but roots, fruits, leaves, and twigs of many trees, reed flags, and even milk in Arabia; and in steril countries animal matters, as dried fish, flesh balls, broth, eggs, &c. But the natural food of the horse is of the vegetable kind; and such of our readers as wish to be intimately acquainted with the chemical nature of vegetable food in general we would recommend to study our chapter on this subject, where we have treated at some length on the properties of the various kinds of grain and pulse, and other vegetable substances.

6649. *The feeding of horses* is a subject that demands much attention, and it is one, observes Mr. Stuart (to whose excellent work we are indebted for many hints), on which people unacquainted with stable affairs are apt to make many blunders, because they reason too much from analogy, and suppose that the rules by which they regulate their own diet should be applied to the horse, although he is an animal whose digestive organs are very different from those of man. "The large stomach of the horse being intended by nature for green food, requires a greater degree of distention for its functions than corn alone can produce; one use of hay, therefore, in addition to corn, is to distend the stomach: as a proof that nature demands this, if a horse is unlimited in his allowance of corn, he will frequently leave this to eat some fodder, or even the litter; therefore, when the usual fodder is too dear, some cheaper substitute must be found. The use of giving condensed food in the shape of corn is to enable him to do more work than he could do upon what is not so. From this the importance of attending to the bulk of the food will be understood. Hay and all kinds of green food and roots contain less nutriment in the same bulk than corn or pulse, and, therefore, the horse must eat a greater quantity of the former; but as this quantity encumbers the horse by its weight, bulky food is not proper for horses where speed is required. Food in the more condensed form of grain and pulse is fitter for fast work; slow or moderate work assists digestion; but such work as horses in general have to perform, and which sometimes produces copious perspiration, requires peculiar management. During fast work it is probable that digestion is suspended, or the stomach is not in a favourable condition for performing its duty. It is, therefore, not right to give horses a full meal immediately before commencing their work, if considerable; the bad effect of doing so is well known to experienced horsemen; the horse wants breath, and is unwilling to go forward; the action of his lungs is impeded, and he has to carry an increase of weight, which, though but a few pounds, has an effect upon his speed; on this account it is usual to feed coaching horses one or two hours before starting, and hay is withheld after the corn is eaten; but it is not proper to keep them from food so long before their work that exhaustion commences.

6650. *The food of horses in this country* is of three kinds: what is called *fodder* consists of grass and all kinds of green food, hay, and straw. *Corn* is a term applied to oats and every kind of grain and pulse upon which horses are fed. *Roots*, as potatoes, carrots, turnips, &c., form the third. The greatest nutriment in the smallest bulk lies in corn; the least in fodder.

6651. *Of herbage given to horses*, the principal kind with us is the extensive class grasses, which may be eaten moist or green, or dried into hay. When eaten moist while it is growing, the horse is said to *graze*; but when the green food is cut and carried into the stable to the horse, he is said to be *soiled*. By the latter practice he loses the benefit of the fresh air of the fields, but much time is saved to him, since, in grazing, he would require several hours to eat sufficient, whereas he could eat the same quantity of green food in his stable in one quarter of the time. Grass is the natural food for the horse; it is composed of a great number of plants growing together, and differing considerably in their properties; some of them are much relished by him, and he rejects others. Although in a state of nature he can subsist sufficiently well upon this food, yet when domesticated and applied to hard work, grass and other kinds of green food are not sufficiently nutritive to keep him in condition; and it is necessary that he should have also the farinaceous food which corn supplies to give him strength. Besides the common or meadow grass there are several species of grasses and plants which are cultivated for green food, as clover, rye grass, lucerne, saintfoin, &c., respecting the particular merits of which there are various opinions; but they appear all to produce nearly the same effects as meadow grass, some horses liking one best and some another; clover, rye grass, and tares are the most common.

Furz, called in Scotland *whin*, is, when green, a very good food for horses, which have often subsisted upon it when there was no other. It must be bruised by a bruising mill, and should be given with straw and oats. It is said that the British cavalry while in the Pyrenees, under the Duke of Wellington, had often no other forage.

6652. *Vetches*, or *tares*, take the lead as a green food for the soiling of cattle; and it is also made into hay while in a state of blossom. They are best for horses when the pod is formed.

6653. *Notwithstanding the good effects of green herbage occasionally, yet this must be given with caution*, since, accustomed as the horse is to an artificial state of living, it effects a considerable change upon him. For the first two or three days green food relaxes the bowels, and increases the secretion of urine and perspiration: if permitted to eat of it as much as he pleases, the belly becomes large, from the quantity of this kind of food required to satisfy him; but though corn gives him more strength than grass, yet his general health is much improved by the latter. When horses are *soiled*, they should never get much green food at a time, a practice too prevalent among servants. The custom of giving corn along with green food is unprofitable; for the grain, thus mixed, passes rapidly off from the stomach, and is never perfectly digested.

6654. *Pasturing Horses*.—We have stated that grass is the natural food of the horse, and it is the kind most conducive to his health. Horses worn down with work, disease, or bad food, are frequently sent out into the fields to renovate, and they are is then said to be "turned out to grass." Pasture fields differ considerably as to their situation, air, moisture, or dryness, and the species of grass that grow in them. Some are hard and injurious to the feet; others are too soft, wet, and marshy. Those on the sea-shore are by some thought to be peculiarly renovating, except they are occasionally overflowed by the salt water, and converted into marsh, when their salubrity is very questionable. It requires some judgment to determine when it will benefit a horse to send him to pasture, or whether giving him green food in the stable is preferable. The plants that form grass being of great variety, some of them are much relished by the horse, while others, though luxuriant and agreeable to the eye, are never touched by him, except there is nothing else to eat. He is, therefore, continually occupied in selecting those kinds which are most agreeable to him; this causes him to take a good deal of exercise, and the exposure to the air is, in general, favourable to health. It is remarked, that horses that have been long accustomed to the stable often have stiff necks when first turned out to graze, from the alteration in the position of the head when feeding; but this soon wears off.

6655. *In turning horses* out to grass, care should be taken to select favourable weather, and to inure them to the change from the warm shade gradually by letting them remain in the field at first only a short time, and by leaving off their stable clothing a little before going to grass. Spring is the season when the horse receives most benefit; the grass is sweetest, and most tender and digestible; sometimes it is even medicinal; he is then also less tormented with flies than in the summer, when the heat is often too great. The autumnal grass is much inferior, and perhaps may then be deficient in quantity, in which case he requires a supply of corn.

6656. *Hay* is grass cut during its flowering time, and dried. In making hay it is first spread out and exposed to the sun and air for a proper time, and then it is collected into large masses called ricks, when it is supposed that a certain degree of fermentation takes place, which fits it for being wholesome and nutritious, as well as for its preservation; it is afterward dried thoroughly. If suffered to remain too long in the rick, the fermentation proceeds too far, and it becomes heated, and is termed *mow burned*, when its nutritive properties are injured, and it acquires noxious properties. The quality of the hay is a matter of great importance to the health of horses, particu larly when they are fed much upon it.

Good hay should be a year old, and have a pleasant smell and taste.

New hay is laxative, and, though horses are fond of it, it seems not to be very digestible, since much of it passes through him unaltered. If the hay is too old, it becomes dry and tasteless; horses will scarcely eat it. It is said that the making of hay is performed more skilfully in the vicinity of London than elsewhere.

When hay is in the least mouldy, it should not be given as food. Sometimes hay is salted to prevent fermentation in the stack; the horse relishes the salt, which is supposed to assist the process of digestion; but it is not well to feed him long on salted hay. Grass, in drying, loses half its weight; and hay gets drier as it grows older.

Many horses thrive best on clover hay, particularly draught-horses, which are very fond of it. In the market it costs twenty per cent. more than meadow or rye grass hay. A horse can live on hay and water; and when not used for work, he often receives nothing else; but this food alone is not sufficiently strengthening: he then becomes feeble and pot-bellied. On hay and corn horses may be fed for a long time without inconvenience. When illness attacks them, soiling in some cases is resorted to as a remedy. In gentlemen's stables scarcely any other than meadow hay is admitted.

6657. *Straw is little used in England as fodder for horses*, but it is employed in many places on the Continent where there is little or no hay. It is sometimes given to farm-horses, but seldom to coach-horses, being less nutritious than hay. Oat straw is preferable to that of wheat, but that of barley is so poor and brittle as to be unfit. Some more nutritious and less bulky food may be added to straw when it is given.

The haulm of beans and pease, but especially the latter, when well harvested, forms a very hearty species of fodder. The stalk of the beans is tough and somewhat woody, and is seldom used, unless softened by being bruised, cut, and steamed. Pea haulm is succulent and nutritious, and is much relished by cattle; but it should be given cautiously, as it is apt to produce flatulency. It should not be kept so long as to grow musty.

6658. *Corn.*—Several kinds of grain are used as horses' food, varying in value according to the proportions of their chemical constituents. In Great Britain *oats* are the general horse grain. They contains seven hundred and forty-three parts in a thousand of nutritive matter. The oats should be nearly a year old. If new, they are more difficult to digest; and, when eaten in considerable quantities, are apt to occasion colic. Musty oats are very unwholesome. Oatmeal is sometimes made into gruel for horses that are sick. Oats give to a horse that masticates well great invigoration; but corn alone, if given to excess, predisposes the animal to fever, and to contract particular disorders, which often fall into the legs; and this effect requires to be counteracted by some means, of which the best is green food, many of the grasses partaking of some medicinal virtue or other, and a cooling principle: this is better than medicines. Upon the whole, oats form the most substantial and most useful food for saddle and coach horses, though this is always varied by some addition. Several substitutes have been tried, as barley, beans, pease, carrots, potatoes, and other roots; but though horses with slow work may do for a time with these, yet to all of them there is some objection not applicable to the oat.

Barley is rarely used in this country for horses, but is common food for horses and mules in the south of Europe, particularly in Spain; it does not appear to answer quite so well with us as oats, notwithstanding it appears, from chemical analysis, to contain a greater quantity of nutritive matter. Before the introduction of oats, it was much more used, and appears to have been the principal horse-food of the ancients. It should be sound in quality, and should be bruised or steeped before it is given. Barley is reckoned to cool the blood of horses, and is occasionally given to them ground in mashes, and mixed with chaff, for fattening them when they are recovering from illness.

6659. *Wheat* is rarely given as horses' food, except when farmers have a quantity that is not saleable. It contains more nutritive matter than any other grain. Horses eat it greedily; but it is difficult to masticate, and also to digest, from the quantity of gluten it contains, which is apt to form obstructions in the bowels. It should never be given alone, but mixed with chaff; and it is a good plan to bruise it or soak it in hot water. The external part of wheat is employed in all town stables, either as bran or pollard, the latter being the most nutritious; but these are more expensive than oats.

Rye is not employed here as horses' food, but is very generally used in North America, coarsely ground, and sprinkled over straw and clover grass previously wetted. It is also used in Germany, but generally in the shape of bread made from the whole flour and bran; and it is not unusual, in travelling through some parts of that country and of Holland, to see the postillions help themselves and their horses from the same loaf. The plan of giving wheaten bread to horses was formerly adopted on some race-courses in England, but was not found to answer.

6660. *The pulse used as horses' food* are beans and pease.

Beans are a very hearty food for draught-horses, but are seldom used alone, on account of their heating and astringent qualities. It is well known to travellers that they produce more vigour than an equal weight of oats; a horse can travel farther on being partly fed with them, and is not so soon exhausted. They should be at least a year old; when they are new they are indigestible and flatulent. If horses are old, their teeth are not able to masticate them, and then they should be bruised in a mill, or soaked. They are usually mixed with oats or bran, or with cut straw or hay.

Pease are seldom used alone, but mixed with beans or corn fodder. They are said to be more indigestible than beans. The variety of pea given to horses is the *gray* or *hog pea*, which is smaller than the garden pea.

6661. *Maize* is not used as horses' food in England; but in the West Indies saddle horses are kept in good condition by it.

6662. *The roots used as horse-food* are such as contain much sugar. *Carrots* are most esteemed, and are much relished by all cattle. They are slightly laxative at first, but this effect wears off when the horse gets used to them. They form an excellent substitute for grass; but though horses can work upon them, they cannot supersede corn. In combination with oats they are said to restore a worn-out horse, and to have an excellent effect upon the coat of horses. They may be given raw, being first washed and sliced; their nutritive property, compared with oats, is as six to four.

6663. *Parsnips* are very nourishing, and are much used in France for horses' food. They are used raw, and also boiled and mixed with cabbages, bran, chaff, or buckwheat.

6664. *Turnips* are sometimes given to farm or cart horses, but seldom to any other. They are not proper to be given in the raw state, but should be boiled, or partially steamed, and mixed with potatoes. The Swedish turnips are much better than the common.

6665. *Potatoes are very nutritious*, but should be always steamed. Professor Low states that fifteen pounds of potatoes yield as much nutriment as four pounds and a half of oats. They are sufficient occasionally for horses that do slow work, and they may for some time supersede the use of corn, even for those that do fast work. Horses eat them very readily. Raw potatoes are found to be extremely prejudicial, and in some cases they have even proved fatal to horses.

6666. It is to be observed that though farm-horses, and such as do slow work, may be kept in condition for a considerable time upon the above vegetables, with only half the usual allowance of corn, and sometimes without any, yet horses that have to do hard or fast work cannot be supported long without high feeding, with plenty of oats or other corn.

6667. *The usual way of feeding carriage, gig, and post horses* is nearly similar. The usual fodder is hay, not cut, in unlimited quantity. In the summer some grass is given, and in winter occasionally, perhaps once a week, a bran mash. They also receive three or four feeds a day, consisting of oats and beans, broken or unbroken, and uncooked, in quantity from twelve to sixteen pounds. The groom should observe whether the horse masticates his corn sufficiently; if not, it should be mixed with chaff, or be bruised.

6668. *Food for the manger is sometimes mixed.* Horses often waste much of their hay and straw by pulling them down out of the rack and trampling them under their feet. This is prevented by cutting them into chaff, which is often mixed with corn or beans. These the horse can thus masticate more easily; and he is also obliged to chew them instead of swallowing them whole.

6669. *Cutting the hay and straw into chaff* has several advantages; it is said to be more easily eaten than uncut hay, and saves time in eating. The trouble of cutting, and the expense of the machine for it, are objections where there are but few horses.

In Flanders it is the universal practice to convert the entire provender into manger meat, and their horses are generally in high condition. Some recommend, however, that a little uncut hay should be put into the rack, to give the horses employment, since when they have none they are apt to become mischievous.

6670. A great number of horses kept in towns receive nothing but oats and hay all the year round. Some add a little grass in summer, and roots in winter, with perhaps a weekly feed of bran; but others, whose work is more laborious, and often performed in stormy weather, are the better for a more complicated diet, containing beans, varied by barley, wheat, or rye, which may be boiled, and given once a day, or as a portion of every feed. But after a horse has been accustomed to a particular kind of food, it is not proper to change it suddenly, as this sometimes causes indigestion and colic; and, upon the whole, a spare diet is generally safest.

6671. *Among other substances used in mixed food* oil cake has been used in small quantity with advantage Sugar mixed with hay has been found to possess much nutriment. Milk and eggs have been given, but only under particular circumstances. Horse-chestnuts, it is said, would prove a useful article: in Turkey they are ground and mixed with other food. Figs and chestnuts are used in Spain and Italy; apples, occasionally, in France; dates in Persia: in short, any vegetables used by man, and possessing farinaceous or saccharine matter, will serve upon occasion as food for the horse.

6672. *Some kinds of food require a kind of preparation, or are improved by it.* Grain and pulse are often bruised by metal rollers. When the corn is to be made into gruel, it must be ground, but without separating the husks from the meal. When barley is used for horses whose teeth are bad, steeping is necessary; but malting is prohibited by the excise. Boiling is sometimes used for grain, roots, and pulse; but the advantages do not appear to be generally very obvious, as horses do not like liquid food; the food should be hard enough to give their teeth some employment; and food in its raw state appears to give them most vigour. Horses particularly dislike boiled food if cold, and they prefer it half boiled. Steaming is preferable to boiling, being more easily performed. The chief value of boiling or steaming consists in rendering the food more easy of digestion, and thus enabling the animal to retain a greater portion of its nutriment than when it is used in a crude state. For old horses, in particular, whose teeth are worn, it is very advantageous to have the food softened. But for young and healthy cattle it is thought that raw food gives most heart.

6673. *The quantity of food required by horses daily* varies with the kind of animal, his constitution and habits, and the work he is to perform. Large draught-horses will consume sixteen pounds of hay, four pounds of straw, and eighteen pounds of corn. The cavalry allowance of hay and oats in barracks is twelve pounds of the former and ten pounds of the latter, on which they are kept in high condition. Saddle horses have about ten or twelve pounds of oats, and more hay than draught-horses. More corn is given when they are in full work. Excess of food produces too much fat, but too limited a diet brings on greater evils. The horse loses flesh and strength, and is then liable to several diseases. But any considerable change should be made by degrees; one suddenly made from poor to rich food may bring on plethora, too great a fulness of blood, and surfeit.

6674. *Salt* is often given to horses; but the propriety of its daily use is questionable. Most quadrupeds appear to be fond of salt, but they probably seek for it only when instinct impels them to desire it as a remedy. It is a good practice to fix a piece of rock salt in the stable, which the horses may lick when they wish for it.

6675. *The times of feeding* must likewise depend upon the kind of work; but it is best for the horse to have regular hours, since he gets accustomed to them, and regularity is favourable to his digestion. Horses in daily work should seldom be allowed to fast more than three or four hours, and may be allowed a little hay between feeding-times. Upon the whole, abstinence, to a moderate extent, is not so prejudicial as much work upon a full stomach.

6676. *Water.*—Bad water is very injurious to horses as well as to human beings. Clear soft water is the best; if it be only a little hard, it may not be hurtful, particularly when the horse gets accustomed to it; but very hard water is improper, and is apt to disorder the bowels. Though cold water would seem to be the natural drink of the animal, yet very cold water, as that from a frozen pond, is not proper in his artificial state. It is generally carried into the stable in pails, and some let it remain there all night, covered up, until it is wanted in the morning; others add a little warm water to it; but Mr. Stewart observes that the practice of giving constantly "chilled water," as it is called, has a bad effect, rendering the horse so tender that he is injured by the cold water which he is obliged occasionally to take. Horses generally receive water three times a day; in hot weather they may need more. The quantity required by a horse in twenty-four hours is variable; one will drink more than another, and much depends upon their kind of work. He requires more with hay than with green food, and more when at work than when in the stable. It is doubtful whether a horse should have water always before him. In that case, probably, he will seldom take more than nature demands; but he should not, in general, be allowed to drink as much as he pleases at one draught; it is best to give it to him at intervals. It is generally necessary to hold it up to him in the pail, manger high, as some horses find it difficult to drink from the ground. Some patience must also be employed, and perhaps, occasionally, a little coaxing, to make him drink. Horses should not be allowed to drink immediately before going to work; during work they should have good allowance.

6677. *Clothing.*—Though horses for carriages and the saddle are kept in an artificial state, and require clothing in the stable, which is not necessary for those which are mostly out of doors, yet it is a common error to carry the clothing to too great extent, which renders them liable to take cold, particularly when their pace is to be slow, in cold weather. The change, also, from warm clothes to the saddle is often too great. Saddle horses should stand in the stable with only very light clothing, except in case of sickness. All horses, except racers, should be without clothing in the summer, or, at most, a thin sheet to keep off dust and flies.

SECT. V.—DUTIES OF THE COACHMAN, GROOM, AND STABLE-BOY.

6678. There is so much to be known about carriages and horses, that servants who have much skill respecting them are rare and valuable. In racing and hunting studs, the grooms employed have been regularly brought up to their business; but in small establishments the knowledge of a horse is less regularly acquired, and of course is less perfect. The coachman, besides his skill in driving, requires complete experience of the stable of which he has the management; he has to purchase the provender, see that the horses are properly fed and groomed, watch the condition of his horses, and report if anything is amiss. To the groom is committed the business of feeding and dressing the horses, for which practice and dexterity are essential. The stable-boy has usually much to do, and besides his immediate business in the stable, must readily turn his hand to whatever he is fit for elsewhere, and is always the better for good looking after, and not having much idle time on his hands.

6679. *The first duties of the groom in the morning*, which generally commences at six o'clock, a little earlier or later according to the work required, is to get the stable cleaned out and the horses fed. The hay should be put lightly into the rack, and a little after racking, as this is called, the usual feed of oats should be put into the manger. The morning allowance of water is usually reserved until after dressing, but sometimes horses refuse to feed except they drink first, and then a small quantity of water should be given. The stable-boy is next to clear away the dung and moistened litter, which should be done every day. The soiled litter should be removed, together with the dung, and none of these should remain in the stable all day. The floor of the stall should be thoroughly swept, even in the joints of the paving, whether bricks or stones.

The use of litter or straw spread over the floor of the stall is sufficiently obvious. It is to form a tolerably soft and warm covering to the naked stones or bricks with which the stalls are paved. It entices the horse to lie down, which relieves him if fatigued, and is favourable to the recovery of over-strained limbs; it also prevents an unequal pressure, which results from rough paving; it may likewise be proper to state that many horses will not stale readily on bare bricks, from the disagreeable effect of the urine splashing against their legs. But if too much litter be used, particularly in the day, some are of opinion that it is apt to heat the horse's feet, and cause a contraction of the horn of the hoof, as well as to make the legs swell; if not changed every day, but suffered to remain soaked with urine, it has a most prejudicial effect, from the noxious vapours that are engendered; and although, in well-managed stables, the litter is changed every day, yet still there is frequently great negligence in this respect among farmers and others. Formerly oak floors were used, with numerous holes to allow the urine to pass, but these are now seldom used here, though they are frequent abroad. The litter should be laid on smoothly, and with great care: wheat straw is the best material, and is mostly used in England; oat straw is softer, but is not so easily even, and is more apt to run into heaps. Bean and pea straw make very indifferent bedding. Where straw cannot be procured, other substances will do, as sawdust, wood shavings, dried tanners' bark, or leaves. Sawdust is very useful to sprinkle over the floor of the stable after it has been washed, to absorb the wet that lodges in the joints of the stones, and likewise prevents them from being slippery. The horses are next to be dressed, and, if the weather at all permits, this should not be done in the stall, but in a sheltered place in the yard.

6680. *What is called dressing the horse* is keeping the hair and skin in order by the use of the curry-comb, brush, and duster. The grooming or dressing a horse can never be learned by oral instruction, and skill must be acquired by imitation of an experienced person; nevertheless, the proprietors of horses should be acquainted with the principal points to be attended to, and it is these we propose to mention. Good rubbing not only clears off the loose dirt, but improves the circulation of the blood. The farmer's horse, that is worked all day and turned out at night, requires little more to be done to him than to have the dirt brushed off his limbs. With the stable horse the case is different.

6681. Currying causes the blood to circulate, opens the pores of the skin, and removes the scurf that accumulates and stops the insensible perspiration. The curry-comb separates and raises the matted hairs, and removes the hardened mud. Notwithstanding these uses, some consider the action of a good brush as producing a more beneficial influence upon the skin and hair; and certainly some grooms use the curry-comb with unnecessary harshness, the horse being seen sometimes to tremble with the pain. After currying, the horse should be well rubbed to take off all loose hairs, and then with wet hands till his coat shines like satin. The mane, foretop, and tail are next combed, and if the legs and feet are stained they are washed with soap and water, and trimmed with the scissors.

Cleaning the carriage has been already described.

6682. *Before the horses are put to the carriage* the brush and a cloth are to be passed over their coats to remove any dust; the wet sponge should be applied to the eyes, nostrils, and rump, and the comb put through the mane and tail. The shoes ought to be examined, the harness then put on, and the horses attached to the carriage.

6683. *While the carriage is out* the stable-boy cleans out the stable thoroughly; in a dirty stable myriads of insects are bred, which are very annoying to the horses.

6684. *On those days when the carriage is not going out*, the horses should be exercised for a couple of hours every day. At noon the horses are fed and watered, again sometimes at four o'clock, and at eight in the evening a little hay is put into the rack for the night.

When horses are much confined to the stable, their hoofs are apt to become dry, and crack; to prevent this, it is necessary to stop their feet occasionally during the night with some moist substance, such as a mixture of cow-dung with some loamy earth.

6685. *When the carriage returns home*, they should not be fed immediately if their work has been fatiguing; they should wait until they are cool. If fed too soon, particularly if they have fasted too long, it may produce indigestion. In such case, it is proper that they be first rubbed down and dressed. If they are heated, the water used to wash their legs should be lukewarm, and they should be walked about until the pulse is lowered before being put into the stable. It is desirable that they should never be kept too long without food, since this may cause debility, and they then, perhaps, eat voraciously or refuse to eat.

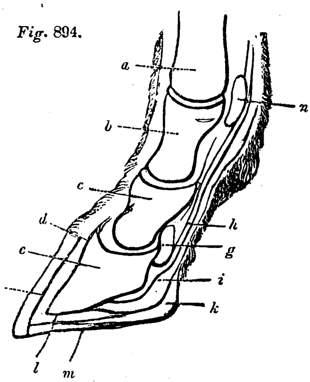
Sect. VI.—horse-shoeing.

6686. *No part of the horse is of more importance to be attended to* by the owner as well as the traveller than his feet, together with the shoes for their defence, and we select this portion of the subject for a more particular detail. Before paved and hard roads were made, probably no defences were contrived for the feet of the horse, and the first that were made use of appear to have been copied from those of his master. A sort of sandals are mentioned as occasionally employed by the ancient Greeks and by the Romans as late as Constantine, and these were stiffened by plates of iron, and sometimes ornamented with the precious metals. The injurious effects of fastening with thongs have given place in modern times to the present method of nailing on iron shoes; and Beckman states that the first account of the modern horseshoe occurs in enumerating the furniture of the Emperor Leo, of Constantinople, but it was not until long afterward that its use became general; and it was first introduced into England by William of Normandy. The art of farriery advanced, at length, into much consideration, and has made, at least, as much progress in this country as in any other.

6687. *To understand the principles of horseshoeing*, and to be able to reason correctly respecting it, it is essential that we should be acquainted with the outlines, at least, of the anatomy of the horse's foot. We shall therefore premise what we have to say on this subject by pointing out the chief anatomical parts.

6688. *Fig.* 894 represents the anatomy of the foot in a section. *a* is the lower part of the shank bone (see the skeleton, *fig.* 892); *b* is the *greater pastern bone*; *c* the *lesser pastern bone*, or *coronary bone*; *d* the *coffin bone*, or bone of the foot; *e* is an elastic process, or coronary ring of the crust; *f* is the *crust*, or outer wall of the foot or hoof; *g* the *navicular* or *nut bone*; *h* the back sinew, or great flexor tendon of the foot, binding over the navicular bone, and terminating in the coffin bone; *i* the *sensible frog*, covering the end of the flexor tendon; *k* the *horny* or *insensible frog*; *l* the *sensible sole*; *m* the *horny sole*; *n* the *sessamoid bone*.

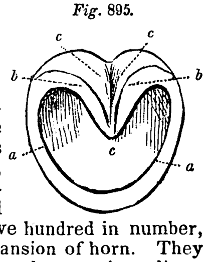
Fig. 894.



The coffin bone is of a light, spongy structure, and is filled with numerous holes for the passage of blood-vessels to the foot. The eminence in front receives the insertion of the tendon of the extensor muscle of the foot, whose upper attachment is to the humerus or arm bone, where it is fleshy, but as it passes it becomes tendinous, expanding over every joint. In the hinder limb this extensor and its two adjuncts arise from the tibia, and, in part, from the femur. To the sides of the coffin bone are attached the lateral cartilages, and around its surfaces are marks of the attachment of the laminated substance. The *crust* or wall of the hoof reaches from the termination of the hair to the ground. It is deepest in front, called the toe, shallower at the sides, called the quarters, and of least extent behind, at the heel. It is placed flat on the ground, but ascends in front with different degrees of obliquity in different horses, the most approved slope or slant being about 45°. In front it is rather more than half an inch in thickness, and becomes gradually thinner at the quarters and heel. As there is only half an inch hold for the nails of the shoe at the toe, and less at the quarters, horses are sometimes wounded in shoeing by ignorant or careless blacksmiths. The horn of the wall is composed of numerous straight fibres held together by a gelatinous cement. This crust, in some horses, is liable to be broken through brittleness, particularly in summer, and it is then proper to rub it with a mixture of oil of tar and common fish oil, to restore the pliancy. The horn of which the hoof consists is naturally kept moist by an oily secretion from the frog, otherwise it would soon crack and be deprived of its elastic power. The smaller pastern bone articulates with the coffin bone at its posterior part, and is connected by ligaments with the navicular bone. The upper portion is united to the shank bone in an oblique direction, which varies in different horses. The shocks in locomotion are broken by so many ligaments and tendons as unite these bones, and, in reality, render the foot stronger by their elasticity.

Some other parts of the foot are best seen by turning up the sole of the foot, as in *fig.* 895. The wall of the hoof, *f* in the section, and *a a* in *fig.* 895, instead of continuing round in a circle on the under part next the ground, is suddenly inflected or bent inward, forming what are called the bars, *b b*, which meet at the point *c* at the toe of the frog. These bars, by their softness and elasticity, serve to prevent the pressure of the horse's weight from injuring the frog and parts immediately above, and therefore the practice of those smiths is wrong who cut them away, as is often the case, and which causes the frog, deprived of its guard, to contract. The inside of the crust or wall of the hoof is covered by numerous thin, horny leaves extending all round it, and reaching from the coronary ring to the toe. They are about five hundred in number, broadest at their base, and terminating in the most delicate expansion of horn. They very much resemble the inner surface of a mushroom. In front they run in a direc-

Fig. 895.



tion from the coronet to the toe, and towards the quarters they are more slanting from behind forward. They correspond with similar cartilaginous and fleshy leaves on the surface of the coffin bone, called, from their construction, *sensible laminæ*, and, the one being received within the other, they form a most elastic body, by which the whole weight of the horse is supported. The inside of the bars, like the inside of the crust, presents a continuance of these horny leaves. The insensible frog fills the space between the bars. It is a triangular or wedge-shaped portion of horn projecting from the sole almost on a level with the crust, and covering and defending a soft and elastic substance called the sensible frog. The insensible frog consists of two rounded or projecting surfaces, *c c* (*fig.* 895), with a fissure or cleft between them. The frog is firmly united to the sole, and, by its softness and elasticity, coming to the ground when the horse treads, prevents him from slipping. The rough and detached parts only should be cut off in shoeing, so as just to bring it within the level of the shoe, but it should never be suffered to project without this level. In the unshod horse, as in the colt, it always touches the ground, but with our hard roads it would soon be worn away were it not for the defence of the shoe; it is quite essential, however, that it should come into contact with the ground sometimes, as want of pressure on the frog, which is sometimes the consequence of too high shoes, will bring on disease of the foot. The *sole* is the under concave and elastic substance of the foot extending from the crest to the bars and frog: it is not so thick nor so brittle as the crust, but is more elastic. It is thickest at the toe, and, to a certain degree, concave or hollow, but descends when the horse rests upon his foot. In shoeing, it should be but very slightly pared, so as to preserve this concavity. Sometimes a stone will insinuate itself between the sole and the shoe, and, if not removed, will cause lameness. The sensible sole, situated between the coffin bone and horny sole, is formed of a substance having a ligamentous or tendinous nature, and is plentifully supplied with blood-vessels; its use seems to be to secrete horn for the sole; it is highly sensible, and is apt to be inflamed by any injury, which causes corns and lameness. The *sensible frog* occupies the hinder part of the foot, and is a soft, elastic mass, partly ligamentous and partly cartilaginous, attached in front to the inferior part of the coffin bone. The navicular bone is a small bone which strengthens the joint at this part.

The reader having now a general idea of the structure of a horse's foot, will be able to understand the reason for the precaution pointed out in shoeing.

6689. *The injurious effects of bad shoeing* only require to be pointed out to excite every endeavour to avoid them, and the importance of shoeing is evinced by the great pains that have lately been bestowed on the subject. There are some circumstances in the common practice of country smiths which ought to be guarded against by every one who possesses a horse likely to come under their hands; but the shoes at present made by the most respectable smiths in the cities and large towns, and their mode of shoeing, are in general nearly unobjectionable. Many persons are very careless as to the state of the horse's feet and his shoes. The shoes are often worn till they drop off in the middle of a journey, and time is lost, the foot broken or destroyed, and, very likely, the horse lamed. If the horse be doing little work, perhaps the shoes are left on too long, and the horn is suffered to grow so as to accumulate too much; then the horse's action is fettered; he cannot step out; he cannot place his foot firmly on the ground, and he is very liable to corns. Hence at certain intervals the superfluous horn must be pared away; a month is the usual time; some may go five weeks. If the heels are weak or the seat of corns, the shoes may require removal every three weeks. If the shoes of fast workers are not worn at the end of a month, the feet should be pared, and the old shoes replaced.

6690. *The preparation of the foot for the shoe is a subject of much moment.* It is, of course, commenced by pulling off one old shoe; for it is better never to take more off at once, otherwise the horse is apt to break away the edges of the horn while standing on the bare ground or pavement. In removing the old shoes, which were fastened by nails clenched, great care should be taken by the smith to raise the clenches thoroughly, or file them off, until the shoe can be taken off easily, instead of wrenching them off with violence, as is sometimes done, by which the nailholes are enlarged, and the future hold weakened by portions of the crust being detached; and the horse shows by his flinching how much he suffers by this violent operation. When the foot is tender, or the horse to be examined for lameness, each nail should be partly punched out, and care should be taken that no stubs remain in the crust, the source of future annoyance. Next, the rough edges of the crust should be rasped, which prevents its breaking away when set down, and also detects any stubs of old nails left behind, and removes loose portions that would hold gravel, either of which might turn the nail that may be introduced there. The sole is to be pared throughout, until it can be what is called "thumbed," *i. e.*, felt to spring by a forcible pressure of the thumb. In this paring, the natural form of the arch of the sole should be as closely imitated as possible, and particular care taken that no part of it be left to protrude beyond the line of the crust; on the contrary, its concavity ought to commence immediately from the line of separation between the crust and sole, but not from the edge of the crust, as is sometimes done. The whole thickness of the crust, be it more or less, ought to be left perfectly flat for the bearing of the shoe. Habit, and a correct eye, can detect any inequalities in this surface, without a momentary application of the heated shoe to try the bearing parts, as is usually done, and which, if the shoe be also previously tried with a plane iron, may very well be avoided. Nevertheless, the outcry raised against this practice is, in a great measure, unnecessary for, unless the shoe be very hot, and held on too long, no harm probably results from its application. In common rough shoeing, also, this error is infinitely less than the application of the unequal pressure, which it is intended to prevent, would prove.

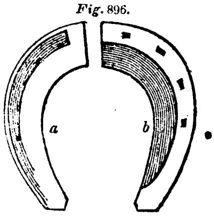
The portion of sole between the bars and quarters should be always pared out; and, if properly done, is the surest preventive against corns. The heels should be an object of great attention, and ought to be carefully reduced to the general level of position which it may be supposed the hoof was originally placed in, and which may always be judged by observing the line of the pasterns with it. It is of great consequence that the inner heel should not be reduced beyond the outer, for its natural weakness gives it a tendency to increased wear; instead, therefore, of paring both equally, in case the outer is the highest, pare only the outer; and, moreover, set the shoe very lightly on the inner heel. A want of attention to this circumstance of inequality in the heels lays the foundation of corns and splints.

6691. *The paring of the insensible frog* is an important part of the process; but it is highly improper to cut it much away, as is the practice of some smiths, particularly when employed by dealers to give an appearance of "opening the heels;" nor should it be pared too much, since it is intended by nature as a resisting prop to support the internal parts of the foot from pressure; it ought not, however, to be suffered to project too much. The most judicious mode is, instead of beginning with the frog, to attend first to the crust, sole, and heels, and then a mistake in paring the frog is less likely to arise; for it may be regarded as a general rule, that when the frog is a very little beyond the level of the return of the heels and the crust, it is as large as it ever ought to be; and the heels of the shoe will raise it up sufficiently for protection against too much wear, but will not elevate it against a proper share of pressure. With respect to the intermediate portion of horny substance that fills up the angle, it should be moderately pared out in every instance, for it is the seat of corns; and if accidental pressure alight and remain there, a corn is the inevitable consequence. If even a small particle of gravel should lodge here, each step forces it farther; and as soon as it has reached the sensible parts, inflammation and suppuration ensue.

6692. *Many attempts have been made to improve the form of the shoe,* and not entirely without success; but it must be observed that no form of this defence for the foot can be adopted as a universal pattern; and it is only by understanding the anatomy of the foot, and the defects and diseases to which it is liable, that the peculiar form can be devised, best suited to each animal. As a general principle, the form of the defence should be adapted to the foot, and the foot should not be altered to the shoe; yet, in some cases of diseased feet, even this rule admits of modification. The foot of an unshod horse expands as soon as it is placed upon the ground and has received its share of the weight of the body; but when such foot is bound within a solid rim of iron firmly round the horny crust, the expansion being thus prevented, reaction takes place, and turgescence of the blood-vessels, by which heat is evolved, and the horny segment so heated contracts its dimensions, and thus presses painfully upon the sensitive part, and disorganization is the ultimate consequence. To form a horseshoe, therefore, such as will protect the foot effectually, while, at the same time, it is left in full possession of its natural elasticity and expansive properties, has been the aim of many veterinarians and many ingenious smiths; but perhaps nothing has yet been contrived com pletely adapted to the natural action of the horse's foot.

6693. *The shoe now usually worn by hacks* is the seated shoe adopted by Mr. Clarke, of Edinburgh, Mr. Moorcroft, and others. *Fig.* 896 is the *seated shoe.* This shoe is represented in two halves, *a* and *b*. The half *a* represents the ground surface; its nail holes enter no farther towards the heels than is necessary to keep the shoe fast. The half *b* represents the foot surface, which is bevelled off, but not entirely to the heels, that there may be no invitation to the heels to contract, from an inward inclination of the quarters of the shoe. The nail holes of the toe portion are carried around the whole circumference, that portion of the horn being best able to bear the shoe pressure without producing contraction. Of course, this shoe may be modified various ways; it may be made wider or narrower, heavier or lighter, or it may be steeled to most unusual wear; but, as we before observed, no positive pattern can be fixed up adapted to all horses. A well-made seated shoe should present "a web" of uniform thickness throughout, and of a width sufficient to protect the foot; but both this and the thickness should be regulated by the size of the horse, the nature of his work, &c., but it should in all cases be sufficient to obviate the effects of occasional hard wear, or the accidental neglect of renewing. To an animal so strong as the horse, the additional weight of one or two ounces to each shoe is very inconsiderable; but this addition to the support and protection of the foot is very material in many cases; and a shoe rather stout is preferable, particularly where there is any tenderness of feet, or tendency to corns. Round the outer edge of this shoe there is a groove, called a *fuller,* in which the nail holes are punched, so that by sinking into the fuller their heads project but a little way, and are soon worn down level with the shoe. The ground surface of the common shoe used in the country is somewhat convex, instead of being perfectly flat as this is, and the inward rim of the shoe comes first on the ground; the consequence of this is, that the weight, instead of being fairly borne on the crust, is supported by the nails and the clenches, which must be injurious to the crust, and often chip and tear it. In the seated shoe there are five nails on the outer and four on the inner side, or four on the outer and three on the inner, because the outer has more thickness and strength to support the nails. The foot surface of the seated shoe presents a bevelled portion over two thirds of its extent, except at the heels, where it is partially plane on both surfaces, which plane portion is intended to receive the heels. This bevel, or seating, allows for the descent of the sole, which certainly does take place in a slight degree; but principally it favours the ejection of stones, &c., which, lodging there, might injuriously press upon the horny sole. The seated shoe is best suited to the flat-hoofed horse, and the shoe itself is rendered lighter by seating, without detracting from its strength. The smith will sometimes make difficulties respecting the making of the shoe; but these will soon be obviated by the owner of the horse declaring his determination to have no other, and paying a little more for them.

Fig. 896.

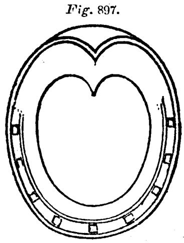


6694. *Clips* are sometimes useful additions to the shoes of horses used for heavy draught; these are portions of the upper edge of the shoe hammered out, and turned up to embrace the lower part of the crust. They attach the shoe more securely to the foot, and relieve the crust from that stress upon the nails which would otherwise be injurious. They are also necessary where horses are apt to stamp, or paw violently with their feet.

6695. *The shoes for the hind feet of most horses* are forged somewhat different from the fore shoes, being made a little squarer at the toe for about an inch; to which squareness the hoof, also, is to be adapted by rasping it slightly. For carriage and draught horses, *calkins* (a turning up and elevation of the heel) may be put on the hind shoes, to enable them to dig their toes more firmly into the ground, and urge themselves forward and throw their weight into the collar with greater advantage; but care must be taken that they are not too high, and that they are of an equal height on each heel.

6696. *The bar shoe* is described by Mr. Stewart as a very useful contrivance. It is the continuation of the common shoe round the heels, and by means of it the pressure may be removed from some tender part of the foot, and thrown on another which is better able to bear it, or more widely diffused over the whole foot. It is principally resorted to in cases of corns or other diseases of the feet; but it must be observed that these shoes are not safe in frosty weather, nor where great speed is required, and that they are apt to be wrenched off in a heavy, clayey country.

Fig. 897.



6697. *Tips* are short shoes, reaching only half way round the foot, and worn while the horse is at grass, to prevent the crust being torn by the occasional hardness of the ground, or by the pawing of the animal; and the quarters being free, feet disposed to contract have a chance of expanding and regaining their natural shape.

6698. *A strip of felt* or *leather* is sometimes introduced between the seating of the shoe and the crust, in cases where the foot is bruised or inflamed, which deadens the vibration or shock in moving, and is useful while the inflammation lasts, but should be removed afterward.

6699. *A piece of leather is also sometimes fitted to the sole* and nailed on with the shoe, in cases where the sole is flat and tender; but there is a great difficulty in padding this so firmly that it shall not become uneven, which would be injurious by giving unequal pressure.

6700. *Frost shoes* are very necessary, and have the heels turned up, the turned up part being made with an edge; calkins are apt to be soon worn, and are therefore insufficient.

6701. *The sandal shoe* is a very useful invention to supply temporarily the loss of a shoe until one can be procured. For want of a provision, horses' feet have been seriously injured in travelling over stony ground The best is that made by Mr. Percival, consisting of an iron shoe bound on with leather straps.

Sect. VII.—Hair of the Horse.

6702. Every spring and autumn the horse sheds his hair. Nature suits the thickness of his coat to the season. When winter approaches, the short hair of summer is cast for longer hair as warmer clothing; and when the summer heat returns, this is exchanged for a lighter covering composed of shorter hair. But as a sleek and glossy smooth skin is desired in the artificial state in which the horse now is, this natural change is counteracted by keeping the horse in warm stables, which has the effect of perpetual summer. The hair is not cast all at once, but comes out gradually; that of the mane does not change so rapidly, and that of the tail is always changing, a few hairs coming out at a time; the mane of carriage horses is made to lie on one side. It is the practice of grooms to pull out the hair from the inside of the ears; but this should not be done, as this hair wards off the entrance of insects and cold winds; neither should they cut off the few long straggling hairs that appear about the face, as they are a sort of whiskers to keep off flies.

6703. Some degree of trimming is generally necessary to all horses required to look well; but this demands a dexterous groom, as, when done, the marks of the scissors should never be visible. The practice of using them on the horse's coat should be avoided as much as possible, and it is only necessary where the coat is very long and rough. The hair of the fetlocks is generally trimmed short, which is done that the legs may dry quickly after washing.

6704. *Docking the tail* is very generally practised in this country, and is done partly through the inconvenience of the tail to the rider; but, as this member was probably given to keep off flies, the horse suffers much from the want of it when he is out at grass. *Nicking the tail* is a cruel operation, which is now going much out of practice.

Sect. VIII.—Diseases of the Horse.

6705. *The diseases of the horse are numerous*, as the present artificial mode of his life and his complicated structure might lead one to suspect. External diseases and cases of unsoundness are much more easy to understand than those which are internal, which can only be conjectured from symptoms. In general there are two obvious indications of disease—a refusal to work and a refusal to feed. Lameness speaks for itself; but there may be something the matter with his collar or part of his harness. Every good coachman, or person habitually employed about a stable, should acquire some skill in detecting the symptoms of disease, and should know how to treat the most ordinary complaints, or at least till a veterinary surgeon can be procured; but it should be borne in mind that the difficulty of treating a sick horse is not only as great, but in one respect greater than that of treating a human patient, since he cannot, like the latter, describe his sensations.

6706. *Before the veterinary art became a distinct profession*, the ignorant farrier, pretending groom, or shoeing smith, were all that the owners of horses had to consult; and the fate of these animals was commensurate with the wretched treatment they were subjected to. These men, without any scientific education, often committed the greatest blunders, though they frequently performed cures, as is the case with other quacks. But the establishment of schools for the veterinary art has disseminated an improved practice and spread good practitioners through the country; and, now that the diseases of the horse have been the subject of scientific investigation, it would be imprudent not to avail one's self of the advanced state of knowledge. By a subscription of two guineas a year to the Veterinary College at Camden Town, the best veterinary assistance, perhaps, in the world can be procured, or an opinion obtained on a horse's soundness on which reliance may be placed. In many other places, now, skilful veterinary practitioners are to be found; and, where their assistance is to be procured, no servant ought to assume more than his proper degree of responsibility in the management of a sick stable, nor should his master be so imprudent as to trust him in serious cases. But as such desirable assistance is not always within reach, it would be well that the proprietors of horses should acquire as much knowledge on the subject as possible, as a check upon others.

Sect. IX.—Purchase of Horses.

6707. *Nothing requires more caution than the purchase of horses;* and we give the following hints, which are extracted from the excellent volume "On Horses," published by the Society for the Diffusion of Useful Knowledge:

In the purchase of a horse, the buyer usually receives, imbodied in the receipt, what is termed a *warranty.* It should be expressed thus: "Received of A. B. forty pounds for a gray mare, warranted only five years old, free from vice, and quiet to ride or drive." It is important to observe that the age, freedom from vice, and quietness to ride or drive should be mentioned, because warranty as to soundness alone does not include these. Many disputes have arisen as to what ought to be termed sound or unsound. A horse is sound in whom there is no disease, nor any alteration of structure which impairs his natural usefulness, and he is unsound if he labours under any disease, or had any accident that has impaired his natural usefulness by an alteration of the structure of any part of his body. The term unsoundness does not apply to any original defect in the temper of the horse, or any deficiency in the strength and powers of the animal. The principal circumstances which constitute unsoundness, besides the great number of actual diseases, are *broken knees*, which may indicate a stumbler, though not always; for any horse may meet with an accident, and the knee may now be quite well, though it requires great judgment to distinguish in this case. *Contraction* of the foot is sometimes, but not always, unsoundness; for it is occasionally natural, and not a fault. The following defects are considered to indicate unsoundness: *Lameness*, through any cause; *pumiced foot; sand-crack; spavin; splent; thickening of the back sinews of the leg; thrush; ossification of the cartilages of the foot; defects or diseases of the eyes; coughs, roaring, broken wind,* or *any defects of the lungs; quidding,* or imperfect mastication; *crib-biting; biting; kicking; restiffness.*

In order to complete the purchase, there must be a transfer of the animal, or a memorandum of agreement, or the payment of earnest-money; the least sum will suffice for earnest. No verbal promise to buy or sell is binding without one of these; and the moment either of these is effected the legal transfer of property or delivery is made; and whatever may happen to the horse, the seller retains or is entitled to the money. If the purchaser exercises any act of ownership by using the animal without leave of the vender, or by having any operation performed or done to him, or medicines given, he makes him his own. The warranty of a servant is considered to be binding on the master.

A man should have a more perfect knowledge of horses than falls to the lot of most persons, and a perfect knowledge of the vender, too, who ventures to buy a horse without a warranty. Where there is no warranty, and a defect is discovered after purchase, an action may be brought on the ground of fraud; but this is difficult to be maintained, for it is necessary to prove that the dealer knew the defect, and that the purchaser was deceived by his false representation. If the defect was evident, the purchaser has no remedy—he should have taken more care; but if a warranty was given, it extends to all unsoundness, palpable or concealed. Although a person should ignorantly or carelessly buy a blind horse, warranted sound, he may return it—the warranty is his guard, and prevents him from so closely examining the horse as he otherwise would have done; but if he buys a blind horse, thinking him to be sound, and without a warranty, he has no remedy. The law supposes every one to exercise common circumspection and common sense. If the horse should be afterward discovered to have been unsound *at the time of sale* when the warranty was given, the buyer may return it and recover the price; but this proof is requisite; coughing on the following morning will not be sufficient, except the horse was heard to cough previous to the purchase, for the horse might have caught cold by change of stable. Although not legally compelled to give notice to the seller of the discovered unsoundness, it will be better for it to be done. The animal should then be tendered at the house or stables of the vender. Should the latter refuse to receive him, he may be sent to a livery-stable; for, in case of action, the expenses will be recovered with the price; and it will be prudent for the buyer to refrain from any medical treatment. If a person buys a horse warranted sound, and discovering no defect in him, and relying on the warranty, resells him, and the unsoundness is discovered by the second purchaser, and the horse returned to the first purchaser, or an action commenced against him, he has his claim on the first seller, and may demand of him not only the price of the horse, or the difference in value, but every expense that may have been incurred. When an action is brought, the lawsuit is usually very intricate; a fair trial of the horse is allowed, and a certain time specified; but it is not always easy to ascertain whether the fault lies with the horse or his rider, and sometimes the dealer, as well as the buyer, is hardly used. If the horse is detained after the specified time of trial, he is supposed to be sold, and with all his faults.

In London, and in most great towns, there are repositories for the periodical sale of horses by auction. They are of great convenience to the seller, who can at once get rid of a horse with which he wishes to part without waiting month after month before he obtains a purchaser, and who is relieved from the fear of having the horse returned on account of breach of the warranty, because in these places only two days are allowed for the trial, and, if the horse is not returned within that period, he cannot be returned afterward. They are also convenient to the purchaser, who can thus in a large town soon find a horse that will suit him, and by which, from this restriction as to the returning the animal, he may, perhaps, obtain 20 or 30 per cent. below the dealer's prices. But although an auction may seem to offer a fair open competition, there is no place at which it is more necessary for a person not much accustomed to horses to take with him an experienced friend, heedless of the observations or manœuvres of the by-standers, the exaggerated commendations of some horses, and the thousand faults found with others. There are also always numerous groups of low dealers, copers and chanters, whose business it is to delude and deceive.

The principal repositories in London are, Tattersall's, at Hyde Park Corner, for racers, hunters, and superior horses; Young's, at the Bazar in King-street, Portman Square, for horses of every description; Dixon's, in Barbican, for machiners and good hackneys; and Morris's, in St. Martin's Lane, for draught horses and hackneys. Horses should be sent two days before the sale.

Sect. X.—Faults of Horses.

6708. *Horses, notwithstanding their many excellent qualities, are likewise subject, more or less, to defects and disagreeable habits, termed vices.* Of these, *restiffness* is one the most dangerous, and is generally the consequence of bad temper or bad training. It appears in the form of kicking, rearing, plunging, or bolting, and but rarely admits of a cure. A good and determined rider may, for a time, conquer a horse, but he generally returns to his old tricks the first opportunity; and the best thing that can be done with a very restiff horse, in most cases, is to turn him over to some other work. *Biting* is a fault that is not easily corrected, and which requires certain precautions to guard against. *Kicking* is another fault for which there is rarely any cure, particularly if not taken in time; it is very bad in the stable, but kicking in harness is much worse. *Irritability* in cleaning is most generally the consequence of a tender skin and bad management. *Viciousness to shoe* is likewise usually owing to want of skill in managing, but should be corrected, since owing to it lameness is often occasioned, and not by any fault of the smith. *Crib-biting* is a troublesome fault, and difficult to prevent; the horse will not only bite and destroy his wooden manger, but, if it is lined with iron, he will bite it and injure his teeth, as well as disperse and lose his corn. The best remedy appears to be muzzle sufficient to enable him to pick up his food, but not to allow him to lay hold of the manger. *Some horses will not readily lie down at night*, and stand still till their legs swell; sometimes a fresh, well-made bed, and casting him loose, will tempt him. *Pawing* is a bad habit which some horses have in the stable, by which they destroy their litter, and also the floor; shackles are the best remedy. *Rolling* in the stable is another bad habit, which must be prevented by not allowing him sufficient length of collar-rein. *Shying* is a vice which may be cured by a good horseman, except it be owing to a defect of sight. *Slipping the collar* in the night is a trick that some horses are very clever at; by this they sometimes get at food and gorge themselves, or do some mischief. *Tripping* is a dangerous fault, sometimes owing to lameness; a known stumbler is never safe to ride.

SECT. XI.—CRITERIA OF THE QUALITIES OF HORSES.

6709. *The criteria of the qualities of horses* are derived from inspection and trial. To judges their outward appearance affords a pretty just indication of their powers, and a moderate trial usually enables the same judgment to decide on the disposition to exercise such powers. The qualities indicated by colour have been already noticed. The strength may be judged of by the general form. The spirit, vigour, or mettle, as it is termed, are best ascertained by trial. A horse of vigour and true courage is highly valued, and shows his mettle only when it is required of him. He walks securely and deliberately, and moves with readiness as well alone as in company. Without requiring the whip, he will go from the walk to the gallop, and as easily from the gallop to the walk again, champing the bit and trotting glibly. He is attentive and cheerful; loves to be caressed even when on his journey. He is easily managed, good-tempered, and quiet under difficulties. A hot, fiery horse is as objectionable as one of true courage is desirable; he is known by his disinclination to stand still, and by his mettle being raised by the slightest exercise, especially when in company. Such horses are not safe; they are impetuous, difficult to manage, and are easily frightened.

6710. *A hackney should be well formed behind* to give him strength; and to propel him forward, it is even of more consequence that he be well formed before. In this kind of horse the hind parts are, in some measure, subordinate to the fore, as safety, or freedom from stumbling, is preferable to speed. The head in the hackney should be small, and well placed on a neck of due length and substance to make an "appui" for the bridle, and that proper resistance to the hand so pleasant to the feel, and so necessary for ease and safety. The shoulders should be oblique, and well furnished with muscle, but not heavy; and the withers, in particular, should be high, for the comfort of the rider. The elbows should be turned rather out than in; and the legs should stand out straight, and by no means fall under the horse, or it betokens a stumbler. The pasterns should be neither too oblique, which bespeaks weakness, nor too straight, which wears the horse out, and is unpleasant to the rider. The carcass should be round, or the horse will be weak; the loins straight, wide, and ribbed home; the thighs of good substance; and although the being cat-hammed, or having the hocks turned inward, is defective in beauty, it often bespeaks a good trotter.

Many who consider themselves as judges are in error respecting the *action* of the road horse. They say, "Let him lift his legs well, and he will never come down." But in proportion as he lifts his legs well will be the force with which he puts them down again, the jar and concussion to the rider, and the battering and wear and tear of his feet. A horse with great "knee action" will not always be speedy; he will, indeed, seldom be pleasant to ride, and not safer than others. It is a rule, confirmed by experience, that the safety of a horse depends more on the manner in which he puts his feet down than on that in which he lifts them up; more on the foot being placed at once flat on the ground, or, perhaps, the heel coming first in contact with it, than on the highest and most splendid action. When the toe first touches the ground, it may be easily supposed that the horse will occasionally topple over. An unexpected obstacle will throw the centre of gravity forward, and down he will come. If the toe dig into the ground before the foot is firmly placed, very little will occasion a trip and a fall. To detect a stumbler, look at the shoes to discover where is the wear. If the shoes have suffered a week's or a fortnight's riding without being unusually worn at the toe, and it is perceived that the horse puts his feet flat on the ground, the probability is that he is safe, although his action may not be the loftiest. A hackney for a gentleman should be in fine condition, and his coat should be kept up fine by good grooming, food, and exercise, and not by heat, clothes, and cordials.

6711. *Quick draught horses*, or those for the coach, chariot, post-chaise, and other travelling carriages, must have forms suited to the several purposes for which they are intended, as requiring either strength or speed in the greatest proportion. To make them safe, the fore-hand should rise, the back should be straight, the step should be short but quick, which fatigues least. As they approach the hunter in form, they are best fitted for quick work, and as they resemble the best kind of agricultural horses, which are large, they are calculated for heavy draughts, as coaches, &c. But in all a portion of blood gives courage, durability, and condenses strength with less bulk, by which activity is gained. It is of great consequence to a coach horse that the neck and head be so formed as to be enabled to remain well to the bridle.

Sect. XII.—Condition of Horses.

6712. *The term condition of a horse*, though conventionally well understood among horsemen, is not easily defined, nor rendered distinctly intelligible to others. It might be supposed merely to imply those appearances that denote ordinary good health; but though it includes this, it has likewise a peculiar technical signification. It means such a condition or state as is most favourable towards performing the particular kind of work to which he is to be applied; this condition in the cart-horse implies a healthy state, with a general fulness and lustiness of body and muscles necessary to his drawing heavy weights. In the racer and hunter, on the contrary, these qualities are not what are required to be in condition, but such a state of body as fits them for accelerated and long-continued motion, dependant upon great condensation of muscular fibre with the smallest bulk, which is promoted by the absorption of all fatty matter, favourable to the lightness and free action of the lungs. The horse-dealer who has, by means of warmth, grooming, and change of diet, produced a shining coat and general good health, may produce a horse apparently in as "high a condition," yet upon trial he may be found defective in those qualities that would be "in condition for the field or road."

6713. *A horse is said to be out of condition* when his health is deranged, or is, in other respects, not fit for his peculiar work, and he is to be brought into condition by veterinary skill, or by a certain training to be given by the experienced groom. To effect this with race-horses or hunters is an affair of great delicacy, requiring much practical knowledge, but to bring and keep carriage and saddle horses in condition is more within the experience of an ordinary groom. To promote this object effectually, it is useful to possess as much knowledge as can be acquired respecting the physiology of the animal in general, the nature of various kinds of food, and the science of nutrition, the best construction of stables, and the effect of exercise, cleanliness, dressing, and good management generally; in short, of every circumstance that may affect his improvement or deterioration. Nor are theoretical and scientific views to be despised, because, although they cannot stand instead of experience, they may confirm or correct the notions of those who have to depend upon practice alone, which, although often the right result of experiment, is sometimes mere empiricism; and it is to the addition of true science to the art of managing horses that many modern improvements are owing.

Sect. XIII.—Precautions in Travelling.

6714. *Before setting out on a journey on horseback*, it is proper that the horse is in good condition, and to see that all the appointments are in proper order. The bridle should not be new, but one that the horse is accustomed to. It should be a double-curbed one. The snaffle can be ridden with certainty; but the snaffle cannot do the work of the curb in staying a horse, in saving him from the ground under stumbling or fatigue, or throwing him on his haunches, or tightening his mouth. It is of still more consequence that the saddle be one that the horse has worn before, and that fits him thoroughly. The girths should be made of the best materials, to prevent accidents; and if the saddle be liable to come forward, however objectionable the appearance, a crupper had better be used. Some days before a journey is attempted, if the shoes are not in order, shoe the horse; but by no means let it be done as you set off, otherwise, having proceeded on your journey a few miles, you find that one foot is pricked, and lameness ensues; or, if this be not the case, one or more shoes pinch, or do not settle to the feet, all of which cannot be so well altered as by your own smith.

6715. *It is always best to begin a journey by short stages*, which accustoms the horse to continued exertion. The distance a horse can perform with ease depends greatly upon circumstances. Light-carcassed horses, very young ones, and such as are low in flesh, require often baiting, particularly in hot weather; horses in full condition, and such as are from seven to ten or twelve years old, are better when ridden a stage of fifteen or twenty miles, with a proportionate length of baiting time afterward, than when baited often with short stoppages. The state of the weather should also be considered; when it is very hot, the stages should be shorter. As fatigue weakens the stomach, it is best to ride the horse gently the last two or three miles. If a handful of grass can be got by the roadside, it will wonderfully refresh the horse without delaying much. In hot weather let the horse have a gulp or two of water in passing a clean pond, but not more. A little cold water, even when the horse is hot, is very refreshing to him, and may be given with safety, although a large quantity at that time would be dangerous. None should be given him till a few minutes after he is pulled up, and has recovered his wind; nor should he have much while he is getting cool. Cold water is apt to produce colic or cramp in the bowels, for which the best preventive is to keep in exercise by a quick or a gentle trot. Should cramp in the bowels take place, the best remedy is four ounces of sweet spirit of nitre, given in a pint of warm milk, with about a tea-spoonful of ground ginger, mustard, or pepper. On going up a hill, walk the horse, and walk yourself if possible, which relieves him, and take care that no stones get into his feet. On bringing the horse into an inn after a journey, after the saddle is taken off let the perspiration be removed with a sweat knife, and then, with a rug thrown over him, let him be walked till he is cool. When dry, let him be put into the stable, and have some good fresh hay, which may be sprinkled with water; if very thirsty, he may have a little water: he is then to be dressed, rubbed, foot-picked, and foot-washed, by sponging, but not by riding into the water; proceed then to feed him with corn and beans. It is to be observed that a horse's digestion does not begin after a bait in less than an hour, and continues three; if the baits are at too short intervals, they fail of their object. If a horse seems disposed to lie down after fatigue, encourage it. At night foot-stopping is useful, and litter, with plenty of water with his food. If very much fatigued, perhaps a mash will be necessary. Some recommend that before a horse sets out on a long journey, he should be a little accustomed to irregularity in feeding. If a shoe should get loose on the road, proceed cautiously to the nearest smith. A fast pace will throw the shoe and break the foot. Should the shoe be hanging off, or twisted across the foot, pull it away entirely, and remove any loose nails that might run into the foot. A sandal has been invented to put on the horse's foot in case of such an accident: it is fastened on by straps and buckles.

Sect. XIV.—Riding.

6716. *The art of riding* is best taught in schools for the purpose; but a recapitulation of the principal points to be attended to may not be useless.

The best form of saddle for general riding is one in which the cantle is not so high as the military, nor so low as the racing saddle. The pommel should be no more raised than is necessary to keep the whole completely free from the withers. The stirrups should be substantial, not only to prevent breaking, but also that by their weight they may fall to the foot when accidentally slipped away, which is of more consequence than at first sight may appear. If they are of the spring kind, it is also desirable; but it is still more so, that the spring leather should be used, which prevents the danger arising from horses catching the leather in the projections of doors, gates, &c.

6717. *To mount properly,* stand rather before the stirrup than behind it; then with your left hand take the bridle short, and the mane together; help yourself into the stirrup with your right, so that, in mounting, your toe does not touch the horse. Your foot being in the stirrup, raise yourself, till you face the side of the horse, and look directly across the saddle; then with your right hand lay hold of the hinder part of the saddle, and, with your left, lift yourself into it. When mounted, let your position in the saddle be square, and the purchase of your bridle such as not to pull your shoulders; and let your body have such an even posture as if you held a rein in each hand. In holding the bridle, grasp the reins with your hand, which should be held perpendicularly, with the reins passed, the lower within the hand, and the upper between the fore and next fingers. The reins are then brought over the fore-finger, and firmly held by the thumb. It is often directed to place the little finger between the lower reins; the practice of this may be optional with the rider, and in a very fine hand is desirable. The bridle should be held at such a length as to enable you, if your horse stumbles, to raise his head, and support it with your arms, and by throwing your body backward at the same time, you frequently may save a horse that would otherwise fall.

6718. *A graceful and proper seat* on horseback is greatly dependant on a right disposition of the legs and thighs, which should hang down nearly straight, easily, and without force or constraint, all which is brought about from above, by placing the body flat and evenly on the saddle, and opening the knees, whereby the fork will come lower on the saddle. The thighs should be applied to the saddle and to the sides of the horse by their inner surfaces, so as to bring in the knees and toes; and although the line may be properly broken by some little irregularities, yet the foot, the knee, the hip, and the shoulder should deviate but little from a perpendicular line. The ball of the foot should rest within the stirrup, and should be even with the heel, or very slightly elevated above it. Avoid any stiffness in the legs, thighs, or body; all should be lax, but in a state able to embrace the horse, either for support or as aids to him. The loins, particularly, should be lax and pliable, as a coachman's on a box, and for the same reasons; for, by sitting thus loosely, the rough motions of both are broken. To depend upon the embrace of the knees for support is to lose the benefit of a true *equipoise* of the body, and is rather to stick on a horse than to sit on one.

6719. *When you are troubled with a horse that is vicious,* which stops short, or by rising or kicking endeavours to throw you off, you must not bend your body forward, as is commonly practised in such cases; because that motion throws the breech backward, and moves you from your fork, or twists and casts you out of your seat; but the right way to keep your seat, or to recover it when lost, is to advance the lower part of your body, and to bend back your shoulders and upper part. The rising of the horse does not affect the rider's seat; he is chiefly to guard against the lash of the animal's hind legs, which is best done by inclining the body backward. But the usual method of fixing the knees in all cases of danger only serves, in great shocks, to assist the violence of the fall. To save yourself from being hurt in these cases, you must yield a little to the horse's motion; by which means you will recover your seat if displaced, or keep it at such times as would dismount a less skilful horseman.

6720. *If your horse grows unruly,* take the reins separately, one in each hand, put your arms forward, and hold him short, but do not pull hard with your arms low; for, by lowering his head, he has the liberty to throw out his heels; but if you raise his head as high as you can, this will prevent him from rising behind. Is it not reasonable to imagine, that if a horse is forced towards a carriage which he has started at, he will think he is obliged to attack or run against it? Can it be imagined that the rider's spurring him on, with his face directly to it, he should understand as a sign to pass it? These rational queries are submitted to the serious consideration of such as are fond of always obliging their horses to touch those objects at which they are or affect to be frightened. Indifferent horsemen, Lawrence observes, should never venture on horseback without spurs. Those who reflect upon the predicament of being placed between a deep ditch and a carriage at which their horse shies, will see the necessity of this precaution.

6721. *Previously to mounting,* every one will find his account in examining the state of both horse and furniture with his own eyes and hands; for however good and careful his groom may generally be, it is a maxim that too much ought not to be expected from the head of him who labours with his hands. Besides, all such sedulously avoid trouble, particularly in nice matters. For example, see that your curb is right; that your reins are not twisted; that your girths, over the other, still bear exactly alike; but, above all, that your saddle lies exactly level upon the horse's back.

6722. *On getting off the horse,* hold the bridle and mane in the same manner as when you mounted; hold the pommel of the saddle with your right hand; to raise yourself, bring your right leg over the horse's back, let your right hand hold the hind part of the saddle, and stand a moment on your stirrup, just as when you mounted. But beware that, in dismounting, you bend not your right knee, lest the horse should be touched by the spur.

Mules and Asses.

6723. *Mules* are a breed between the horse and the ass; but the race is incapable of reproduction. Mules are highly esteemed in the south of Europe as beasts of burden, but in this country they are only occasionally used for draught. They are more hardy in constitution, more muscular in proportion to their weight, and more patient than horses. They are also less subject to disease, and longer lived, being commonly able to work during full thirty, or even forty years. They are fed at less expense, and when in the hands of humane masters, it is said that their character for restiffness is unjust. They answer well for hard and rough roads, being very sure-footed. They have been long introduced into Ireland, but in England there is a prejudice against rearing them. In Spain, where great attention is paid to the breed of mules, they are used to draw carriages and for riding, and there is a royal stud of asses for breeding them at Reynosa in the Asturias. It is thought by some persons that their employment might be usefully extended in this country.

6724. *The domestic ass* is comparatively of recent adoption in Europe. It appears that they were scarce in England in the time of Queen Elizabeth. Little or no attention has been paid to the common and inferior breed here. They are several others of different qualities, as the Arabian race, chiefly used for the saddle; and a fine sort is reared in the Isle of Gozo in the Mediterranean, &c. Asses are little employed, except by the poorest people ,and are then chiefly supported by the pickings of lanes and by-ways, and yet they carry heavy loads, and might be rendered very useful in many ways. Their employment for riding and drawing small vehicles is well known.

BOOK XXV.

DAIRY, AND THE MANAGEMENT OF DOMESTIC ANIMALS.

CHAPTER I.

THE MANAGEMENT OF COWS.

6725. It can scarcely be necessary to point out the advantages to many private families in the country of keeping a few cows, particularly where the distance from a town is considerable, and the facilities for obtaining milk few. Besides the gratification of having cream unadulterated, butter churned fresh for breakfast, syllabubs, and other preparations, the possession of a supply of the most nutritious food for the younger members of a family is of great value.

In the following observations we propose confining ourselves to directions for keeping cows for the domestic dairy, and for making butter and cheese; but we do not intend to go into all the details necessary for a dairy farm, where the manufacture of those articles is carried on with a view to profit.

6726. *Cows may always be purchased* at the markets and fairs in the vicinity of large towns, the price varying from £7 to £20.

Certain characters or marks of a good cow have been given by writers on cattle; such as wide horns, a thin head and neck, large dewlaps, full breast, broad back, large, deep belly, the udder capacious, but not too fleshy, the milk-veins prominent, and the bag tending far behind, teats long and large, buttocks broad and fleshy, tail long and pliable, legs proportioned to the size of the carcass, and the joints short, &c. But these descriptive indications will be of little or no use to a person inexperienced in the purchase of cows; and, as much imposition is frequently practised in markets, it would be advisable to have the selection made through the medium of a person skilled in this matter, in whom confidence can be placed. Some recommend, as the most certain way of knowing how long a cow may be presumed to continue in milk, to purchase one which has a calf a fortnight old; the calf may be disposed of immediately, as the feeding it up to a state fit for the butcher will scarcely compensate for the loss of the milk.

6727. *It is of importance to select cows of a proper breed*, as there is a great difference in their qualities as to affording quantity as well as richness of milk; some are also of a quiet and docile temper, and others more or less wild and unmanageable. It is observed, as a general rule, that the cows of the short-horned or hornless breed afford milk of the best quality, while they are less dangerous to the milkers than the long horned. The cows that afford the greatest quantity of milk are the large breeds of Lancashire, Yorkshire, and Staffordshire; but they require much food, and would starve on land where a smaller kind, as the Scotch or Welch cows, would find an ample supply. The Suffolk duns and the Ayrshire cows, both small breeds, unite in a useful degree quantity and quality of milk; and the Devonshire and Welch thrive under ordinary keep, and stand the winter season well. But the Alderney cow is superior to every other for the richness of its milk and butter, though the quantity is small; it will yield only two gallons of milk a day, while the Suffolk dun will give more than double that quantity. The Alderney is small and gentle, but looks always poor; they are now dear, and are found only in private establishments.

Where the best milk is the only or principal object in a private family, the Alderney breed is preferable; but where butter is a great consideration, those breeds are to be chosen which are known to afford good milk and cream in the largest quantity.

6728. *The various modes of feeding cows are technically divided* into *grazing*, or feeding on grass in the fields; *soiling*, or giving them green food cut and taken into the house; and *stall-feeding*, which is confined chiefly to hay, together with succulent roots, either in a raw state or steamed.

6729. *Of these the most perfect is certainly grazing on pasture land*, where the cows can range at liberty amid abundant pasturage; but this, if many cows are kept, requires fields of considerable magnitude, and that suitable land can be had contiguous to the mansion. Although much has been said respecting the good qualities of certain roots and artificial grasses, yet experience has shown that no food is comparable to that of good natural pasture for milch cows; for not only does it yield a greater quantity of milk, but the flavour of grass butter may always be distinguished, by its superior richness and delicacy, from that which has been made from milk produced by feeding in the house; its quality, however, may be injuriously affected by the recent application of manure to the land. Cows, though quiet in their stalls during the winter, yet evince a strong degree of restless anxiety to be at liberty when the spring season advances; and when pasture land is abundant, they should be turned out during the day as early as possible in the spring, and brought in at night to be fed upon sound meadow hay, until the weather becomes warm, and the grass affords a full bite. Some even allow them to lie out during the whole night, from the month of May until about the end of October; but then they ought to have a shed to take shelter in, and to shield themselves from the heat of the sun in the middle of the day. It is the custom in Scotland, and many parts of Ireland, to tether the cattle upon the grass lands, which is rendered necessary, in general, by the want of enclosures. This, in some instances, is better than suffering them to wander over the ground, as only part of the grass is eaten up at a time, while the rest has time to grow. Whether a professed dairy servant be absolutely necessary will depend upon the number of cows and the nature of the establishment, and whether butter and cheese are to be made, &c.

6730. *In cases where grazing land cannot be procured*, and yet the advantage of keeping a cow or two may be desired, this may be effected, in many situations, by keeping them in doors in a cow-house; although it cannot be expected that they will thrive quite so well, nor yield such milk, as when they have the opportunity of collecting their food in the open fields. It is well known, however, that in many parts of the Continent, particularly in Switzerland and the whole of Flanders, as well as in the vicinity of London, cows are kept in this manner all the year. There are, indeed, many advocates for this mode of feeding cattle, called *stall-feeding*, as preferable on the score of economy. It is argued that cattle injure the grass by treading, staling, dunging, and lying down upon it; and also that many grasses go to seed, and are wasted from not being cut in time; whereas the manure being collected in the stable can be employed more advantageously, and that the cattle are not so much annoyed in the house by flies, and do not injure the fences. It is likewise shown that the same quantity of land cultivated for stall-feeding will support a great many more cattle than as pasture land. Stall-feeding is much practised in Sussex, and Lord Egremont used to have his milch cows tied up during the greater part of the year; he maintained that one third of the food was saved, that the cows were fed with a fourth part of the usual trouble, that more dung was made, and that there was no spoiling the ground.

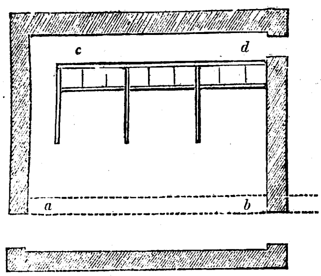
6731. A small piece of land, even perhaps little more than half an acre, may be made to produce grass sufficient, when cut and brought into the house, to keep a cow nearly the whole year; whereas it would be quite impossible for her to derive her whole food from the same quantity of land were she suffered to tread over it. Indeed, it would not be judicious management even to suffer the cows to range over the grass after the hay had been taken from it, on account of the injury it would occasion by treading; it would be much better to close the field at this time, and allow it to revive with the aid of a little manure and fresh grass seeds. Notwithstanding these facts, this practice is not much followed in England, though enough has been done to show its practicability if found desirable. The trouble attending it appears to be a considerable objection.

Construction of the Cow-house.

6732. Horned cattle are much hardier than horses, and much less liable to disease; they will endure a greater degree of cold in winter, and of heat in summer, and they require less delicacy of management in their lodging. No horse could be kept in his stall for months without exercise in the open air and yet retain his health; but milch cows are kept in the neighbourhood of London standing in the same stall for a year or two with scarcely ever being taken out; and in Germany, from the severity of the climate, and the poorness of the pastures in many places, the cows are stall-fed the greater part of the year. It does not follow from this, however, that cows are not benefited by being frequently in the open air. In many parts of England, from the usual mildness of the winters, the cows, instead of being tied up, are allowed to run at large in a yard which has a cow-house attached to it for them to shelter in; and when this is the management, the construction of the cow-house is usually little attended to. Indeed, in many parts of this island, the cow-house is kept in a dirty condition; and we would do well to take a lesson from our neighbours in Holland, and in some parts of France, where the cow-houses, even of the common farmers, are kept in a very superior degree of cleanliness, and are well lighted and ventilated. In some of our large establishments for supplying milk, and in those of many wealthy individuals, great improvements have been made in this part of domestic economy, the leading principles of which we propose here to state.

6733. *On common farms, cows are not usually kept in separate stalls* in the cow-house, except in cases of sickness, or when they are near calving; but although it requires a little more room, separate stalls are preferable; the divisions need not be long nor high. The floor of the stalls, or of the standing room, ought to be perfectly level, since it has been found that a slope is apt to occasion abortion. One of the principal differences between the house for horned cattle and those for horses consists in the gutter *a, b, fig*

Fig. 898.



898, owing to the more fluid nature of the dung of the former, which makes it necessary to have a passage, *c d*, for serving them with food between the manger and the wall. This gutter for the dung should be about eight or nine feet from the manger, and generally one foot broad, and three or four inches deep; it is better to be flat than curved at the bottom, because, in the latter case, the cattle are apt to slip in crossing it. The dung is cleaned out every day by a scraper, and there should be a space of three feet between the gutter and the wall. In some establishments the bottom of this gutter has been laid with oak planks bored full of holes, or cast iron grates, to allow the fluid dung to pass into a drain beneath; and if a broom be now and then passed over this bottom, together with some small supply of water at one end of the gutter, the cow-house may be perfectly sweet and clean; or, if the aperture into the drain do not extend the whole way, there might be gratings at certain places, or round openings with covers. The dung may be passed into the manure tank.

6734. The manger is a trough of boards, stone, or iron; and it should be so placed that the upper edge may be from a foot to eighteen inches from the ground, or about the height of the cow's knees; and it may be eighteen inches broad, and a foot deep. In order that it may hold the various kinds of food conveniently, it may be divided into three parts; one for dry food, another for moist food, and the third for water. Some have also a kind of rack for hay or grass.

6735. Litter in the stalls is not universally used; but it is better for the cows to have straw to lie down upon than the bare paving, or even boards. The cows are fastened by a halter or chain, passing through a ring in front of the manger, and loaded. Cow-houses in England are generally kept almost quite dark; but this is unfavourable to *cleanliness*, the want of which is detected by light. When windows are used, they should be provided with outside shutters luffer boarded, to keep off the intensity of light, and yet allow of ventilation, too much light being found to disturb the repose of cattle, and to encourage flies. Some space should be appropriated for the store of dry food. In Holland and the Netherlands, and likewise in some of the first dairies in France and Germany, cows are combed and brushed like horses; and this is beginning to be practised in gentlemen's dairies in England.

6736. In general, cleanliness is not only agreeable to the sight, but it is very beneficial to the health of all animals; on this account it is best to have the inside of a cow-house whitewashed, if not plastered. Ventilation should be provided for, which is best done in the roof, or it may be managed by tubes in the walls, in the same manner as was recommened in stables for horses, should there be any rooms over the cow-house. It is not only necessary that a cow-house should be comfortably warm and very airy, but more especially that it should be dry; for although a certain degree of warmth is healthful, yet cows, if kept dry, are not very susceptible of cold; and fresh air should never be excluded.

6737. *The calf-house* should be separate from the cow-house, placed so near as not to be inconvenient in carrying the milk, and yet not so placed that the cow cannot hear or see the calf, as that would disquiet her, and prevent her feeding. The calf-house may be fitted up like the cow-house, only on a reduced scale. Great cleanliness is particularly important.

6738. *A feeding-shed* for cattle is a useful appendage, where the cows can be in the open air occasionally, or while the cow-house is cleaning: it may have a rack or manger for food. *A room for steaming food* for cattle, and for washing potatoes and other roots, is likewise found convenient.

6739. *The sorts of food to be given to cows* that are kept in houses, with little or no access to fields, must depend, in a great degree, upon what is to be procured in the locality; but it may be well to point out the usual kinds. Cut grasses, natural or artificial, such as lucern, clover, and vetches, being generally plentiful in the neighbourhood of large towns, are frequently sold in bundles, and should be given, if possible, fresh cut, and before they have had time to wither. Hay has been sufficiently described when treating of horses, and forms great part of the food of cows, particularly in the winter: it should be of the best quality. Straw is likewise used, of which oat-straw is the best.

Fresh grains from breweries, public or private, can generally be procured in all towns, and are much used in some places, as in milk establishments; but though they occasion a great flow of milk, it is of a poor kind. The grains should, if possible, be fetched three times a week, that the cows may have them perfectly sweet, for they will refuse this food as soon as it acquires an ill taste. In the neighbourhood of London, where the cow-keepers make great use of grain, it is the practice to put it into pits, in which they tread it down and cover it close, by which it will keep fresh for a month or two. It may likewise be packed very close in casks, which should have holes in the bottom to drain off the moisture; for this purpose sugar casks, which may be purchased very cheap at the grocers', answer very well.

Those who have gardens of any extent usually have some spare vegetables for the cows, from which the rotten leaves should be carefully separated. Roots of all kinds, as carrots, parsnips, mangel-wurzel, and potatoes, are excellent food for cows. Turnips are likewise much used, but they impart a disagreeable flavour to the milk and butter; the Swedish less than the others. It has been asserted that this unpleasant flavour may be corrected by mixing a small quantity of saltpetre with the milk; but this has scarcely any effect. Linseed, pea, and oat meal, mixed with other food, improves the quality of the milk; and mashes of bran and pollard have the same effect.

6740. *It is not a general practice with us to prepare food for cows by cookery*, yet it is well known that most vegetable substances have their nutritive properties developed and improved by some kind of culinary preparation. Some trials have been made in boiling and steaming roots, and it is thought with advantage. Bran, which contains but little aliment, is improved by steeping it in water, and allowing it to ferment: in Prussia it is the practice to prepare winter food for their cattle, by making cabbages and beets into a kind of sour-crout.

6741. The grasses, when they can be procured, form the best summer feeding in doors, or, as it is termed, *soiling;* and hay and carrots constitute the most salubrious and best fodder for winter. Succulent vegetables of all kinds contribute much nutriment to cows, and increase the quantity of their milk; and milch cows may be maintained through the winter in milking condition by giving them some of these with sound wheat or oat straw, with, or even without, hay.

6742. In beginning cattle with green food in the house, after they have been used to dry, it must be given at first sparingly, lest they should eat more than is proper; thus, tares, lucern, and clover, which cattle relish extremely, would, if eaten too greedily, ferment in the stomach, engendering air and causing disease. If they have more than they can eat, they will blow upon it, and afterward reject it; and it is proper to remove it from them before they are quite satiated. Straw or hay should be given as fodder, to correct the laxative effect of the grasses and raw roots; and, in general, it is proper to vary the food of cattle somewhat, to cause them to relish it.

6743. *To keep cows in the best condition for milk*, they should have hay of the first quality in the winter season, and this in an unlimited degree, that they may always feed till they are perfectly satisfied; and, when the weather permits, they should have access to meadow land, where they may feed on such green vegetables as are present, which will give their milk and butter a greater degree of richness: if they are always kept in doors, and foddered with straw, their milk cannot be expected to be so good. Common salt is much relished by cows, and, when added in moderate quantities to their food, is said to improve their milk, and likewise their general health.

6744. It is very essential that milch cows should be kept always in good condition; as, when they are ever suffered to become very lean, particularly in the winter season, it is impossible that they can be brought to afford a large quantity of milk, except by getting them into perfect condition in the summer months.

6745. *The times for feeding* should be as soon as possible after daylight in the morning, at noon, and a little before sunset, leaving sufficient time for the animals to lie down and ruminate.

6746. *The water given to cows* should be of the purest kind; and, if taken from a cold spring, should be warmed till it is of the temperature of the air in summer. Some recommend stirring a handful of meal in each draught occasionally.

Having described the general principles of feeding and managing cows, it may be proper to state what has been found to be a judicious daily routine in the cow-house.

6747. *The daily business of the cow-house* should commence at five in the morning, by removing the soiled litter, cleaning out the manger, and putting into it the food to be given first, whether grass mixed with a little hay, or any other; the door should now be shut, and the cows left for an hour to eat their meal undisturbed. At six the milking may take place, taking care to follow the directions to be afterward given. After this is finished, the cows may be turned out into the yard, or wherever they can take exercise, and have access to plenty of good water; and in the mean time the cow-house can be cleaned out thoroughly, and the manger scalded. At nine o'clock, when the cows are again put into the house, a mash may be given, consisting of half a bushel of grains to which has been added a sufficient proportion of water at a scalding heat in which has been boiled a quart of barley meal and a pint of malt dust; a table-spoonful of salt may be added, and the whole suffered to cool a little below blood-heat before it is given. At two o'clock the cows may have a second feed of the green food and any other vegetables with water, which may have a little meal stirred in. At four the second milking takes place, and at six a mash, as before. At eight the litter is made up for the night, and the manger and rack, if any, supplied with green food and hay.

The above-mentioned is the usual summer treatment of cows kept wholly in the house; the winter treatment only differs in substituting various roots sliced, raw or steamed, with some hay, for the green food. The roots must be laid up in store in a cellar or some dry place where frost cannot touch them, in sufficient quantity to last for the season.

A moderate-sized cow will consume from 80 lbs. to 100 lbs. of green food per day, and a bushel of roots per day in the winter. She will eat a truss of hay a week in winter, and half as much, if on the grasses, in the summer.

6748. *The cow goes between nine and ten months with young*, and rarely produces more than one calf at a time. She should be dried off at a reasonable distance of time before the expected time of gestation be completed. If she be continued in milk too long, it will injure her health as well as that of her progeny; but this time will depend, in a great measure, upon her keep. In some cases cows are run dry six weeks or a month before calving, while in others, where they are very well kept, they may be continued in milk, without injury, until a fortnight before the time: when dry, they should be suffered to remain quiet, and should be well attended to. The time when they are near calving may be known by what is termed springing at the udder, or a collection of liquid in the bag, which assumes, in some degree, the appearance of milk, and may be drawn from the teats.

6749. *When the time of gestation draws near*, the cow should be placed apart from other cattle for a week or two previous to her calving, and where assistance can be had when needed. Should this be neglected, the progress of the birth should be left as much as possible to nature; but in difficult cases we refer the reader to Mr. Youart's "Account of Cattle." In ordinary cases, he recommends that "a pint of sound warmed ale should be given in an equal quantity of gruel; warm gruel should be frequently administered, or, at least, put within the animal's reach; and access to cold water should be carefully prevented." Parturition having been accomplished, the cow should be left quietly with her calf, which she then licks and cleans. A warm mash and gruel should be put before her, and slightly warmed. Two or three hours after, it will be prudent to give an aperient drink consisting of a pound of Epsom salts and two drachms of ginger; the calf should be suffered to remain with her, otherwise fever and inflammation of the udder may ensue: in case of the teats being sore, they should be fomented with warm water. In general, things go on regularly; but should it be otherwise, a cow-doctor or other skilful person should be called in.

When, from neglect, a calf drops in the yard or field, there is a great hazard of its perishing, and this may considerably endanger the life of the cow. Should this happen, and the mother take cold (which may be known by her shivering and refusing her food), she ought immediately to be driven into a warm place, together with her calf, and fed with sugar sops and ale, and with the best and sweetest hay, and should not be suffered to drink cold water. By this treatment she will most likely recover in a few days; but, should the disease continue, recourse must be had to balls composed of aromatic cordial substances.

CHAPTER II.

MILKING AND MANAGEMENT OF MILK.

6750. *Cows are generally* milked at stated intervals, twice in twenty-fours hours, throughout the year. In some districts they are milked three times; but though by this more milk is obtained, it is of poorer quality. Milking, in some parts of England, is performed by men, but it is most usually the work of women. The milker ought to be mild, good tempered, and cleanly. If the operation is performed harshly, it becomes painful to the cow, which, in this case, brings into action her faculty of retaining her milk; but, if gently performed, it seems rather to give pleasure, as appears from the cows coming to be milked, in some countries, at the call of the milkers. Dr. Anderson observes that many instances have occurred in which cows that would not let down a single drop of milk to one dairy-maid, let it flow in abundance to another. For the same reason, when cows are ticklish, they should be treated with the most soothing gentleness, and never with harshness or severity; and when the udder is hard and painful, it should be tenderly fomented with lukewarm water, and stroked gently, by which simple expedient the cow will be brought into good temper, and will yield her milk without restraint. It is of importance that the whole of the milk in the udder should be thoroughly drawn from the cow when she is milked: that portion of milk which is left seems to be gradually absorbed into the system, and nature generates no more than to supply the want of what has been taken away. If this lessened quantity be not again thoroughly drawn off, it occasions a yet farther diminution of the quantity of milk generated; and so on, from less to less, till none at all is produced. In short, this is the practice followed when it is meant to allow a cow's milk to dry up entirely, without doing her any hurt.

6751. *If the milking be not carefully performed*, not only will the quantity be diminished, but the quality will also be inferior; the first of the milk is the poorest, and gradually becomes richer, until the last drainings of the udder, or what is commonly termed the "afterings."

It has been ascertained by Dr. Anderson that the loss of half a pint of this milk occasions the loss of as much cream as would be afforded by a far greater quantity of the first milking, besides that portion of the cream which gives the greatest richness and flavour to the butter. This he decided by the following experiments: "Having taken several large tea-cups, exactly of the same size and shape, one of these was filled at the beginning of the milking, and the others at regular intervals till the last, which was filled with the dregs or 'afterings.' These were each weighed, the weight of each cup being settled, so as to ascertain that the quantity of milk in each was precisely the same; and from a great number of trials frequently repeated, with many different cows, the result was thus: the quantity of cream obtained from the first drawn cup was, *in every case*, much smaller than from that which was last drawn; and those afforded less or more as they were nearer the beginning or the end. The quantity of cream obtained from the last drawn cup from some cows exceeded that from the first in the proportion of *sixteen* to *one*. In other cases, however, and in particular circumstances, the disproportion was not so great; but in no instance did it fall short of the ratio of *eight to one*. The difference in the quality of the cream, however, obtained from these two cups was much greater than the difference in the quantity. In the first cup the cream was a tough, thin film, thinner, and perhaps whiter than paper; in the last, the cream was of a thick consistence, and of a richness of colour that no other kind of cream was found to possess. The difference in the quality of the milk that remained after the cream was separated was, perhaps, still greater. The milk in the first cup was a thin bluish liquid, like as if a very large portion of water had been mixed with ordinary milk; that in the last cup was of a thick consistence and yellow colour, more resembling cream than milk, both in taste and appearance."

6752. *The average quantity of milk* which is afforded by cows varies according to the breed, pastures, season, and winter keeping. In the principal cheese districts, large cows will give from eight to twelve quarts per day, and some will give nearly twice this quantity for short periods; but when cows give an unusual quantity at one milking, it is remarked that they either go off their milk much sooner, or else their milk has less richness in it than that of others which do not give so large a quantity. Smaller breeds do not give nearly so much; perhaps from two, three, six, eight.

6753. It is better to milk them abroad in fine weather than to drive them home from any considerable distance; and it is advisable to have some home paddock not far from the house, where they can be put under cover while milking; at which time it is expedient to lay before them some favourite food which they can relish with appetite; for they will thus not only remain more quiet, but they will also yield their milk more readily.

6754. *When the milk has been drawn from the cow, it should be carried gently*, and with as little shaking as possible, to the dairy, where it is strained through the sieve. It is then put into the coolers, or shallow pans, which should not exceed three or four inches in depth, and about a gallon and a half or two gallons in capacity, where it is left for the cream to rise to the surface, which it does within a few hours, according to the temperature of the air. Those who are particularly nice, either in the consumption of the raw cream, or in making the very best butter, skim the milk, perhaps within six or eight hours; but when intended for ordinary butter, it is generally left at least twelve hours, and in cold weather twenty-four, or even thirty-six hours, according to the weather, and then it is sometimes skimmed a second time. It is requisite that the milk-pans themselves should be nearly of the temperature of the milk when that is put into them, and therefore, in winter, they should be scalded with hot water, or placed before a fire previously to their receiving the milk, as the cream will rise if this be suddenly chilled.

Milk, which is put into a bucket or other proper vessel, and carried to a considerable distance, so as to be much agitated, and in part cooled before it can be put into the milk-pans to settle for cream, never throws up so much or so rich cream as if the same milk had been put into the milk-pans directly after it was milked.

6755. *In separating the cream from the milk*, first run an ivory or silver bladed knife closely round the sides of the pan, to which the cream adheres firmly, and draw it to one side; lift it off with the skimming dish, which is generally pierced with small holes, an act which requires some dexterity, both to avoid leaving any creaming behind and to prevent any portion of the milk being mixed with it. The cream is put into the cream-bowl to be carried to the cream-barrel. In large dairies, the milk coolers have sometimes an aperture in the bottom, stopped by a peg, which is taken out when the cream has completely risen, allowing the milk to pass through, leaving the cream at the bottom, and this is then drawn up in the same manner.

With respect to the thick milk from which the cream is taken, or *lappered milk*, as it is called in some parts of the country, it is usually employed in England for feeding pigs, though in Scotland and Wales it is thought no bad food for human beings; and it is, without doubt, *particularly wholesome*

CHAPTER III.

CONSTRUCTION OF THE DAIRY-HOUSE.

6756. Where one cow only is kept, a separate dairy-house can scarcely be necessary, or it may be on a very small scale; but where several cows are kept, and butter or cheese is to be made, this becomes essential, and we proceed to point out the principles on which it ought to be constructed.

6757. *The spot where it should be placed* must depend much on convenience and the nature of the locality, but it should not be too far from the house, nor too near the cow-yard.

6758. *The temperature of the dairy* should be as equal as possible at all times of the year; that is to say, as cool as possible in summer, and sufficiently warm in winter. The building should be so placed, if possible, as to be defended from the sun's rays, which may be sometimes effected by trees; and the construction of the building should be such as to prevent, as much as possible, the changes in the temperature of the external atmosphere from affecting that of the interior.

6759. *The walls* may be of any convenient material. Some have been made of brick, built double, or hollow in the interior; and such walls are, upon the whole, the best for preventing the passage of heat through them; but this construction may be limited to the chamber appropriated to keeping the milk.

6760. *The roof* has most usually been made of very thick thatch, either of straw, reeds, or fern, these being bad conductors of heat; a tiled roof is either too hot in summer or too cold in winter; but thatch is subject to early decay, besides harbouring vermin. Large, strong slates are to be preferred, as being more impervious to the weather, and more durable, and they require few rafters. A lath and plaster ceiling below the slates, either plain or covered, will be necessary for warmth.

6761. *The floors* of ordinary dairies are usually paved with brick or tiles; but neither of these can be recommended; for they are never so level, nor the joints so close, but that the spilled milk will lodge there, creating an unpleasant odour. Brick and tile also absorb much wet, and, being long in drying, cause a chill in winter that gives rise to dampness and mouldiness; large, smooth slabs of paving-stone are much better. Lately, slate has been satisfactorily introduced for this purpose; it is sawed into plates three feet square and half an inch thick, at 5*d.* per foot superficial, 7½*d.* per ¾ thick, and 10*d.* for 1 inch thick, by North and Co., at the London Docks. The slates are laid in a bed of mortar, or, what is better, having a layer of concrete four inches thick under the mortar. This slate has been found to be even stronger than stone. The floor should have a fall to a trap drain in the corner. It appears from experiments of the Bishop of Llandaff, that slate absorbs only $\frac{1}{200}$th part of its weight, whereas tile absorbs $\frac{1}{7}$th; and the slate, when exposed to a temperature of 60°, was dry in a quarter of an hour, while the tile had not lost all its moisture in six days. For an ornamented dairy, tiles to imitate mosaic may be employed.

6762. *The sides of the interior* should be plastered or stuccoed; but if they are lined for three feet above the shelves with glazed Dutch or white tiles, it will have an agreeable effect.

6763. *The windows* should be double, but made to open, with lattices covered with wire gauze, to prevent the entry of flies, and with double shutters of wood, to guard more perfectly against severe cold in winter.

6764. *The shelves* may be of flag-stone, marble, wood covered with lead, or slate. The latter appears to be the best material. The proper thickness for slate shelves is one inch, which costs 1*s.* 2*d.* per foot superficial, without fixing, and if polished, 1*s.* 6*d.* per foot. The brackets to support them may also be of slate four inches deep and two inches thick, fixed edgeways, with one end let into the wall; or they may be of iron. A large table in the centre will be found useful.

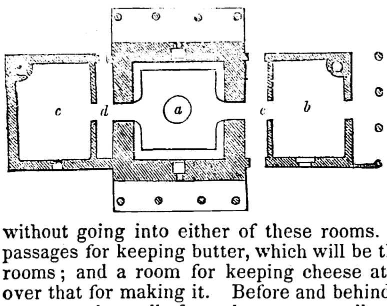
6765. *Ventilation* will be best obtained by means of an aperture in the roof, through which a funnel may be carried from the milk-room, having a regulator.

6766. *A complete dairy* should consist of several apartments, depending upon whether butter only, or both butter and cheese, are to be made. It should have an apartment to keep the milk in while it is throwing up the cream, a room to serve as a dairy-scullery, and a third for churning: cheese may be made, perhaps, in the last; but if there is much of it, or if more convenience be desirable, a fourth room may be devoted to cheese-making.

6767. *Abundance of good water is essential to a dairy:* if a well can be had adjoining, it will be very desirable; if not, there should be a cistern conveniently placed, and well supplied; likewise proper drains should be made for carrying off the water.

6768. *A dairy for a private family* may be constructed according to the plan, *fig.* 899.

Fig. 899.



a is a milk-room; *b* the dairy-scullery with a copper fixed in the corner, and a pump communicating with a well, or having a cistern for water; the outer door opens into a covered place to hold the vessels that are drying. *c* is the room for churning butter, and also for making cheese, having its copper, cheese-press, various vessels, shelves, &c. These two rooms are separated by passages from the milk-room, *d*, *e*, which is thus kept more cool and quiet, the entrance being into one of the passages without going into either of these rooms. Space may be found in the ends of these passages for keeping butter, which will be then accessible without going into any of the rooms; and a room for keeping cheese at a distance from theb utter may be placed over that for making it. Before and behind the milk-room may be verandas effectually to screen the walls from the sun, as well as for ornament. The plan is the only thing necessary to be given here, for the elevation may be of various designs, according to the taste of the architect or builder. Nor will it be necessary to give plans for a dairy on a smaller scale, or a more extensive one, which may require the talents of an architectural designer. It is sufficient if we point out the principles upon which they should be constructed.

6769. *A dairy-room is sometimes an elegantly ornamented apartment*, and much taste has been employed in fitting them up, with a fountain playing up in the centre, which has the effect of keeping the air cool. A thermometer should be kept in the room, and the temperature should range from 48° to 55°; if it falls too low, the heat should be raised by some artificial means. When there is much milk, its warmth, as just drawn from the cows, will raise the temperature a little. It has been suggested by Mr. Young that there should be a trough passing through the wall of the dairy of sufficient dimensions to admit of pouring the milk from the pails with safety, having a hair sieve so placed as that the whole of the milk may pass through it before being conveyed to the cooling-pans, as by this simple contrivance the necessity of boys or others with dirty shoes entering the dairy-house is prevented.

6770. *The utensils of the dairy* are pails for milking into; sieves of hair cloth for passing the milk through to free it from hairs or other impurities, sometimes silver wire cloth is used for this purpose; milk-dishes, or coolers for holding the milk while it is throwing up its cream; a cream-knife of ivory for separating, and dishes of marble, or of tin, for removing the cream, with holes in the bottom to let the milk run off; bowls or barrels for holding it; churns for making butter; scales, butter-prints, and boards for weighing, measuring, and ornamenting it; tubs for hot and cold water for washing the various vessels, and a portable rack for drying them on in the open air.

6771. *Milk coolers* are the shallow vessels to put the milk in after it is drawn from the cow, that the cream may be thrown up. They are generally made of wood, and maple-tree is preferred, from its lightness and cleanliness of appearance; the best milk-pails are made of the same. The only objection to wood is the great trouble that is required to keep it perfectly clean, and it wears rough. Metals have been tried, as lead and zinc; but these, the former in particular, being poisonous when dissolved, as they are apt to be when the milk becomes acid, should be banished from the dairy. It has been said that zinc will cause the milk to throw up more cream; but this is an error. Tin plate is safe, but rusts except it be kept very dry; and cast iron, tinned inside, is heavy, though durable. The brittleness of earthen-ware in general is an objection; and common ware being covered with a glaze in which lead forms an ingredient, is thought to be improper, since the milk, when it becomes acid, may act upon the lead in the glaze. Earthenware coolers, glazed with salt, were such made, would be free from this objection, as also would be porcelain; but the latter is far too expensive for common use. Slate is sometimes formed into coolers, and answers very well, except that the cement at the angles is apt to give way sometimes.

6772. *The most perfect cleanliness is essential* in every operation of the dairy. All the vessels in which milk is put, as well as the cheese, must be scalded, scrubbed, rinsed, and dried every time they are used. If any vessel is neglected, and tainted with soured milk, it acts as a lemon upon milk put into it, and this is sometimes difficult to remove, and perhaps may require boiling with a little potash or soda, and washing very well afterward in hot water, that none of the alkali may remain to give a disagreeable taste. Some recommend soap instead of alkali, as it leaves no taste behind. Dairy-maids should be extremely clean in their persons and dress, and should never enter the milk-room with a dirty apron covered with hairs from the cow-house.

6773. *The management of a dairy should be conducted with the greatest regularity*, and every operation should be performed at the proper time. It has been observed that hastening or delaying any of these will cause butter or cheese to be of an inferior quality, even from milk that, under other circumstances, would have produced the best.

CHAPTER IV.

THE MAKING OF BUTTER.

6774. The chemical principles of milk and butter, as well as the varieties of each, have been explained in Book VII., Chap. IV., and to that we refer the reader; we propose now to give the details of the usual method of making butter.

6775. *Butter* is made either from the cream alone or from the milk unskimmed. When quantity rather than quality is desired, the latter method is practised, but the former furnishes the best butter.

6776. *When butter is to be made from the cream alone*, the milk is skimmed two or three times till it will yield no more cream, and the barrel or other deep vessel into which it is put should have a spigot with a piece of close silver wire gauze over the aperture on the inside for drawing off, from time to time, any thin serous part of the milk which may happen to be there, for, if that be suffered to remain, it would act upon the cream, and injure the quality of the butter. It does not appear to have been determined exactly how long the cream should be kept before it is churned, but from three to six days is the usual time, which, however, varies among persons who make good butter, being, in a great measure, regulated by convenience. Many people imagine that no butter is of good quality except what is made from fresh cream; but this is an error, for the formation of butter only takes place after the cream has acquired a certain degree of acidity, and no butter, of even tolerable quality, can be obtained from cream that is not more than one day old. The cream from every milking should, however, be kept apart until it becomes sour, and not be mixed up with sweet cream, at least not until the moment of churning, for the mixture occasions a fermentation, which, though partly prevented by the churning, is liable to dispose the cream to become a little putrid. When, however, the cows have been fed on roots, the sooner the cream is churned the better. The best butter is made from the cream skimmed off the first time, and the second skimming will make an inferior butter.

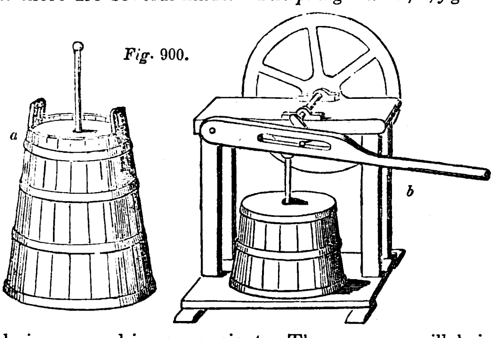
The practice of putting the milk of all the cows into one vessel, there to remain till the whole milking be finished is injudicious, not only on account of the bad effect of agitation and cooling, but because it prevents the distinguishing of the best from the worst cow's milk, and using them separately where it is desirable.

6777. *Particular attention should be paid to the temperature in which the milk is kept while it is throwing up the cream.* It is found by experience that if the heat be too great, the milk is apt to coagulate suddenly, with little separation of the cream, and it becomes sour so rapidly as to injure every operation; while, on the contrary, when the milk is kept in a low temperature, the cream separates in a very slow manner and with difficulty, acquiring a disagreeable bitter taste, the butter being scarcely able to come at all, and, when obtained, is small in quantity and poor in taste. If the cold should ever become too great in the winter season, this may be remedied by artificial means; among the simplest of which is introducing a barrel of hot water closely bunged up, and placing it on the floor of the milk-house, where it cools, giving out its heat very gradually; or hot bricks may be laid down for the same purpose; a chafing-dish with burning embers is objectionable, as the air generated by charcoal is apt to prove injurious to the milk.

6778. *When butter is made from whole milk,* the process, as followed at Glasgow, and described by Mr. Aiton, is as follows: The milk, as drawn from the cow, is placed in the coolers until the cream has risen, and it is emptied, before it has acquired any acidity, into a well-scalded vat of size sufficient to contain the whole of the milking, or, perhaps, of two milkings. The whole must now sour before it is churned; in souring it becomes thick, or, as it is called, lappered, which will require a few days. Care must be taken not to break the curd or lapper of the soured milk before it is put into the churn.

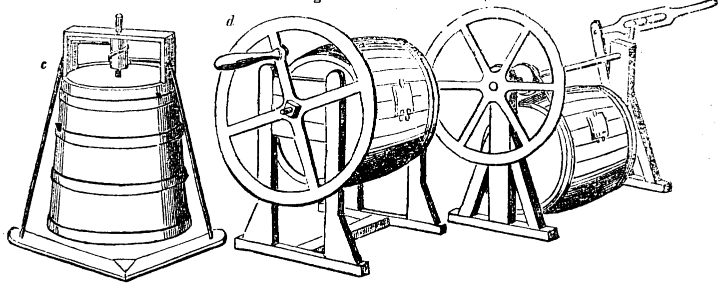
6779. *Of churns* there are several kinds. The *plunge churn, a, fig.* 900, is that which

Fig. 900.



is most commonly in use, and is very ancient. The cream or milk being put in, and the top put on, the churning is performed by means of a long handle passing through a hole in the top, and furnished at the lower end with a perforated circle of wood, which agitates the milk by being moved up and down by the dairy-maid. This method is the most effective for the purpose, but is very laborious in its operation. Mere agitation of milk in a close vessel, a large glass bottle, for instance, continued for a sufficient time, will produce butter, but not of the best quality, if the agitation be not given with a degree of regularity. It requires some skill to churn properly with the common plunge-churn: a few irregular strokes have been known to injure the butter. When once begun, the churning must proceed regularly. The best time for churning in the summer is early in the morning, before the sun gets much power. To obviate the difficulty and fatigue of working this churn, another mode is sometimes employed, as shown in *b, fig.* 900; in this the plunge-staff is moved up and down by a lever worked by hand, and, by means of a crank, motion is given to a fly-wheel. In very large dairies this method is extended by causing the levers to be worked by a horse. In the *Lancashire churn, c, fig.* 901, the barrel is upright, and the axis, with its beaters within, is turned by a cord passing round, the two ends of which are fixed to a pair of levers or treddles worked by the

Fig. 901.



feet of a person standing upon them, the motion being given by alternately pressing first one and then the other.

6780. The *common barrel-churn, d, fig.* 901, is turned round by an axis and winch, to which is attached a fly-wheel, the barrel lying horizontally; on the inside are perforated beaters, and there is a square aperture on the side for having access to put in the milk and take out the butter; this is securely closed by an iron fastening. One advantage of the barrel-churn is, that it requires no skill to work it.

e, fig. 901, is a construction of the barrel-churn by which it can be worked by the action of a lever instead of a winch, a crank connected with the lever giving the rotatory motion. Several other contrivances for churning have been invented, but the above may sufficiently serve as examples. We may observe that an objection to the barrel-churn is the difficulty of cleaning the inside, from the smallness of the aperture.

6781. *The operation of churning,* whether it be cream or whole milk, is performed in the same manner; but the latter, being so much larger in quantity, the process is more laborious, and requires more time. From two to three hours' churning are necessary in making butter from milk, whereas an hour and a half is sufficient with cream. The best temperature for churning butter from cream has been very satisfactorily determined by a number of experiments sanctioned by the Highland Society of Scotland, and published in their Transactions. From these experiments it is concluded that the most proper temperature at which to commence the operation is from 50° to 55°, and that at no time ought it to exceed 65°; while, on the contrary, if at any time the cream should be under 50°, the labour will be much increased without any advantage being obtained, and a temperature of a higher rate than 65° will be injurious as well to the quantity as quality of the butter. But milk and cream, when churned together, require a higher temperature, which, it is generally thought, must be equal to 70° or 75° before butter can be obtained, and the common practice is for one person to pour in a small quantity of warm water gradually while another is churning. A thermometer here, it is evident, would be very useful, but the only one the dairy-maid knows is her fingers, and she is usually correct. It is necessary to observe that all churns should be well washed out and scalded immediately after the butter is taken out, and that butter-milk should never be suffered to remain in them. The churn should be scalded in the inside with hot water before the cream is put in, to prevent the butter from *clinging* to it. Should the butter stick to the churn, which it is apt to do in warm weather, pour in a little cold water to solidify it.

6782. *As soon as the butter is made* it must be separated from the butter-milk, and put into a clean wooden dish, the inside of which should be well rubbed with salt, to prevent the butter from adhering to it. The butter must now be pressed, to get out all the milk that may be lodged in the cavities of the mass. In this operation some persons throw the butter into cold water, or pour water on it, to assist in separating the milk, but this should never be done, as it injures materially the quality of the butter. It should only be well worked with the hand, or, what is much better, with a flat wooden ladle or skimming-dish, having a short handle. A considerable degree of dexterity as well as strength is requisite in effecting completely the extraction of all the moisture, and, in some places, it is the practice to beat the butter with two flat pieces of board, but it must not be too much kneaded, or it will become tough and gluey. A small quantity of salt is usually added, though some prefer it entirely without salt; this is matter of taste.

6783. In the summer season, while the cows are fed on grass, it is not requisite to give butter any factitious colour; but in the winter and spring months it is common with dairy people to alter that tallowy appearance which is natural to butter at these seasons: this is effected by means of a little arnotto, which, after being reduced to as fine a powder as possible, is incorporated with the cream before it is put into the churn. In Devonshire they sometimes make butter from clouted cream, which, they think, gives a superior butter. For the manner of making clouted cream, see Book VII., Chap. IV.

6784. *Butter is made up*, before it is sent into the house or to table, in various forms, sometimes into rolls or cylinders six or eight inches long, and from an inch to two inches in diameter, or into round pats stamped by butter-moulds. When butter is too soft for the latter purpose, it may be put into small wooden vessels, which may be allowed to swim in a tub or cistern of cold water; or, what is better, they may be set in an ice-house for an hour or two, or the water in which the small floats are set may be iced; but on no account should water be allowed to touch the butter in making it up. When formed into the desired shapes, it may be kept in a cool place till wanted.

6785. *The salting and curing of butter* have been already treated of in Book X., Sect. IX., "On the Preservation of Food."

CHAPTER V.

THE MAKING OF CHEESE.

6786. The chemical nature of cheese, and of the coagulation of milk by which it is formed, have been already treated of in Book VII., Chap. IV., Sect. III., to which we refer the reader; and we proceed to the practical directions for making it.

6787. In the preparation of cheese several circumstances must be considered: such as the season of the year; the milking, as well as the cattle furnishing the milk, and their feeding; the method of preparing the rennet and colouring; the mode of breaking the curd; the management of the cheese in the press; and its treatment afterward in the cheese-room. The goodness of cheese depends more or less upon all these, but most of all, perhaps, on the mode of making; for, although it is generally considered necessary, in order to make the best cheese, to use new milk that has not been skimmed, yet some of the best cheese in Europe, as that of Parmesan, is said to be made from skimmed milk. The processes in different parts of England likewise differ somewhat, and hence the various kinds of our cheese; but the general principles and mode of manufacture are nearly as follows, being the mode usually adopted in Cheshire, as described by Holland.

6788. *The utensils requisite for making cheese* are, besides the usual ones for holding the milk, *the cheese-tub*, in which the milk is coagulated and the curd broken; the *cheese-knife*, generally a thin spatula of wood, but sometimes of iron, used for the purpose of cutting or breaking down the curd while in the cheese-tub; *the cheese-tongs*, or *ladder*, being a wooden frame occasionally placed on the cheese-tub, when the vat is set on it in order to drain the whey from the curd; *the vàt*, a strong kind of wooden hoop, turned out of solid elm, with a loose bottom, which, as well as the sides, is perforated with holes to allow the whey to escape while the cheese is pressing; its size must depend upon that of the cheese to be made; *the cheese-cloth*, a piece of thin open linen, in which the cheese is placed in the press; *the cheese-press*, a power obtained by a weight, screw, or lever, used for forcing the whey out of the curd while it is in the vat; *cheese-boards*, circular pieces of wood on which the cheeses are put in the cheese-room.

6789. *The proper season of the year for making cheese* is from the beginning of May till the close of September; or, in favourable seasons, to the beginning of October. Very good cheese, however, may be made in winter, provided the cows are well fed.

Previously to commencing the process of making cheese, besides the milk, two materials must be ready for use—the rennet for coagulating the milk, and the substance for colouring the cheese, if any is to be employed.

6790. *The substance called rennet, generally used for coagulating or turning milk to curds and whey*, is made from the stomach of a calf, preserved by means of salt. To understand its operation, we may observe that it is the nature of the gastric juice secreted in the stomach of all animals to coagulate the milk taken into it, as is well known to those accustomed to children. The prepared stomach of ruminating animals is found best for this purpose, and that of a young calf that has been killed before the digestion is perfected is generally preferred for rennet. This preparation is made in different ways in different districts; but the following method, used in Gloucestershire, according to Mr. Marshall, is one of the best: "Take a calf's bag, maw, or stomach, and, having taken out the curd contained therein, wash it clean, and salt it thoroughly, inside and out, leaving a white coat of salt over every part of it. Put it into an earthen jar, or other vessel, and let it stand three or four days, in which time it will have formed the salt and its own natural juice into a pickle. Take it now out of the jar, hang it up for two or three days, and let the pickle drain from it. Resalt it, plunge it again in a jar; cover it tight down with a paper pierced full of holes by a large pin, and in this state it ought to remain twelve months. It may be used, however, a few days after it has received a second salting; but it will not be so strong as if kept a longer time."

6791. *When wanted for use, the rennet so prepared is soaked in water*, to which some add a little lemon and cloves, or an infusion of sweet-brier and dog-rose, to do away any disagreeable smell, and give an agreeable flavour. The strength of the liquid will of course be increased in proportion to the length of time the bag remains in it, and therefore the quantity to be used for turning the milk cannot be stated in any exact portion, but must be ascertained by practice: on an average, we might say that half a pint of the liquid will be sufficient to turn fifty gallons of milk.

As the account by Mr. Aiton of the mode of preparing the rennet in Ayrshire is considerably different, though successful, we shall describe it also. He observes that, "so far from washing away the curdy matter or chyle found in the stomach of the calf, it is carefully preserved; for this chyle is formed by a mixture of the gastric juice of the calf with its food, and, the gastric juice being the coagulating power, the rennet will be stronger for retaining it: indeed, pains are taken, before the calf is killed, to have as much as possible by giving it milk. Accordingly, in preparing the bag or maw, as soon as it is taken from the carcass of the calf, its contents are examined, and any straws or indigested food that may happen to be there are thrown away, but no part of the chyle is suffered to be lost. Two handfuls of salt, at least, are put into the bag and upon its outside; after which it is rolled up in salt, and hung near a fire till it is well dried; and it is understood that it is improved by hanging a year. When rennet is wanted for making cheese, the bag with its contents is cut small, and put into a jar with a handful or two of salt; and a quantity either of soft water that has been boiled, and cooled to 65°, or of new whey taken off the curd, is put upon the bag in the jar. The quantity of water used must vary according to the kind of calf; if that has been newly dropped and not fed, three English pints will be enough; but if it has been fed four or five weeks, a couple of quarts may be put upon the bag to mash, the older calf furnishing most gastric juice. After the infusion has remained in the jar from two to three days the liquid is drawn off, and an English pint more of water or whey put upon the bag in the jar; and that, after standing in a mash one or two days, is also drawn off, and, with the first infusion, strained; the whole is then put up in bottles for use as rennet, and the bag is thrown away and not used for the milk. The liquid may be employed immediately, and will keep for many months. A table-spoonful of rennet so prepared will be sufficient for thirty gallons of milk; but its great superiority over the English is, that it will coagulate the milk in five or ten minutes, whereas the latter requires from one to three hours to form the curd. No harsh taste is communicated to the cheese, if sufficient care be taken in preparing rennet in this way."

6792. *In a case of emergency,* it is said that a decoction of the yellow flowers of the herb called "cheese rennet," or "yellow lady's bed-straw," which blossoms in July and August, will answer instead of rennet. The stomachs of lambs and pigs will likewise coagulate, but not nearly so well as those of the calf.

6793. *In Holland, instead of rennet,* they use a small quantity of muriatic acid for turning milk; and it is said that it is the use of this that gives to Dutch cheese its peculiar pungent flavour.

6794. *Colouring cheese* is, with us, a very general custom. Cheese properly manufactured from good milk, and at the proper season of the year, is always of a yellow cast; and hence the idea of excellence is attached to what is of that colour; and, when made for sale, it is always more or less coloured by artificial means. Turmeric, marigolds, and other materials were formerly used for this purpose; but these have given way to Spanish arnotto, which is a preparation from the red pulp that covers the seeds of an American tree, the arnotto-tree (*Bixa orellana,* Linn.). This pulp is mixed in hot water, and, when allowed to subside, it is made into balls and dried. The usual manner of applying the arnotto is to dip a piece of the requisite weight in a bowl of milk, and rub it on a smooth stone until the milk assumes a deep red colour. This infusion, without the sediment, which is separated by standing a little, is to be added to the milk of which cheese is intended to be made, in such quantity as will impart to the milk a bright orange colour, which will become the deeper in proportion to the age of the cheese. The addition of the arnotto in no way affects the taste or smell.

6795. *The milk intended for making cheese* should be carefully passed through the sieve placed on the ladder over the cheese-tub; and, for the very best cheese, that produced at a single milking is preferable: when it is brought in warm from the cow it is easily turned by the rennet: if the warm milk of one milking be mixed with that of an earlier one, the whole will take longer time to turn.

6796. *The degree of heat of the milk most favourable for coagulation by rennet* is from 85° to 90°, the natural heat at which it is drawn from the cow: if it is below 85°, the milk must be brought to that degree by some means. Some warm it over the fire, which is liable to burn or smoke it; others immerse the lower part of a vessel containing a portion of it into the copper of hot water, and mix this with the rest until the required temperature is obtained; and another method is to add some boiling water to the milk, to bring it to the required temperature, which is said to accelerate the coagulation. If the milk be not warm enough when the rennet is put into it, the curd will be tender, the cheese will never be firm, and will bulge out at the sides; and if too hot, it will cause the cheese to swell, or "heave," and become spongy, hard, dry, and tasteless, because much of the richness has gone off with the whey.

In hot weather the milk in the cows' udders is liable to become very much agitated and heated by their running about; and if rennet be put to it in that state, the curd, instead of coming in one or two hours, will require three, four, or five hours, and will be so spongy, tough, and imperfect, as to be scarcely capable of being confined in the press or vat; and, when released from the press, it will heave or split, and be good for little. Whenever, therefore, the cows are discovered to be in this state, which occurs not unfrequently, during hot weather, where cows are pastured in unsheltered grounds, or where water is not within their reach, it will be advisable to add some cold spring water to the milk as soon as it is brought into the dairy, until it arrives at the proper degree of heat.

6797. *To effect the coagulation of the milk, or, as it is called, to set the curd,* the milk now in the tub has the proper quantity of rennet and colouring added to it. The proportions of these can only be regulated by experience and practice. If there is too little rennet, the milk will not turn; if too much, the cheese will be apt to heave, as well as be rank and strong; and the same effect will be produced if the rennet has been made with bad or foul materials. A handful or two of salt, added previously to mixing the rennet, will promote the coagulation. The proper quantity can only be regulated by practice. After all the materials are put into the tub, the whole is well stirred together; a wooden cover is put on the tub, and over that a woollen cloth is thrown; during the process the milk ought not to loose more than five or seven degrees of its original heat. The usual time of curdling is from an hour to two hours, during which time it is to be frequently examined. If the dairy-woman supposes the milk to have been accidentally put in cooler than was intended, or that its coolness is the cause of its not curdling, hot water or hot milk may be poured into it, or hot water in a brass pan may be partially immerged in it to raise the temperature. This must, however, be done before the coagulation commences, for the forming of the curd must not be tampered with. If it has been set together too hot, the opposite means may be resorted to; but the more general practice is to suffer the process to proceed, hot as it is, until the first quantity of whey is taken off, a part of which, being set too cool, is then returned into the tub to cool the curd. Within an hour and a half, as already mentioned, if all goes on well, the coagulation will be formed—a point which is determined by gently pressing the surface with the back of the hand, in which test experience is the only guide.

6798. *When the curd is sufficiently firm,* the usual practice is to cut it across with a knife through to the bottom, making the incisions an inch apart, and again crossways and round the sides, slowly and gently in the same manner, for the purpose of causing the whey to rise through, that the curd may sink to the bottom with more ease. After a short time, having taken some of the whey out, the cutting is repeated until the curd is reduced to very small pieces. This operation may require half or three quarters of an hour. The cheese-tub is then covered with a cloth, and is allowed to remain for about a quarter or half an hour for the curd to subside; but, previously, some break the curd as small as possible by the hand.

6799. *To separate the curd from the whey,* part of the latter is taken off with a skimmer; the bottom of the tub is now set a little a-tilt, the curd is collected to the upper side of it, and a board is introduced of a semicircular form, and fitting loosely one half of the tub's bottom. This board is placed on the curd, and a 60 lb. weight upon it to press out the whey, which, draining to the lower side of the tilted tub, is ladled out. This operation of placing the curd under the weighted board is repeated several times, until the whole of the whey is drawn off, and the mass of curd is then turned upside down to undergo the same pressure. The board and weight being removed, the curd is then to be cut into pieces again, and pressed both by the weight and by hand as long as any whey appears to remain. Great attention is required in conducting this part of the business. If the whey is of a slightly greenish colour, it is a proof that the curd has been properly formed; but if it be white, it is equally certain that the coagulation has been imperfect, and that the cheese will be of a poor flavour, and that much caseous substance has been lost in the whey.

6800. *The next process is to transfer the curd to the cheese-vat.* For this purpose, the curd is divided into two or three portions, according to its size, and one is put into a pan and broken extremely fine; and some mix a handful of salt, more or less, with it: this portion is then put into the cheese-vat placed to receive it, on a cheese-ladder over the cheese-tub, a coarse cloth having been first placed over the vat; the other portions of curd are treated in the same manner, and added to the last: this breaking may occupy, perhaps, half an hour if the cheese is large. The curd, in its broken state, is now heaped up above the vat in a somewhat conical or roundish form; and, to prevent it from crumbling down, two or three women turn the corners of the cheese-cloth over it, and gently press the curd together with their hands, until it adheres so much that a board can be placed over it, with a part of the cloth between it and the curd. The whole is then put under a 60 lb. weight, or into a press; and, at the same time, if the cheese is large, it is the practice in Cheshire, but nowhere else, to stick skewers into the cone and into the middle of the curd, through holes in the sides of the vat, to facilitate the escape of the whey when they are drawn out. These skewers are frequently shifted to fresh places; and this operation of breaking, pressing, and skewering is repeated if thought necessary, the operation generally lasting about two or three hours.

6801. *The newly-formed cheese is next taken out of the vat,* and put into a vessel of warm or hot whey for an hour, to harden its skin. On taking it out of the whey, and when it has become cool, it is wiped with a clean, dry, fine cloth, and again put into the vat. As the upper surface of the cheese is still above the edge of the vat, this upper part is bound round with a cheese-fillet, or has a hoop put round it over the cloth that covers the whole of the cheese, to preserve its shape, and the cheese is again submitted to the press for twelve or fourteen hours, when it is well skewered as before: if the press stands near the wall, one half only can be skewered at a time; but this occasions no inconvenience, as the skewers must be frequently shifted, there being numerous holes in the sides of the vat. After remaining in the press for half an hour, the cheese is taken out and turned in the vat with another cheese-cloth; and in this manner it continues in the press for forty-eight hours, being turned several times, and the skewers having been lain aside for the last twelve hours. The process just described is for large cheeses; if the cheese is small or thin, it will not require so much pressing and skewering; but, in cheese-making, the perfect extraction of the whey is a very important part of the process, for, if any is left, it occasions rankness and speedy decay.

6802. *The cheese-press* is of various constructions, but should be so contrived that its force be proportioned to the size of the cheese. Its power may act as a screw, a lever, or a dead weight: the last is the most common, as being the simplest. *a, fig.* 902, rep

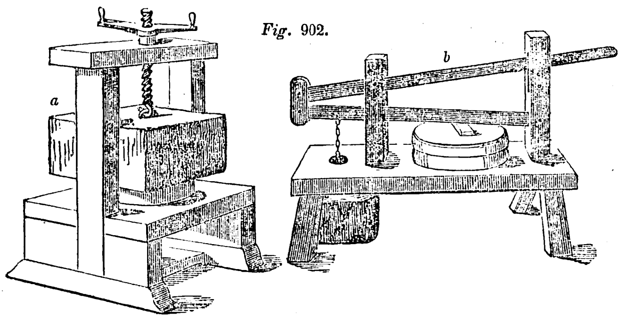


Fig. 902.

resents a cheese-press acting by a weight, consisting of a block of stone raised by a screw, and fixed between uprights that cause it to press level, which is essential to proper pressure. Instead of a single stone, some have a box raised in the same way, but filled with loose stones, which has this advantage, that the weight may be varied at pleasure. *b, fig.* 902, is another press in which the weight is raised by means of a compound lever. Some use a heavy stone, raised and lowered by a tackle.

6803. *The next process is salting the cheese.* For this purpose, in Gloucestershire and Cheshire, it is taken out of the press, and placed nearly mid-deep in the salting-tub for three days, its upper surface being covered all over with salt; or, instead of this, some rub the sides and edges of the cheese with finely-powdered salt. The salting is thus performed after the cheese is made; but in Scotland and some other places the salt is minutely mixed with the curd previous to its being put into the vat. Both practices appear to be equally successful; but the latter is least troublesome, and occasions less waste of salt. Although we have mentioned three days for salting, this must depend upon the size of the cheese, and the time must be varied by experience. Too much salt is unpleasant, and with too little the cheese will not keep. The cheeses, after being salted, are returned to the vats without the cloths, and are again pressed. They are then to be well wiped, and dried for about a week.

6804. *The cheese, being at last completed, is now to be placed in the cheese-room.* This may be a loft, and should be airy and dry: it should be fitted up with proper shelves for the cheese; or, if on a small scale, a cheese-rack may be suspended to receive them, made to lower by a rope and winch. The cheese should be turned three times a week for some time. If they are liable to a kind of blistering, called heaving, occasioned by a slight fermentation, and the formation of air in the interior, the latter may be discharged by pricking them pretty deep in the blistered places, and removing them for a time into a cooler situation. A preventive is to rub on a powder, sold in the shops under the name of *cheese powder*, composed of nitre and bole armeniac: this is put on before the salting, and sometimes proves serviceable; but, if too much be applied, it gives the cheese an acid taste, and actually increases the evil it was intended to prevent. The cheese-room must be kept of a certain temperature; too great warmth will make the cheeses sweat and lose their oily parts, and too much air, or the rays of the sun, would dry them too fast, and make them crack: a medium temperature and ventilation is best.

6805. *The difference in cheese,* not only of different countries, but of different districts in the same country, is very remarkable, and is not yet well accounted for, nor have sufficiently numerous and accurate experiments been made to determine all the circumstances that are most favourable to its manufacture. It is said that little or no improvement has been made of late in the manufacture of cheese.

6806. *The whey formed in making cheese* is generally employed in England to fatten pigs, and is sometimes conducted by leaden pipes into an underground cistern near the pig-styes, where it is raised by a pump when wanted. In some places, however, they first set it by to throw up a sort of cream, from which they make whey butter, which is much inferior to milk butter. Others put the whey on a smart fire, and, when near boiling, mix it with a quantity of butter-milk, and these *flectings*, or *flit milk*, as it is called, form curds, which are skimmed off so long as they arise, and are used as agreeable food.

CHAPTER VI.

POULTRY.

6807. *The term poultry includes* the common fowl, the turkey, goose, duck, guinea-fowl, and tame pheasant. Each of these requires peculiar treatment, which we must describe separately. In Book VII., Chap. V., "On Food," we mentioned the peculiarities of these different birds, and to this we refer the reader; what remains to be treated of is the manner of rearing them.

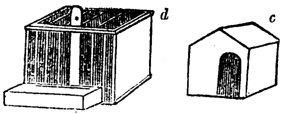
6808. *In some places, a poultry-house* is built large enough to contain all these animals, and this is often found an agreeable as well as useful addition to a mansion, affording an opportunity of observing their habits. Some poultry-houses have been fitted up on a considerable scale, consisting of various compartments, each species of bird being placed in circumstances suited to its nature and habits; and each compartment, besides, including separate divisions for feeding, roosting, incubation, and rearing. Among the most extensive of these, we may refer to that at Lord Penrhyn's, at Wilmington, in Cheshire, which consists of a handsome building 140 feet in length, built of bricks covered with closely-jointed slate, pointed and sanded. It has an extensive court or yard, with colonnades, pavilions, and a pond, the whole being kept in a state of the most perfect cleanliness; others have been erected at Mr. Wakefield's, near Liverpool, at Mr. England's, Aberdeen, &c. How much of the excellences of these first rate constructions are attainable on a small scale will depend upon the taste of the owner, and other circumstances; but although a small collection may be kept in one place, yet the principle of separating each species should not be lost sight of, and it will be found proper to give them different habitations, according to their several habits.

SECT. I.—COMMON FOWLS.

6809. The variety of this bird most usually kept, and the most useful, upon the whole, is the *barn-door fowl*, or common dunghill cock and hen, which are of the middle size, and very hardy. The *Dorking fowl*, with large bodies, short legs, with five claws on each foot, furnish the largest and finest capons, and also lay the largest eggs. *Game fowls* are remarkably delicate in their flesh, and their eggs, though the smallest, are by many preferred. The *Polish fowl*, of a shining black, with crowns of white feathers, resemble the Dorking in their general qualities. The general method of managing them is nearly the same.

6810. *The hen-house* should be on a very dry soil, as nothing is so injurious to the fowls as damp; the place where they are kept should be properly drained, the house paved with brick, and the yard covered with some sound material, as brick rubbish, with sand and gravel, perhaps with a foundation of concrete. Poultry are often confined in a dark, close, diminutive hovel, which is injurious to their health; on the contrary, they should have an airy, well-ventilated place constructed for them, with a yard for exercise. A few hens, for laying only, are easily kept over an out-house, in a convenient situation. Warmth is very essential to fowls, cold rendering them torpid, retarding and diminishing their laying; but too much heat enfeebles them. White hens are more tender, and require to be kept warmer than the dark coloured. It is desirable that the walls of the poultry-house should, if possible, receive a little heat from a chimney or flue in some part of the dwelling, which in some cases may be effected with a little contrivance; and it is not well that the poultry-house should be too large for the number of fowls, as they rather prefer being a little crowded together, on account of the warmth they receive from each other; but ventilation should not be neglected, as bad air generates disease. The walls are best of brick, and may be built hollow, the better to confine the heat; a window is best to the east, and another to the west, with wired lattices, and shutters to close in very cold weather. Roosting-perches or rails should be placed in convenient situations in the poultry-house; and they should not be round nor smooth, but nearly square, and somewhat rough, of a size suitable to be grasped by the claws of the fowls. It is important that every part of the building should be finished close, without crevices, to prevent the entrance of vermin, and the inside should be frequently whitewashed with hot lime; it is necessary to observe that the utmost cleanliness is requisite in a poultry-house. The litter of the nests and the dung should be frequently removed, for no poultry can thrive where this is neglected; the brick floor should be washed every week.

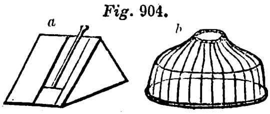
Fig. 903.



6811. *Coops* for fattening, *d, fig.* 903, are likewise requisite, with a trough before for food.

6812. *Nests* are sometimes fixtures, and may be built against the wall, either in one tier or several, according to the number of fowls and the size of the house. When there is more than one tier, each of those above the ground must have a projecting shelf at the bottom for the fowls to reach the nests by, and a slanting board leading to it, with slips of wood nailed on. Moveable nests, *c, fig.* 903, are also occasionally useful. These nests should be well cleaned out with hot lime water after every hatching, to destroy the fleas which infest poultry, and which are not only annoying to them, but also to visiters. It is sometimes necessary to separate some fowls from the rest; such as those which are diseased, which are liable to be ill treated by the rest, as also strangers, and fowls of particular breeds. Coops and cages are useful for this purpose, which may be made in various ways, as *a* and *b, fig.* 904.

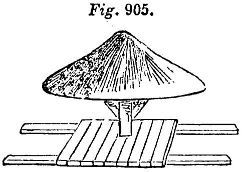
Fig. 904.



6813. *Pens* also may be provided, made of lattice-work, each for a cock and four or five hens to be in during the day, to enjoy the fresh air, and yet be protected from bad weather; and these may serve instead of a poultry-yard when but a few fowls are kept.

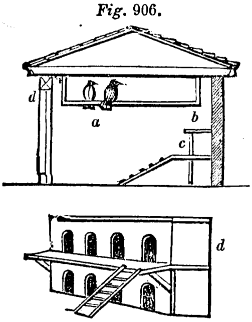
Places for shelter, in case of rain, are necessary to be provided, and *fig.* 905 represents a portable shelter, which can be placed where it is most convenient. In short, it is of great use to make their abode not only healthy, but agreeable to them, in order that they may remain stationary and quiet, and lay and sit when it is desired; as fowls, if they are dissatisfied with their position, are apt to lay in secret places, where it is not always easy to discover their eggs. Among other conveniences in the poultry-yard, there should be small plots of grass or clover planted here and there, if there is space enough, and a few heaps of gravel, sand, or ashes, for the fowls to roll themselves in and cleanse their feathers from vermin.

Fig. 905.



6814. *Fig.* 906 *is a transverse section, showing the interior arrangement of a poultry-house* on a moderate scale, which is found convenient. A row of laying nests, *c*, arranged along the wall, is shown in perspective at *d*, with a shelf before, and a sloping board to ascend to them; there may be breeding boxes beneath. The perches or roosting places are several bars, *a b*, suspended from the timbers of the roof, and a sloping board may assist the fowls to get up to them. The door, *d*, may be high, for the benefit of ventilation when it is opened, and there should be an aperture in the opposite side, immediately below the ceiling, with a regulator. The door should have an opening, also, at the bottom, for the egress and ingress of the poultry, but only just large enough to admit them. Sometimes the place of roosting is distinct from that where the laying and breeding nests are put.

Fig. 906.



6815. *Poultry eat a great variety of food:* all kinds of grain and seeds, and preparations made from them; also most sorts of vegetables, raw or boiled; and they are fond of a certain quantity of animal food, raw or cooked; insects and worms, grubs and maggots, they search for and devour with avidity, and some persons collect these on purpose for them. Potatoes form some of the most economical food; but it is essential not only that these should be boiled or steamed, but that they are given *warm*, for fowls dislike them if cold. In many houses there are many well-known scraps and refuse that will serve for fowls, such as crumbs of bread, fragments of pies and puddings, and even bits of meat and fish, and vegetables, such as lettuce, endive, cabbage, spinach, turnips, carrots, chickweed, and grass. It is generally necessary to give them some kind of grain, as wheat, barley, oats, rye, buckwheat, and maize, or meal made from them into a paste with water. Rice they are fond of at first, but soon tire of it; and much oats, Mowbray says, is apt to scour. Pease and beans are best boiled, and some recommend boiling barley also; but that does not appear to be necessary.

Fowls do not judge so much by taste and smell as by the eye in distinguishing their food, which, when first swallowed, passes into their crop, and, after being there macerated, goes into the funnel-stomach, and then into the gizzard, in which, being a strong sac of the nature almost of gristle, the food is subjected to a powerful trituration, as in a mill, this appearing to answer the same purpose as the teeth of quadrupeds. To assist this effect fowls pick up and swallow many small pebbles and stones; and it is proper to lay some of them about in the place where they are kept. It is proper, likewise, to scatter some lime rubbish, as this earth is necessary to supply the calcareous matter which forms the shell of their eggs. The water given to them should be of the purest kind, for foul or bad water is sure to cause disease.

6816. *The expense of feeding chickens to a condition fit for the table*, according to a statement in the 6th vol of the "Agricultural Magazine," would appear to be very inconsiderable, independently of the trouble and attention required. It is there stated that three pounds of meal of any kind, that will not cost above a penny a pound, made into a paste with water, is sufficient, with such scraps and crumbs as may be easily set aside in a house, to feed and fatten a chicken from the time it bursts its shell till it is fit for the table. It is also said that old fowls, even though fed with food for which money proportionate to the just market value must be paid, will, by their eggs, pay annually at least three times the cost of their subsistence, besides the advantage of the manure which is afforded.

If highly fed from the nest, chickens will be always fit for the table; and pullets which have been hatched in March will lay plentifully through the following autumn and winter, and may be got ready for the table in February, when their laying is finished. High feeding shows itself not only in the size and flesh of the fowls, but in the weight and substantial goodness of their eggs.

6817. *The fattening of poultry*, like that of all other animals, depends upon receiving more nourishing food than ordinarily. In a farm-yard they will thrive upon the common run of the yard, with such offals as may occur from the house or stables. At threshing time they get particularly fat, owing to the plentiful supply of corn, and then they are styled *barn-door fowls*, which are considered by some as the most delicate and high flavoured of all others, both from the full allowance of the best food, and the constant health in which they are kept, by living in a natural state, and having their full enjoyment of air and exercise. The same advantages may be obtained from a good poultry-yard, and feeding them in a similar manner. But there is likewise an artificial mode of fattening that is generally practised, not only by those who bring up poultry for sale, but by others. In this method the poultry not only receive plenty of the most nourishing food, but they are prevented from having their usual exercise, which naturally induces obesity.

In Mr. Wakefield's establishment the poultry were fattened successfully with steamed or roasted potatoes given *warm* three or four times a day; the chickens and pullets, after having been brought to condition in the yard, were confined in dry, well-ventilated coops, and covered in, so as to prevent the entrance of too much light. In this mode of fattening, in general, they are kept in coops so confined that they can scarcely turn themselves, and the food is varied sometimes in different places according to custom. Keeping them in the dark appears to be an important part of the process, but they must likewise be kept clean, and each fowl by itself. Besides potatoes, boiled barley, or meal made into thick gruel with milk or water, or mixed with potatoes, or any of the farinaceous foods which have been mentioned, as pea and bean meal, are particularly fattening. Confinement for ten days or a fortnight in this way will be sufficient for effecting the fattening of chickens. When kept too long, and made too fat, disease ensues.

6818. *Chickens and fowls are fattened for the market usually by the process called cramming*, which is forcing the food down their throats either in pellets or by means of a cramming funnel. For this purpose, in those counties of England most famous for fattening poultry, as Sussex, and Berks, and Essex, various kinds of food have been used, such as ground oats made into gruel, mixed with hog's grease or mutton suet, sugar, hot liquor, and milk; or ground oats, treacle, and suet; also sheeps' pluck, &c.; a mixture of meal made of barley, wheat, millet, maize, and the like, soaked in milk; or oatmeal and water with milk. These are the least objectionable materials; but it is said that poulterers employ likewise animal garbage, which can scarcely produce wholesome flesh. In our Section "On Food," Book VII., Chap. V., Sect. II., where we treated of poultry, some observations by Mr. Mowbray will be found on the probable effects of cramming, which we need not repeat; at the same time, it may be observed that, provided the health of the fowls does not suffer by this mode of feeding, and if only the materials we have mentioned are employed, there may not, perhaps, be much objection to this mode of fattening.

6819. *Capons fatten better than other fowls*, and the operation of making capons is practised by persons who make a trade of it; and is generally best to employ them when they can be had. They are put up in coops to fatten, and are not allowed to go into the yard, as the other poultry would destroy them. They are not subject to moulting.

6820. *One of the principal objects in the keeping of poultry by a private family is to have fresh eggs.* The time for the hens laying eggs depends much upon the warmth in which they are kept, and, therefore, in general, on the season. Cold retards or prevents this, and hence the scarcity of eggs in winter. There are two periods of the year when poultry lay most: these are spring and autumn. The approach of the time for laying is denoted by the hen's cackling, which she does three or four times before she begins; and she then appears very restless, seeking about for a place to lay in, which, after some time, she will choose; but she will require then to be well watched, and means must be employed to induce her to lay in one of the nests prepared for this purpose, for want of which she will be apt to go to some inconvenient place, and it sometimes happens that it is difficult to discover the eggs; but after she has settled herself, she will return again to the same nest. There is a considerable difference in the number of eggs that the different breeds will lay, as well as of the chickens in each breed. Some hens will lay an egg every day; others, one every other day; and others, only one in every three days. The best hens for laying are generally considered to be the dark-coloured, black, brown, or tawny russet; the white are not so good. Pullets, in their first year, if early birds, will probably lay as many eggs as ever after; but the eggs are small; and such young hens are unsteady sitters. The best layers are the Poland breed; the Dorking are likewise good; the latter are remarkable for their tameness and good temper, and possess every good quality required in a small stock. Hens are in their prime at three years old, and after four or five years old they lay unfrequently, and cease altogether on becoming very fat: it is not advantageous to keep them after that period. The eggs should be removed each day as they are laid, as they are liable to be spoiled by the warmth of the hen. They are best kept for a short time in bran, with the large end uppermost: some recommend their being turned every day, but this is useless labour, as the yolk cannot be displaced except the membranes give way or become relaxed by the eggs becoming very stale. For the best methods of preserving eggs for a long time, see "Preservation of Food," Book X., Sect. IX. The chief secret of having new-laid eggs in the winter season is to keep the hens very warm and comfortable, feeding them on cooked food, and to have them young, or, at least, early in moulting, so that the renewal of their feathers may take place in the beginning of winter.

6821. *Moulting.*—Hens, after they begin to lay, continue to do so mostly through the summer, and they cease through the natural process of *moulting*, or casting their feathers, which they do once a year. This is a critical time for all birds; they are usually more or less ill during this time, and poultry are then unfit for the table or for breeding. In moulting, the new feathers grow, forcing out the old ones, and all the nutriment is necessary for the growth of the feathers. The moulting season is later with old fowls than with young ones, and it continues to occur later and later every year as the fowls advance in life; it lasts from one to three months, according to the age and strength of the bird. Young poultry under three years old shed their feathers in the spring; but this period, for full-grown fowls, begins in the autumn. Old hens, therefore, cannot be depended upon for eggs in the winter, such being scarcely full of feathers until Christmas; and these do not begin to lay again until April, producing at last, perhaps, not above twenty or thirty eggs. In general, it is most profitable to dispose of hens while they are yet eatable, or saleable for that purpose, which is the spring of the third year.

6822. *Hatching.*—The females of most birds are disposed to hatch their eggs as soon as they are laid. Hens form an exception, for they may be induced to lay all the summer by removing their eggs before they show any signs of a disposition to sit. This appears at last by a clucking well known to those accustomed to poultry. Hens vary much with respect to their fitness for hatching, and it is remarked that the best layers are generally the worst sitters; it is therefore important, for breeding, to select such hens as are known to be patient and assiduous in sitting on their eggs. It is best, if possible, to select from your own eggs, as most to be depended upon; they ought never to be above three weeks or a month old; they should be nearly of one size, and quite perfect. Some persons are so particular as to mark with ink on the eggs the time they were laid, and it is proper to make an entry in a book of the date when they are set to be hatched. The usual number of eggs placed in the nest is from nine to fifteen, according to the size of the hen. In preparing the nest, short, soft straw should be used, for, if the straw is long, the hen is apt to draw it out with her claws and disturb the eggs. The nest and eggs being ready, the hen should be gently placed upon them and covered with a cloth till she is perfectly quiet. The period of incubation is twenty-one days; and care should be taken that she is not disturbed by any accident, also that the place is warm and quiet: repose and darkness are favourable. The best age of a hen for hatching is from two to five years old. Pullets under two years are too young for that purpose; and the month of February is the best for hatching, though any time from that till October is good; but with proper management a brood may be had at any time of the year. Some recommend that the food should be placed so close to the nest that the hen can feed without leaving it; but it is better, perhaps, to place it at a small distance, as a little exercise is good for the hen. Some will sit so close as to be thought in danger of starving; but that is best left to nature in general. The hens should at this time have plenty of clean water, as they generally drink a great deal. Sometimes they break some of their eggs by accident; when this happens, the broken eggs should be at once removed. The hen instinctively turns her eggs frequently, that every part may receive equal warmth; and this is best left to her management. In some hens the desire of incubation is so powerful that they will sit several times in the year; others will only sit once or twice in the season. Advantage must be taken of the several qualities of being good breeders or layers.

6823. *The young chick*, when hatched, lies in the egg, rolled up like a ball, with its bill under the right wing, and begins generally on the morning of the twenty-second day to break its way out; this it usually does successfully; but it sometimes happens that it cannot extricate itself, and may require assistance, which must be given with much precaution, and does not often succeed. The parental affection of the hen, as Mowbray and Parmentier have remarked, is always intensely increased when she first hears the voice of the chicks through the shells, and the strokes of their little bills against them. The signs of a need of assistance are observed to be the eggs being partly pecked, and the efforts of the chicken discontinued for five or six hours. The shell may then be broken cautiously, and the body of the chicken carefully separated from the viscous fluid which lines it. It is the opinion of Reaumur that no aid ought to be given to any chickens but those which have been near twenty-four hours employed without success.

6824. *The chickens, when hatched,* should, after an hour or two, be removed into a basket lined with wool or soft hay, and kept in a moderate degree of warmth; and, if the weather be cold, near a fire. They require no food for many hours, sometimes even twenty-four. When the whole brood is hatched, the hen is to be placed under a coop, upon a dry spot, with the young chickens. Several different broods should not be within reach of each other, lest they should mix, and the hens maim or destroy those that do not belong to them; nor should they be placed near young fowls, which will be likely to crush them under their feet. The first food should be eggs boiled hard and chopped small, boiled rice, split grits, or oatmeal: watery food, as soaked bread or potatoes, is improper at first. As they gain strength, in a few days, bread soaked in milk, and boiled or roasted potatoes, may be added. Their water should be pure, and often renewed: there are convenient pans made in such forms that the chickens may drink without getting into the water, which often, by wetting their feet and feathers, numbs and injures them. A basin full of water whelmed in the midst of a pan of water will answer the end. Most of the disorders of chickens arise from their getting cold and wet. There is no necessity for cooping the brood more than a few days, but they may be suffered to go out into some small enclosed place for some time before they are trusted in the yard.

In about fifteen or twenty days the hen may conduct them there, and it is highly interesting to see what pride and satisfaction she appears to feel in her young brood, and what solicitude she shows for them. Artificial means may be employed to induce hens to sit when they show no natural disposition; and thus a brood of chickens may be produced at any time of the year. These means depend chiefly upon keeping her on the eggs in a nest or hatching box in a dark, warm place, confining her there by tying her with a string or some gentle means, and giving her a little stimulating food, such as toast steeped in ale.

6825. *It is well known that chickens can be hatched by artificial heat* without a hen. This is practised to a great extent in Egypt, and the method has been imitated on a smaller scale successfully in various parts of Europe; lately by steam, as at an exhibition in London. Although sufficient has been done to prove the perfect practicability of the process, yet it does not appear that in this climate, at least, it could be carried into effect with profit; nor is it, of course, likely to become general, though an extremely interesting experiment. We have already stated the method adopted by Bonnemain in France, which was nearly the same as that employed here lately, only that pipes of hot water were employed by him instead of steam to warm the little chamber in which the eggs were placed.

6826. *The persons whose business it is to look after the poultry* should have been accustomed to live in the country, and should be regular in feeding, keeping them clean, and giving them every other attention; they should be of a mild disposition, should study the habits of the various fowls, strive to please them, and maintain peace among them, as they soon learn to know those who treat them well. The fowls should be carefully watched as to their number, and whether they are gaining or losing condition, what kind of food they relish most, and what agrees best with them. They should be turned out in the morning, according to the weather, and shut up in the evening, at regular times.

6827. *The good health of fowls may be known* by the fresh and florid colour of the comb, and the brightness and dryness of the eyes, the nostrils being free from any discharge, and the gloss of the plumage. The indications of old age are, paleness of the combs and gills, dullness of colour, and a sort of stiffness in the feathers, length and size of talons, and the scales upon the legs becoming large and prominent.

6828. *Fowls are liable to several diseases,* as the pip, roup, fever, rheumatic and inflammatory diseases, besides various others. These have hitherto been little studied, perhaps from the small value of fowls, which offers little inducement to take much pains in their case. It is necessary that those who have the care of them should be acquainted with the most popular remedies, but our limits will not allow us to go into the subject, for which no written directions would avail without experience. Some valuable observations are contained in Mr. Dickson's work "On Poultry."

6829. *With respect to the supply of the market with poultry,* it is remarked that "in most of our farm-houses and cottages in England the poultry are very indifferently accommodated with shelter and food, and large farmers breed only for their own use. On the Continent such quantities are reared, that they are very nearly as cheap as butchers' meat, so that the table of the Londoners are, in a great measure, supplied from France."

SECT. II.—TURKEYS.

6830. Turkeys are more delicate and difficult to rear than common poultry, and preserve something of the wild habits of the original bird in a disposition to wander from home. They have a dislike to be shut up in close places, and the roosting bars in houses appropriated to them should be placed as high as convenient from the ground, being made also much thicker than those for fowls.

6831. *Their food*, in a domesticated state, is the same as that of common poultry, and they consume a great deal; if left at at liberty at a farm-house, they often destroy much of the corn, trampling more under their feet than they eat; they require, therefore, to be kept in some enclosure.

6832. *Turkeys lay* in March; some every day, others every other day. The eggs are fifteen or twenty in number, of a dull cream colour, with reddish speckles. The time of laying is indicated by the vivacity, haughty strut, and peculiar note of the hen, which requires them to be watched, for they are very apt to steal away from home, and lay in some secret place; when this is discovered, the eggs must be brought back, and they must be made to lay in the proper place. To prevent their laying from home, they should be fed by hand in the morning before they go out, and those that are going to lay should be kept back. One turkey cock is sufficient for several hens; where there are more than one, they generally fight.

6833. *The hens begin to sit in April*, and they then cluck like a common fowl. A nest must be prepared of a circular pad of straw, about fifteen inches in diameter, with some bruised straw within. The number of eggs they sit upon is usually eleven or thirteen, and the time of hatching is between twenty-five and thirty days. They are easily made to sit, and are patient sitters. They will also sit anywhere in the house, as in the corner of a back kitchen; but they make inattentive mothers, for they will sometimes straggle a great way over the fields, dragging the young brood after them; and, in consequence, frequently some of the young get left behind, and are lost.

6834. *The young, when just hatched*, are very tender, and require to be kept warm. Some have recommended giving them cordials of various kinds at first, but this is not necessary: the best way is to leave them quiet in the nest to the care of the mother for a day or two, after which they may be put into a basket, or on the ground, as may be found to suit their strength and the weather. When they begin to eat, they should be fed with bread moistened with water or milk. Some recommend a strong paste made of meal of barley, pease, or maize, mixed with chives chopped small, or nettles, or parsley, according to local resources; this is made into balls about the size of a turkey's egg, and held in the hand, or laid in flat cakes on stones, for the young ones to pick at till they are satisfied. Curd, eggs boiled hard, and boiled meat torn in shreds, are likewise given. Meanwhile the hen should be cooped, or put under a kind of cage or crate, such as earthen-ware is packed in, lest she should rob the young of their food. When she is kept in this manner, the young chicks can run about, without wandering too far, and return to her call. They should be fed several times a day, and water should be given as directed for common poultry. They should be accustomed to the open air gradually, at first two hours in the sunshine; and during the first six weeks they should not be allowed to stray from home, but, with the mother, they should be confined to the vicinity of a shed, where they can find shelter in case of rain or cold winds, which are very injurious to them. Or, if they are permitted to cater for themselves in the fields or about the hedges, which they are fond of doing, they should be attended by a boy or girl, who will bring them home again before the dew falls. The mother does not, like common fowls, seek food for them by scratching and other contrivances, nor teach them to do so; therefore the young require more care: some have put a few common fowl's eggs under the turkey with her own, that the chickens hatched from them may set an example to the turkey chicks in looking out for food; others cram the turkey chicks; but this is a bad practice.

6835. *The young, when about two months old, are termed turkey poults*; at that time the membranes on the neck and head shoot out and become of a flesh-red colour; this is called *shooting the red*, and is a critical change in the turkey's life, more so even than moulting. They then require particular care, and to have the best food. After that they may go about into whatever place their mothers are allowed. If there are any woods near, where they are safe, or can be looked after, they are fond of frequenting there, and picking up fallen acorns, beach wart, or wild fruits of any kind, corn in gleaning time, or insects; but a scorching sun, as well as rain, is fatal to turkey poults.

6836. *Turkey poults, which some prefer to the full-grown birds, are fattened for the table* when about six months old, and for this purpose the food which is usually given consists of farinaceous materials, such as soddened barley or wheat, or meal of any grain, boiled with kitchen stuff, or dregs of melted tallow or fat, together with various pot-herbs and potatoes; but their food being much the same as that of common fowls, much oily substances impart a disagreeable flavour to the flesh. Some persons, to save the trouble of breeding turkeys, buy the poults in the market, and fatten them at home by the various scraps left in the house. A fine turkey, when fattened, will weigh fourteen or fifteen pounds when ready for cooking, though it will weigh from twenty to twenty-five pounds when alive. It may be observed, the *turkey cock* is so pugnacious and troublesome a bird, particularly to children, that many object to having one about the house. But though quarrelsome, the turkey is a cowardly bird: they are swift runners, but in their domesticated state are but indifferent flyers: their remarkable antipathy to red is well known, and their strut and pomposity are proverbial.

SECT. III.—GEESE.

6837. *The varieties of the goose are numerous*, but the common domesticated kind is distinguished by the colour, as being white or gray. The one most esteemed is the large Embden white. Geese should not be kept so as to have access to other poultry, being very pugnacious, which harasses the rest. They may be bred on a common, or on marshy ground, as they feed much on grass ; but they should not be suffered to range about the house and grounds, as they are very destructive to gardens and farm crops, preserves, and orchards. Access to water is essential.

Geese and ducks, being nearly of similar habits, may be lodged in the same house, having separate places for laying, sitting, and fattening.

6838. *If kept in the poultry-yard*, they are fed on grain, refuse vegetables, boiled potatoes, warm, or with the meal of oats, pease, beans, or maize, mixed with potatoes, carrots, or turnips. In the harvest, the stubble-field of corn is a proper place to turn them into. They are voracious feeders, and are rather expensive to bring up in a yard only: grass seems to be essential to them.

6839. *Geese begin to lay early in the spring*, generally in March ; and the sign of hens being about to lay is their carrying straws to make a nest with. They require to be watched at this time, lest they should lay in some inconvenient place ; and a nest should be of prepared straw, lined with hair, and made deep ; when once the goose can be induced to lay in it, she will continue to do so. She lays from eight to twelve eggs before she sits ; but if the eggs are removed as soon as laid, a goose may, by plentiful food, be made to lay from twenty to fifty eggs.

6840. *The goose sits thirty days*, and the gander generally remains near her nest, as if for a guard. They should have plenty of food and water near them, that they may not remain long off the nests, and let their eggs get cool. From fifteen to twenty eggs are as many as the goose can cover. The turkey hen is sometimes employed to hatch them ; and sometimes a common hen is made to perform the same office with eight or nine eggs, when it is required not to interrupt the goose from laying.

6841. *When any of the goslings are hatched*, some take them out of the nest, and keep them in a basket with wool until the whole brood has come out, when all should be put under the care of the mother, until they are sufficiently strong to follow her with ease, which they will in a few days. They are fed at first on crumbs of bread soaked in milk, grits, wheat, barley, or oats, coarsely ground, bran, or pollard, and lettuce leaves. The mother may have the same food, but with more corn.

6842. *Geese are fattened* either in their young state, or when they are a month or six weeks old, when they are termed *green geese*, or after they have attained their full growth. The methods for both are nearly the same. They will generally get sufficiently fat if they have the run of the stubble on a farm, but they may likewise be easily made fat by confining them in coops, and feeding well on steamed potatoes, mixed with any kind of bruised or ground grain, pea or bean meal, pollard, milk, &c., made into a paste, giving them, at the same time, plenty of water. The best time for fattening grown geese is in November, or when the cold weather begins ; if put off longer, the pairing season approaches, and prevents their becoming fat. As one of the principles of fattening consists in depriving animals of exercise, this has been carried, on the Continent, to an extravagant length ; and methods have been put into practice which must be branded with the appellation of cruelty ; but, as we do not wish to see these imitated, we avoid describing them.

SECT. IV.—DUCKS.

6843. Ducks being, in a great measure, aquatic birds, will not thrive unless there be a piece of water of some kind for them to swim, or, at least, to dip in, and it is useless without this to attempt keeping them. They ought to have a place separated from ordinary poultry, on account of the great difference in their habits. The wild duck, or mallard, common in many parts of the kingdom, is the original of our domestic breed, of which there are several varieties, though it is not usual to keep more than two or three of these for the table, the rest being only for ornament or curiosity. The tame variety, which is the most common, is the *Rhone duck*, originally from France, which is of larger size than the wild, and high flavoured. The English, or Aylesbury white duck, is milder in flavour, which some prefer, and numbers of them are bred in Buckinghamshire for the London market, on account of their size. The Muscovy duck is not uncommon in a domesticated state, but it is of a different species from the others, and, though it breeds with them, the offspring is a hybrid.

6844. *The best situation for ducks* is where there is a piece of water in pleasure grounds, considerable enough to have a small island, on which may be planted rushes, osiers, and other aquatic plants and shrubs, among which the ducks are fond of rubbing ; and they will breed there, and become so wild that they must be taken by snares or nets. They are likewise reared in abundance about the house, where there is a small pond, and, besides, being easily kept and fattened, have the advantage of being ready for the spit as soon as killed. Although we have stated that a pond or piece of water of some kind is necessary, yet a few ducks may be kept by having merely a shallow tub sunk in a corner of the yard, in which they may dip and wash themselves.

6845. *The food of ducks* is extremely various, and they are, therefore, not difficult to provide for. They will eat all kinds of grain, and every sort of mealy substance, particularly potatoes, as likewise herbage, roots, and fruits, provided they are soft enough. They also devour the offal of animal substances, and are very fond of seeking among the mud of water for worms, insects, and vermin, such as slugs, frogs, &c.; in short, scarcely anything comes amiss to their voracious appetites. As they do not scratch up the soil, they may be sent into the garden, when the dew is on the ground in the morning and evening, to pick up the slugs and snails, which they will do without injuring the borders.

6846. *Ducks begin to lay* in February, or even earlier, and will sometimes lay as many as fifty or more eggs, if these are taken from them before they show a disposition to hatch. They are very apt to lay away from home, and require careful watching; nor are they so easily brought to lay in their proper nests as common fowls. To prevent their wandering, it will be proper to feed them in the laying season in a particular place three or four times a day, observing that the better they are fed the more they will lay, provided they are not made too fat.

6847. *Ducks, when domesticated, are not so well disposed to hatch as hens*, and there is sometimes a little trouble in getting them to sit; when they do, they must have their food placed near, otherwise they are apt to neglect their eggs; and as soon as the young ones are hatched, which is generally in about thirty days, the mother takes them to the water, where they dabble before they have acquired sufficient strength, and often perish, if the weather be cold. On this account, it is a common practice to have ducks' eggs hatched by common fowls, which show more assiduity and patience in sitting. As these mothers have no propensity to go to the water, the young breed gets a little hardy before they are allowed to take to it. But such is their natural instinct, that, although not taught to do so by the nurse, no sooner do they see a piece of water than they plunge into it, to the great alarm of their foster mother, who cannot follow them, and whose warning and anxiety they disregard. This exhibition of natural feeling is so painful to some persons, that they object to have young ducks hatched except by their own species. From eight to ten eggs is the utmost that the ducks can cover. Light-coloured ducks produce white eggs, which are not easily distinguished from those of the hen, but the eggs of dark ducks are of a bluish-green colour. If sitting ducks are given eggs not of their own colour, they will sometimes turn them out of the nest.

6848. *Young ducklings* are hardy, and need not be taken from the mother; it is best to secure both under a coop for eight or ten days, to strengthen them before they take to the water. Their food for the first few days may be bread soaked in milk, and then they may have a paste of meal of any kind, with nettle leaves boiled and chopped. When they have a little more strength, a mash of bran soaked in water, with barley, acorns, or potatoes boiled, together with pot-herbs, may be given, and a little fish may be added to this. From the most tender age, ducklings exhibit great voracity, and eat almost any food that is given to them. They should likewise have a pan of water to dabble in. As one of the natural habits of the duck is to *sift* its food out of water, it is a good mode of feeding young ducklings to throw some oats or other grain into a shallow vessel of water, and to allow them to gather it up, which they appear to take more pleasure in than if it is given to them dry.

6849. *To fatten ducks*, the same principle must be followed as in other poultry; they must be regularly fed with the best food, and kept quiet. As they are greedy, but not nice feeders, various kinds of food are employed; boiled potatoes mixed with oatmeal or bruised oats are found economical and effectual; barley should not be given, as it is said to destroy their flavour. Acorns, when they can be had, are a favourite food with them, and very fattening: malt is likewise highly recommended. When fattened on animal substances, which are very expeditious in accomplishing the business, some are of opinion that the flesh is not so delicate, somewhat resembling that of the wild duck.

Sect. V.—Pigeon-House and Pigeons.

6850. The pigeon-house, or dove-cot, is not so much a favourite appendage to a mansion as formerly, perhaps from the destruction by these birds of the neighbouring crops; but on a small scale, or when they are well fed in the house, this objection may disappear. Some account of the various species of pigeons, and of their qualities as food, will be found in Book VII., Chap. V., to which we refer the reader. We shall here consider the method of breeding them, and their management in the dove-cot.

6851. *The common domestic or house pigeon* runs also into several varieties, commonly called *fancy pigeons*, which are kept for sale by persons who breed them for purposes of amusement only.

Of these, the *carrier* is perhaps the most remarkable. Though removed from their homes to a considerable distance in covered baskets, yet, when let loose, they will find their way back with unerring instinct. This faculty is well known to be employed fo various purposes, as for conveying intelligence in a rapid manner, and even for stock-jobbing purposes. The *pouter* forms another variety, distinguished by its large, distended crop and grotesque attitudes: it is the tamest and most familiar of them all. The *tumbler* has beautiful plumage, and his name is derived from the singular manner in which he tumbles over and over in descending from a great height in the air. Some sorts of fancy pigeons sell for very large sums when very perfect and of rare breeds.

6852. *To stock a pigeon-house*, it is proper to obtain the young birds, called *squeakers*, which are in the best condition in two seasons, May and August; the last is said to be preferable for stock. The common house-pigeon partakes so much of the character of the carrier, that it is difficult to keep old birds in any other place than where they are reared, being known to fly back again and find their way home, even when removed with every precaution; and it becomes necessary, therefore, to procure the young before they have acquired any attachment for locality. The male pigeon is distinguished from the female by his superior size, and he attaches himself to one female only, being proverbial for constancy.

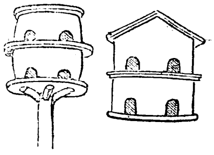
6853. *The pigeon lays two eggs*, which, when hatched, produce a bird of each sex. Having laid one egg, she rests a day before she lays the other, and then proceeds to sit. The period of incubation is about fifteen or twenty days, and the male and female sit alternately, the former in the day, while the female is seeking refreshment abroad: both are equally industrious in procuring food for their young. When the young ones are hatched they require only warmth for the first three days, and the mother during that time never leaves them. Pigeons produce two or three broods in a year.

6854. *Their manner of feeding their young is remarkable.* The old ones swallow their food, consisting of pease and various seeds, and fill their crops, which are the largest in proportion of any birds, and after the food has remained there until it is macerated or softened, and half digested into a sort of pulp, they have the power of forcing it up at will and ejecting it into the opened bills of the young ones, whom they generally feed in this manner three times a day. They continue this mode of feeding for a week or ten days, and then they gradually add food of a harder kind. While so fed by the old ones the young are called *squabs*, which are most in demand for pies; in the next month they are able to shift for themselves, and until they are six months old they are termed squeakers.

6855. *Pigeons live almost entirely on grain and pulse*, but will sometimes likewise eat aromatic vegetables; their power of digestion is very great, and they consume a large quantity of food. To procure it, they fly over a considerable space of ground, and are very destructive to crops at seed time; it is therefore hard upon farmers that persons should be allowed to keep many pigeons without having land of their own. If left at liberty, they will procure food for themselves; but if confined, they must be fed. The best way is to feed them well in the dove-cot, both to keep them at home and prevent their doing injury to the crops. If well fed, they will afford young for the table every month in the year. It is recommended, where there is danger of their destroying crops, to take all the young of the spring brood, or feed them in the house, only suffering the August brood to go abroad, when the crops are off the ground. In general, pigeons live about eight years, but they are only prolific for the first four years; afterward they are worth nothing; and when they are past that age they only prevent the profit that might be reaped from those that are young. It is somewhat difficult, and requires considerable experience, to distinguish their age.

6856. *Pigeon-houses, or dove-cots*, are of several kinds. A small one may be made of a cask, or any boarded box, placed upon a pole or against a wall. A larger one may be a loft in some outhouse, or a house may be built on purpose, or the highest part of any tower or ornamental building may be designed as a pigeon-house. The holes by which they enter should not be too large or too numerous, and should have a little shelf at the entrance; they should have a southern aspect, as pigeons delight in the sun. Great care should be taken to guard against the entrance of rats, which are dangerous enemies. An objection to wooden dove-cots is, that they are too cold in winter and too hot in summer; but this may be in a great measure prevented by making the wood double, with a space of two or three inches between, which will form a nonconductor of heat. The holes should have a piece of weather-boarding over them to keep out the wet.

Fig. 905.



6857. *The interior of the pigeon-house* must have cells for nests; and these may be made by putting up shelves of wood, stone, or slate twenty inches wide and one foot apart, the spaces between being divided by upright partitions three feet from each other. Across the front of each nest there should be a board of three inches wide, sliding up and down in a groove, to prevent the young ones from falling out, which they are apt to do; by having this board moveable, the nests may be cleaned out occasionally. As tame pigeons seldom take the trouble to make any nest themselves, it is proper to make some for them of hay or straw, to be put into the cells; a kind of basket is best. It is recommended to fix a partition of similar height in the middle of each three feet division, thus parting it into two nests: this is to prevent the young from running to the mother when she is sitting over fresh eggs, and perhaps occasion her to cool and addle them; for sometimes, when the young are about a fortnight old, the female, without waiting till they are fledged, will leave them to the care of the male, and lay again; and it is not uncommon to see a fresh hatching going on while the young ones are in the same nest. When the young ones are taken the nests should be cleaned out, and they should be frequently examined, lest any of the young ones should die in the holes, as they will become putrid, and produce maggots and bad smell. Every summer, after the first or spring flight of young, the nests should be thoroughly cleaned out and the dung removed. This should be done in the morning, and the dove-cot should never be entered later than midday; if disturbed in the afternoon, the pigeons will be discontented all night, and perhaps will sit outside, while their eggs are spoiling. The inside of the house should be well plastered, to keep out vermin. Pigeons are generally fed in the open air, adjoining their cot; but when the weather is inclement, or when it is desirable to attach them to their house, both food and water should be given them in it: for this purpose, a small hopper may be fixed outside, from which the food, being put in, can descend into a shallow box within. Pease, the smaller kind of horse-beans, wheat, barley, buckwheat, and oats are eaten by pigeons; pease are the best: old tares are considered excellent food; new tares are reckoned scouring. Water may be supplied in a similar manner by a small bottle of water reversed in a small basin, in the manner of the common bird fountain.

6858. *Pigeons require to have fine sifted gravel*, or coarse sand, as they are in the habit of picking it up to assist their digestion; and if that is not supplied to them, they are apt to peck the mortar from the roofs of their houses or adjoining buildings. The usual mode of supplying them is to place what is termed a *salt-cat* in or close to the pigeon-house. This salt-cat is a jar, with holes punched in the side sufficiently large for the pigeons to get out with their bills the following mixture put into it: a gallon of fine gravel or drift sand; another of lime rubbish of an old wall, or, if none be at hand, lime mixed with sand; a pound of cummin seed, and a handful of salt; the latter two of which pigeons are very fond of; the whole is moistened with stale urine. Strong scents, such as asafœtida, are said to be agreeable to these birds, so as frequently to attach them to their habitations when they will not stay under other circumstances.

6859. *Cleanliness is essential* to the health of pigeons; a neglect of it will cause them to be covered with vermin. The common house-pigeon is little liable to disease, although fancy pigeons, being monstrous productions, are particularly so. Little is known respecting any modes of curing them.

6860. *Laws respecting Pigeons.*—Shooting, or destroying pigeons by any other means, is punishable by a fine of 20*s*. for every bird killed or taken. Any lord of the manor, or freeholder, may build a pigeon-house upon his own land, but a tenant cannot do it without the lord's license. Shooting or killing within a certain distance of the pigeon-house renders the person liable to a forfeiture.

Sect. VI.—Guinea Fowls.

6861. This bird, retaining somewhat of the wild nature of the original, which was from Africa, is apt to wander from home, and of course cannot be so conveniently kept as common fowls. They are remarkably shy, and are apt to forsake their nests if disturbed; but in general their habits and mode of treatment resemble that of the turkey. There are several varieties, but being rather difficult to rear in our climate, and being noisy and turbulent in the poultry-yard, they are seldom kept, and generally more for curiosity than use, though they are excellent for the table, and their eggs, though small, are particularly good. They can seldom be brought either to roost or lay in any house. Like the peahen, they dislike confinement, and generally choose some shed, tree, or bush for their roosting place and nest.

Sect. VII.—Swans.

6862. Tame swans are never kept except there be a piece of water for them to swim in, to which they are a great ornament; and it is necessary that the water should be clear, towards keeping it in which condition they assist. In its food it is very similar to the goose. The swan lays early in the spring, only once a year, and has seldom more than three eggs. The male assists in hatching. They require little attention in breeding, except a small house for their young, for they usually build their nests in some secluded spot near the water, and prefer an island if there is one. They should not be disturbed; and, indeed, so powerful are they, that a stroke of their wing might have a serious effect. The cygnets are dark coloured when first hatched, and do not become white till their second year. Their bringing up is left to the mother, and may or may not have food supplied, according to the locality. They have sometimes been fattened in the same manner as green geese, by those who choose to try them at table: in severe weather, in winter, they require being fed.

SECT. VIII.—PEACOCKS AND PEAHENS.

6863. The pea-fowl require the same treatment as turkeys. Though formerly brought to table, they are not eaten now, their flesh being coarse and ill-flavoured; they are, therefore, kept only for ornament. The tail, which is so eminently beautiful, comes to its full size when the bird is three years old; and some peacocks live twenty years. They subsist on the same food as domestic fowls, but prefer barley; and though they are very destructive in gardens, yet they are useful in destroying all kinds of reptiles. In her hatching, the hen has the same habits as the turkey, and the pea-chicks are extremely tender. It is necessary to keep the peacock from having access to the young, as he is apt to kill them; and he will kill young chickens in the same way.

SECT. IX.—PHEASANTS.

6864. As this bird has not hitherto been perfectly domesticated, and as the flesh of those brought up in the house is much inferior to that of the wild pheasant, they are bred chiefly for show only, for the park, or for very recluse scenes, which they will not readily leave if well fed and not much disturbed. Their beautiful plumage renders them very interesting.

6865. *To stock a pheasantry*, the general mode is to procure eggs from some establishment of this sort, or sometimes they are found in the woods: these are set under a hen that has kept the nest three or four days; a bantam is best. When the hens have sat their full time, which is from twenty-three to twenty-seven days, the young pheasants as they are hatched should be put into a basket with a piece of flannel; after the first day they should be put under a frame with a net over it, with a separate place for the mother: they should be fed with boiled eggs cut small, boiled milk and bread, alum curd, ants' eggs; a little of each sort, and often. After two or three days they will be acquainted with the call of the hen that hatched them, and may have their liberty to run about, observing to keep them out of the sun and the cold winds. It is proper to choose a situation for a pheasantry where they may be well protected from dogs, foxes, &c. Those young birds that are intended to be turned out wild should be taught to perch, by tying a string to the hen's leg, and obliging her to sit in a tree all night, till she becomes accustomed to this situation. The young birds will follow the hen and perch with her. Those for breeding are to be put into a pen, having their wings clipped: such as are to be turned out are put into another pen, netted over, and having their wings untouched. When first penned, the birds must be fed with dough of barley meal, corn, and plenty of green turnips. As the birds are fond of ants' eggs, some should be procured, if possible; and some persons make artificial ones by rolling flour beaten up with an egg. Great cleanliness must be observed with respect to pheasants.

Hen pheasants seldom succeed in rearing their brood, through their extreme shyness; but, to induce them to do so, a retired place must be provided, well sheltered by trees, and having a supply of water. Pheasants appear to show great partiality for marshes near the sea, or cliffs with any furz or cover for them, and which join the salt water; for, like pigeons, they are great lovers of salt. In such advantageous situations, Mr. Daniel says they can be retained plentifully, provided they have abundance of food with perfect quiet; and that, when reared with common fowls, they sometimes become very tame.

SECT. X.—AVIARY.

6866. This is a house for keeping birds that do not come under the description of poultry; such as gold and silver pheasants, partridges, quails, red, black, and wood grouse, turtle-doves, and the rarer pigeons; Muscovy ducks, Canadian geese, bustards, gulls, curious varieties of the fowl, &c.; also singing and other small birds. A large aviary requires an enclosure of some extent—perhaps an acre or two—and in this must be the various houses for the different kinds of birds: these may be small, rustic structures, provided with the conveniences of roosting places, nests, &c. Elegant aviaries may be seen at Woburn Abbey, Bedfordshire; Cobham Hall, in Kent; and Knowlesly Hall, near Liverpool. Some of the birds that are wild require to have small nests or enclosures, covered with netting, to prevent their flying away, and to protect them from birds of prey. The construction of aviaries on a small scale is too evident to require particular description: they must be enclosed with wire netting, and have the usual contrivances for holding food, drink, &c.

CHAPTER VII.

PIGS, AND THEIR MANAGEMENT.

6867. Pigs are not very agreeable to have about a house; and it is therefore desirable that they should be kept out of sight as much as possible, which can only be done where there is some kind of yard. Where cows are kept, it is generally found convenient to have also some pigs. It is well known that the most delicate pork is that produced by feeding pigs on milk and whey from the dairy, with meal; and that it is much superior to any that can be had from the butcher. Nevertheless, if any inexperienced person should set about feeding his pigs for his table, the pork might prove very expensive; and this branch of domestic economy requires some little skill. Even in a farm, hogs are generally considered rather as a subordinate species of live stock, and chiefly valuable as consuming what would otherwise be lost: there is one advantage which this animal has, which is, that his keep usually costs little, and is not attended with much trouble to those accustomed to them.

6868. *There are various breeds of swine*, and some fatten more readily upon the same food than others; and the breeds vary considerably in their size. Those which are reckoned the best of the small kind are the Berkshire and the small Essex, or the latter crossed by the Chinese. Of larger hogs, for bacon, the Hampshire, the Norfolk, and the Cheshire are the principal; and, as porkers, the Suffolk, Essex, and Oxfordshire are among the best. The long-legged Irish pigs are considered to be the worst.

6869. *In purchasing pigs for fattening*, it is not always easy to procure the very best breeds; but some of the others may do very well. The sow should be at least ten months old before she is fit to breed from: she goes with young a little more than four months, and has often two litters in a year, generally producing a numerous progeny, consisting of from eight to sixteen at a litter. Hogs, when suffered to see the natural term of life, live from fifteen to thirty years. Their size and strength continue to improve till they are five or six years old. The best season for their farrowing is in the summer, as young pigs are exceedingly tender and difficult to rear in the cold of winter.

6870. *Pigs are very troublesome in cultivated grounds*, ploughing them up with their snouts in search of wild roots, of which they are fond. To prevent them from turning up the soil, the best method is to cut the two strong tendons of their snouts with a sharp knife, about an inch and a half from the nose; this may be done with little pain and no prejudice to the animal when about two or three months old. The common practice of restraining them by rings fixed in the snout is painful and troublesome; these must be replaced as often as they give way, and that happens so frequently that rings afford little security against this nuisance.

6871. *The piggery should be so situated* as not to be offensive, and yet be easily supplied with food from the scullery and dairy. Each animal requires to have a separate sty, which should open into a little court or area, for exercise, and to hold his feeding trough. The large piggery erected by the Earl of Egremont is said to be one of the most complete in the kingdom.

6872. *The pig-sty* may be built of any convenient material: stone or brick are the best. It should be dry and warm; and for this purpose the floor is best paved with large stones, and should be raised a little above the ground, and slope a little towards a channel conducting the wet into a drain leading to a cess-pool or manure tank: one of the usual defects of pig-sties is the neglect of proper drainage. The roof may be thatched with straw, reeds, heath, or any other warm material. Every piggery should have a rubbing-post for the animals to clean themselves against. When circumstances permit the pigs to have access to a field, or an orchard, or wood, where they can find fruits and vegetables of various kinds, it is of great advantage to their health.

6873. *When a sow is expected to farrow*, she should be separated from the rest, and littered down with a small quantity of dry, short straw; but if too much straw is used when she has young, the latter are apt to nestle under it and be smothered by the dam. Sows should likewise be carefully watched for some days after farrowing, as they are apt to eat their offspring: she ought to be well fed while nursing. The young pigs are generally weaned at the end of six or seven weeks: and, when sows are weaning, they ought to be kept low, and allowed to wallow in wet, as they are at that time very subject to a milk fever.

6874. *Cleanliness should be observed as much as possible with respect to pigs*, although it is an opinion not uncommon among some country people that changing the litter and cleaning the sties protract the time of the animal's arriving at his required degree of fatness; and that filth contributes to his health and prosperity. This opinion is fully contradicted by experiment. Although pigs in general are not clean in their usual habits, yet few domestic animals are more pleased when they have clean, comfortable beds, and certainly none on which cleanliness has a more evidently beneficial effect, so far as feeding and fattening are concerned. Pigs are particularly liable to disorders of the skin, and to vermin, probably from their gross feeding; and cleanliness assists very much to remove these. It is good management to give them occasionally a little sulphur and nitre with their meat: when first put up to feed, some add a small portion of antimony. Some pigs are liable to inflammatory disorders, which are seldom curable. To prevent this, some wash and scrub them every week.

6875. *The pig is a voracious animal*, gross in his feeding, and almost omnivorous. He will devour animal matter, but it is chiefly on vegetable food that he is fed. He will graze, eat cabbage leaves, common and Swedish turnips or turnip tops, carrots, parsnips, and mangel-wurzel: potatoes afford him much nutriment, but should never be given raw, but always boiled, and the water in which they were boiled should be thrown away. Besides this, all the peelings and refuse of potatoes, cabbages, and other vegetables, and greasy slops from the scullery, are made up into a mash for the pigs; and there should be a spout leading out of the wall of that place conveying it into proper receptacles for carrying it to the hog cistern or trough. Pigs will thrive and be in tolerably good condition when kept upon food of this kind; but besides this, there is another stage in his feeding, which is *fattening* him for the butcher. For this, food of a more nourishing quality is requisite; and farinaceous food is found to be more fattening, such as barley meal, pea meal, and buckwheat; these are boiled with milk, or mixed with other kinds of food. If pigs are suffered to gorge themselves with food, they are liable to have surfeit and indigestion, which is removed by abstinence for a day, or giving nothing but a warm mash, with bran or pollard.

6876. *In fattening sucking pigs*, all that is requisite is to keep the mother well lodged and nourished. *Weaned pigs*, when to be fatted, are to be kept constantly on whey, or skim-milk, or butter-milk, with frequently an addition of pease, or beans, or barley meal. Such good keeping makes them increase rapidly in size, and renders them fit for use at an early age.

6877. *When pigs are of a proper age to fatten for pork or bacon*, they are kept in the sty, and well fed with the best food. This must vary somewhat according to circumstances; but certain kinds of food are usually employed for this purpose. Milk, whey, and scullery wash, with steamed potatoes, meal of barley, pease and beans boiled with milk, are all fattening materials; also Swedish turnips and carrots boiled or steamed. Potatoes, if raw, are of little use to fatten, and hence the inferiority of the greatest part of the Irish bacon that comes to market; they are much more nutritive if boiled. Grains from the distiller are likewise used where they can be obtained; and here it may be proper to notice an error respecting the last. It is a general idea that distillers' grains are the cause of a constant intoxication of the pigs, and hence that their flesh cannot be healthy; but it is a mistake to suppose that there is any spirit left in the grains; observation has shown that pigs fed upon such food are quite as healthy as any other. Bacon, however, fatted upon porridge of barley meal and skim-milk, is the finest.

A pig may be fattened in about six weeks or two months. Young porkers are generally fattened between October and Christmas; if fed on boiled pease or beans, or meal from them, for the last fortnight, the flesh and fat will be firmer. A little salt sprinkled with their food will often make them relish it better. There is no necessity that the wash from the scullery should be always given fresh; on the contrary, pigs seem to prefer that which has been accumulated, and kept a little so as to be stale or sourish, and perhaps beginning to ferment, on which account some recommend having several tubs or cisterns to collect it in, so that one may be emptying while another is filling.

6878. *The hog cistern* for containing the wash is best made of stone or slate; wooden vessels are liable to decay, and lead is dangerous. Some have been made of brick and Roman cement, or bricks laid in strong ferruginous clay, lined with a coat of the same, so as to be perfectly water-tight. A slanting shed roof should be placed over them, and it may be sunk in the ground with advantage, to prevent freezing in winter.

The feeding trough ought to be kept very clean, and frequently washed out with hot water.

6879. *Where a single cow is kept, much cannot be expected from her for the pigs;* and yet many a cottager contrives with that, and the refuse of his garden, with offal of his kitchen, not only to keep one, and perhaps two, but to fatten them tolerably. When little more than potatoes are employed to fatten, the quantities requisite have been stated thus: To feed a pork pig of 8 stone, or 128 lbs. weight, allowing a peck a day in 15½ bushels, very little oatmeal or barley meal will be necessary. A pork pig of 6 stone, or 96 lbs., may be fattened by 11½ bushels of potatoes at 1 peck a day. A bacon pig of 20 stone, or 320 lbs., will require 38 bushels of potatoes, and a load of oatmeal or 16 stone weight. With one cow, two pigs may be kept with good management.

CHAPTER VIII.

RABBITS.

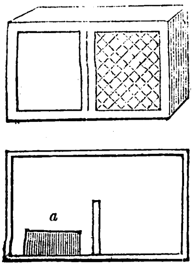
6880. Rabbits are not only kept in a domestic state, but also largely in a wild state in warrens, particularly in sandy districts. A warren is an enclosed piece of ground where the rabbits live in holes which they burrow beneath the surface, as it exists naturally; or in banks raised artificially for the purpose: level ground is not fit for a warren, these animals, in their native state, delighting to burrow in the sides of sandy hills. It is essential that the soil should be dry, sandy and poor; a damp situation will be fatal to the stock, as they are very liable to the rot; and too rich herbage is unfavourable to their health. In the winter season, when the weather is severe, food must be supplied to them, consisting of green hay, turnips, and other vegetables. The wild rabbits are taken in the warrens by nets or traps, and sometimes by terriers: they are in season from the end of October to the beginning of January, and are better as food than tame rabbits. There is seldom any other variety kept in warrens than the gray. Vast numbers of these wild rabbits are sent to the London markets in the winter months, and sold at a very cheap rate.

6881. *Tame rabbits* are reared in rabbit-houses, or in hutches: there are several varieties of them; the large white and yellow species, and a larger variety of the hare colour. These and other varieties may be had of the London dealers and poultrymen.

6882. *The doe will breed* at the age of a year, and sometimes in six months, and her period of gestation is thirty or thirty-one days. Some days before parturition hay is to be given her to assist in making her bed, to which she adds the flue which nature has instructed her to tear from her body for that purpose; forming this bed is the first sign of pregnancy. There are generally from five to ten produced at a litter, but if any of these appear defective or sickly, they are usually destroyed, five being as many as she can well rear: at the end of six weeks they may be separated from her and weaned. The buck should be kept at a distance while she is nursing the young, or he will kill them. Should the doe be weakly during nursing, it is common to give her more nourishing food than usual. With due attention in keeping them warm and feeding them well, rabbits may be bred throughout the whole year, though four or five litters may be considered sufficient.

6883. *The rabbits' hutches*, in which they are kept, are wooden houses, *fig.* 906, two feet six inches or three feet wide, and one foot six inches high, divided into two by a partition within that has an opening forming a communication between them; the use of this division is, that the rabbits may be confined in one while the other is being cleaned out, which must be done frequently, otherwise the animals will become diseased. Each division should have a door, and one of them may be wired or fitted with bars an inch apart, two of which should be moveable, to put in food. The food is put into a trough, *a*, which should be of pewter, iron, or earthenware, as rabbits are apt to gnaw them when of wood. Their grass and greens may be laid on the floor. These hutches are ranged in the rabbit room along the wall a few feet from the floor, or in any other way that may be found convenient, the apartment not being always intended for the rabbits to run about in; though some prefer this, if there are but few.

Fig. 906.



6884. *The food of the rabbit* is entirely vegetable. They feed upon common grass, clover, lucern, and on good hay, and pea and bean straw; greens and roots form excellent food, and potatoes boiled or steamed. They will fatten upon them, but still more if they are given corn and pollard. Some think that the flesh is less dry when fed chiefly upon succulent herbs; but with these moist foods they must always have a proportionable quantity of the dry foods, as hay, bread, oats, bran, grains, chaff, and the like, or they will become pot-bellied, and die. This food may be given three times a day; and when they have greens, they must not have drink; at all times they drink but little The test of health is their dung being not too moist.

6885. *Rabbits are in perfection for feeding* at the fourth or sixth month, or much less sometimes, if they are given farinaceous food.

6886. *The diseases of rabbits* are not numerous, if moderately taken care of; keeping them too much on green food will, as has been stated, cause them to be pot-bellied, the cure for which is changing their diet by giving them hay and corn, ground malt, or pease, or any farinaceous food. They are also liable to liver complaints, which are incurable Fattening should not be pushed too far, otherwise they will sometimes drop off suddenly.

CHAPTER IX.

APIARY, AND MANAGEMENT OF BEES.

6887. The natural history of bees, with their divisions into queens, drones, and working bees, is so interesting that it has been treated of in an ample manner in a variety of popular books: it is not necessary to repeat it here, and we refer the reader, for the nature of honey and wax, and the manner of their production by the bee, to Book VIII., Chap. XIV., "On Honey," and to Book IV., Chap. II., "On Wax." We propose at present to confine ourselves to the methods of managing and preserving the stock of bees in their hives. In modern times, the importance of bees has suffered a considerable diminution in consequence of the introduction of sugar; still, this part of our economy is cultivated with considerable care, and improvements have lately been made in it.

6888. *The locality and particular situation* where it is proposed to keep bees must be considered with reference to their natural food, and whether it is likely to be in sufficient abundance. The spot selected for placing the hives should be well sheltered, and have a southerly aspect, with garden herbs, and flowers, if possible, in the vicinity. Foul smells and loud noises have been thought annoying to bees, and hence it is deemed advisable never to place them in the neighbourhood of forges, pig-sties, and the like. This opinion with respect to noises, however, is doubtful, since they do not appear to be furnished with the organs of hearing.

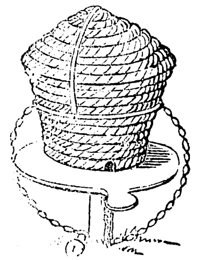
6889. The advancement of agriculture, and the consequent decrease of wild flowers, with the enclosure of wastes and commons, have been unfavourable to the keeping of bees; and in an arable country, with good farming, few stocks can be supported. Near large tracts of heath land, where the flowers of the heather furnish an ample supply of food, bees generally thrive. In Germany and Switzerland it is not uncommon to transport bee-hives into these places during the summer season; this change of situation is effected in some parts of France by means of boats on the rivers. Bees are supposed to range a mile or two in quest of food.

6890. *To establish an apiary*, it is necessary to procure, by purchase or otherwise, a hive of bees, or as many as are required to commence with. Common straw hives with bees will be sufficient. The hives should be selected by a skilful person in a cool evening, or very early in the morning: the spring is the best season: he will be able to form a tolerably good idea whether or not a hive is full of bees and combs by tapping on it. The hives may be easily moved by placing a square board under each, and putting it upon a cloth, which is to be drawn up all round it; then carrying it upon a man's head. When brought home, the hives may be placed on stands, or in a bee-house; this may be a wooden closet raised on feet, and having doors opening in the front and sides; it may be four feet wide and six feet high, with three shelves, each large enough to hold two hives, with a slanting roof to turn the wet. The holes for the entrance of the bees should be three inches long and a quarter of an inch high, with a little shelf before each, for the bees to light upon.

6891. *Bees require a warm temperature*; and it is said that neither the larvæ nor chrysalis will live in cold of 60°. They appear to have the faculty of perceiving the approach of cold weather and rain, and even while busy abroad at their work, they will suddenly leave off, and hurry home in crowds, till the doors of their habitations can scarcely admit them fast enough; and they are seldom caught in a shower, unless at a great distance from the hive. Cold is a great enemy to them; and in this climate their hives must be kept well sheltered and warm: to defend themselves against it in a hard winter, they crowd together in the middle of the hive, and buzz about, exciting a warmth that may be perceptible by laying the hand upon the glass window of the hive. Sometimes, in very cold winters, they form clusters, hanging on each other, and continue for some time in a torpid state. When they appear to be dead with cold, they may be frequently revived by laying them on a cloth at a distance from the fire, or by applying artificial heat to them in some other mode. Mild winters, as well as severe cold, are often injurious; sunshine in winter tempts them to go abroad, and exposes them to a change of weather.

6892. *Bee-hives* have been made of various forms: the common form answers in general, is well known, and easiest procured. Hinsh recommends that represented in *fig.* 907. Instead of having three or four legs, as is usually the case, a single one is preferable, as being a better protection from vermin and insects: the hive may be chained down and locked. It should be placed about two feet from the ground when on a separate stand. The fittest material is straw, which affords the best defence against the extremes of heat in summer and cold in winter; this is, in general, preferable to wood, though some ingenious kinds have been constructed of this substance. Hives, with glass, have been made for the purpose of studying the habits of the bee, but only with this view. A superior kind has been invented by Mr. Nutt, and is described in his work on bees. The size of the hives should correspond, as nearly as possible, with that of the swarms. Bees will endeavour to fill with combs whatever hive they are put into before they begin to gather honey. Owing to this, when a hive is too large for its inhabitants, the time for collecting their winter store is spent in unprofitable labour, and starvation is the consequence. This evil also extends to occasioning late swarming the next summer; it being long before the hive becomes so filled with young bees as to produce a necessity for emigration, from which cause the season is too far advanced for the young colonies to procure a winter stock. A full-sized straw hive will hold three pecks; a small-sized one from one and a half to two pecks.

Fig. 907.



When there are many hives, it is usual to collect them together in a bee-house, or apiary, for the greater facility of protecting them from the cold or thieves, and greater facility in examining their condition and progress. It may consist of a wooden closet, as above mentioned, or merely a simple recess in a wall exposed to the south, and with shutters to exclude the sun occasionally in summer and the cold in winter. The hives are often placed in the kitchen garden, where they are considered as useful, by aiding the impregnation of flowers.

6893. *The swarming of bees* generally commences in June; in some seasons earlier, and in cold climates or seasons later. It is preceded by their hanging in a kind of string. Hives should, if possible, be placed in the neighbourhood of gooseberry or currant bushes, rather than of large trees, as the bees are sure to fly to the first tree they can find.

When the bees are observed hanging together in a string, they should be carefully watched till the swarm has settled, which it generally does on a bush or tree, when a new, clean hive should be brought and placed over the bees for them to go up into; or the swarm should be swept into the hive, which must be immediately carried to the place where it is to stand. It sometimes happens that the swarm will leave the old hive and return again several times, owing to the queen not having accompanied them, or from her having dropped on the ground, when too young and weak to fly to a distance. It was formerly the practice to wash the hive with beer, or sugar and water, and, after the bees were hived, to let it stand till evening before it was removed to the place where it was to remain; but both these practices are now thought unnecessary, and the latter even injurious. Should the weather, for some days after swarming, be unfavourable for the bees' going out, they must be fed with care until it clears up, otherwise the young swarm will run a risk of dying.

6894. *The honey is taken from the hive* in two different modes. The most ancient, and still the most usual mode, is by suffocating the bees, which is done in the following manner, in the autumn, generally in October: Linen rags smeared with melted sulphur are introduced to the hive by placing it in a hole in the ground, where a few shreds of this article are undergoing a smothering combustion; or the full hive may be placed on an empty one inverted, and the sulphureous smoke introduced by a fumigating bellows. The bees will fall from the upper to the lower hive in a few minutes, when they may be removed and buried, to prevent resuscitation. The combs, being thus cleared of bees, may be cut out. Although this practice has been mentioned as cruel, it is, in fact, not more so than any other way of killing animals for food, and it would be impossible to preserve all the swarms, as the bees would multiply too fast. However, where the preservation of the lives of the bees is an object, another method is employed, by which only a part of the honey is taken, about September. It is effected as follows: Having ascertained the weight of the hive, and determined on the quantity of honey-comb that is to be extracted, begin the operation as soon as evening sets in, by inverting the full hive, and placing an empty one of exactly the same diameter over it. A table-cloth must be tied round the whole, to prevent the bees from molesting the operator. The hives being thus arranged, beat the sides gently with a stick, particularly in those parts to which the combs are attached, which are parallel with the entrance of the hive. The bees will then ascend in a few minutes into the upper hive, which will be known by a loud humming noise; or this transfer of bees may be effected by a slight fumigation with burned paper. When the whole community has ascended, the hive with the bees may be placed upon the pedestal from which the full hive was removed, and that from which the bees have been driven may be taken into the house to have the comb extracted. Particular care must be taken to cut out only one comb at a time; not to take too much. Having thus obtained a sufficient quantity, the hive may be placed over that containing the bees, which must be reversed, and both left in that position until the next morning, when the bees will be found to have taken possession of their former hive; and if the season proves fair, they will be able to make another quantity of comb and honey equal to what they lost. If the honey is taken early in the season, immediately after the first swarm, the whole of it may be cut out, and the bees, being returned into the emptied hive, will, perhaps, be able to make honey enough afterward for their winter stock; but it is to be observed that, in this case, the hive cannot be expected to be full of honey, because the bees, in June and July, are chiefly occupied in breeding, and by this method one, if not two swarms are lost. Various other contrivances have been invented for taking the honey without destroying the bees, but their description would demand more details than our limits will allow, and we must refer the reader to works written expressly on the subject, as Bagster on Bees, 1834; and Nutt's work on the same.

By managing the temperature of the hives, Nutt prevents young bees from being produced, and, consequently, no swarms can take place, which often occasion so much trouble. It appears that under a certain degree of heat the queen will lay no eggs, nor would they be hatched, although the collecting and storing of honey will go on at this low degree of heat; the hives are, therefore, kept cool by ventilation. That ventilation is important to the health of the bees there can be no doubt; but the swarming being natural to bees, it is impossible altogether to prevent it. There is some difference of opinion respecting the utility of Nutt's boxes, the advantages of which are thought to be exaggerated, though they are certainly more elegant and convenient than the common ones, where amusement chiefly is the object.

6895. *To protect the ordinary hives from the cold*, they are covered with a thatch of straw or rushes about the end of September, according to the climate and season. This is very essential, and well-covered hives are always in a better condition the following spring than such as have not been covered. In October, the aperture at which the bees enter should generally be narrowed, so as only to admit of one bee passing at a time. Indeed, a very small portion of air is sufficient for them in winter, when they are mostly in a torpid state; and it were better for them, during severe frosts, to be entirely shut up, as numbers are often lost from being enticed to quit the hive during the sunshine of a winter day. It will be proper to remove, by a crooked wire, the dead bees and other filth, which the living at this season are unable to perform of themselves. To the hives whose stock of honey was sufficient for their maintenance, or those to which a proper quantity of sugar had been given for that purpose, no farther attention will be necessary until the breeding season arrives; this, in warm situations, generally takes place about the beginning of May; and in cold, about a month after. The young bees, for a short time previous to their leaving their cells, and some time after, require being fed with the same regularity that young birds are by their parents; and if the store in the hive be exhausted, and the weather such as not to admit of the working bees going abroad to collect food in sufficient quantity for themselves and their brood, instinct impels them to kill and throw out some of the larvæ. To prevent such accidents, it is advisable, if during the breeding season it should rain for two successive days, to feed all the bees indiscriminately, as it would be difficult to ascertain only those which required it.

6896. *It is sometimes necessary to supply the bees with food early in the spring*, should they have consumed their winter's stock, or if kept during the winter, after their honey is taken. This should not be deferred too long; the hives should be examined in September, and if a large hive does not weigh thirty pounds, it will be necessary to allow it half a pound of honey, or the same quantity of soft sugar made into sirup, and less in proportion for smaller hives. It is sometimes the practice merely to dissolve sugar in water, but without boiling it into a sirup; but this does not answer properly, for, when the water evaporates, it leaves the sugar to crystallize, and in that state the bees cannot act upon it. A sirup is a closer combination of sugar with water, by which the latter is prevented from flying off, the consistence resembling honey. Some recommend a plate of diluted inferior honey crossed with straws, and covered with a paper pierced with numerous holes, through which the bees will seek the honey without daubing themselves.

6897. *When honey is scarce in the hives* early in the spring or late in the autumn, and there are no flowers to furnish them with more, and the bees have ranged the fields without success, they will endeavour to supply themselves, at the hazard of their lives, from the stores of other bees; and conflicts sometimes occur in consequence of depredations on neighbouring colonies, which frequently terminate fatally to many of their number.

6898. *The best remedy for the sting of the bee* is stated in the Quarterly Review. "Extract at once the sting, which is invariably left behind; if a watch-key is at hand, press it exactly over the wound, so that much of the venom may be squeezed out; and in any case apply, the sooner of course the better, laudanum, or the least drop of spirit of ammonia. Oil and honey, which are also recommended, probably act in keeping off the air from the wound. The cure varies much with the constitutions of individuals; but the poison being acid, any alkali will probably be serviceable."

6899. *Those who wish to amuse themselves with bees* should study their habits; it is remarkable how easily many bee masters can manage them. In particular, they cannot bear to be breathed upon.

CHAPTER X.

FISH PONDS.

6900. It is much less the custom to keep fish in ponds at present than it was in former times, when the Roman Catholic was the established religion of this country, in consequence of which fish was almost an essential article of food two days in the week, and for which reason fish ponds are still very numerous on the Continent. At that time, also, the communication between the seacoast and the inland parts of this kingdom was much more difficult than at present.

The situations in which fish ponds are most easily formed is in a small, narrow, steep valley, through which a stream of water runs. By building a dam across the valley, the water is stopped and collected, and a pond is formed without any farther trouble. Several such ponds may be made by collecting the water that overflows by similar dams lower down, provided there be water enough. In other situations, ponds must be dug, and made water-tight by clay or some other material; a soft, marly, or muddy bottom is best, with a warm exposure.

6901. *The kinds of fresh-water fish generally kept in ponds* are, carp, tench, perch, gudgeon, eel, and pike. Of these carp is the most useful; they multiply fast, and grow to a large size. Under the best system of management three ponds are required, one for breeding, another for rearing, and a third for fattening.

6902. *To stock a pond*, full-grown fish should be put in early in the spring, the season for spawning being from the latter end of May till the beginning of July. When the fish have spawned they should be put into the feeding pond, and the young fry should be left to themselves till the spawning season next year; they are then removed into the rearing pond, where they remain for two years, when they will have grown to the length of four, five, or six inches. This pond is then drawn, and all the fish above five inches are put into the feeding pond, from which the largest are taken as wanted for use. The natural food of carp consists of larvæ of insects, worms, and soft aquati plants; but to obtain these fish of a large size, they are fed in stews in rain-water, on garbage, boiled potatoes, rice, bread, or any soft food. Carp will grow to the weight of three pounds in six years, and six pounds in ten years, and they have been known to exceed that considerably. They are in season from October to April. In very large ponds, such as they have on the Continent, scarcely any food is given. Tench are generally put into the same pond with carp, as is the case in Berkshire, where there are many fish ponds. They will live in foul, stagnant water in which no other fish can exist: this occasions them to have often a muddy taste when cooked for table, except they are kept for about a week previously in clean water. Perch require cleaner water than either carp or tench, and the pond in which they are kept ought to have a stream running through it; but they will thrive in stews if the water is kept clean; they grow sometimes to the size of two feet. Gudgeons are small fish, and, being much inferior to carp or tench, are reared chiefly as food for pike and perch. Eels will live in stagnant water, and require a pond through which there is some current, as mill ponds, but may also be kept in stews; in ponds they are destructive to other fish. The pike is a very voracious fish, and requires to be kept by itself; some grow to the size of several feet; in default of other fish as food, they will devour any small animals.

6903. *Salt-water fish* of several species can be preserved, and even fattened, in fresh-water ponds, particularly the flounder and other flat fish of the genus Pleuronectes, the mullet, &c. Lately some experiments of this kind have been attended with complete success. See Brande's Quarterly Journal, Nos. 33 and 34.

BOOK XXVI.

PRESERVATION OF HEALTH, AND DOMESTIC MEDICINE.

CHAPTER I.

HEALTH IN THE NURSERY.

SECT. I.—GENERAL OBSERVATIONS.

6904. *Health in infancy and childhood* will always form a consideration of deep interest to parents. Their earliest solicitude must always lead them to seek the means of developing in fair proportion all the infantile powers, bodily and mental, of their offspring. These means are comprehended in the term "good nursing," or, in medical language, "physical education." Maternal attention and foresight should always be directed to this subject; for "bad nursing," the mismanagement or neglect of the bodily powers of children, is often the foundation of diseases in infancy, which leave permanent effects in the constitution, or bring forward diseases which might otherwise have always remained latent, thus blighting all the enjoyments of life that result from good health; besides which, so connected are the physical, intellectual, and moral systems of human nature, that in no individual can one of them be impaired without danger to the others. The wisest system of education may never be sufficiently effective to eradicate the evils of "bad nursing."

6905. If any of the following details and observations appear applicable chiefly to the affluent conditions of life, or comparatively useless to those whom pecuniary considerations would restrict in their domestic arrangements, still there will be found suggestions of a general description, and applicable to the common nature of childhood—suggestions which may serve for any sphere of life in which sensible, active mothers devote themselves sufficiently to their maternal duties. Such mothers may bring up as fine, healthy, happy children as the most expensively appointed nursery can display; and even more so, for luxury and indulgence are not in themselves at all favourable in their influences over childhood.

6906. *Children, under all ordinary circumstances,* may be brought up in the wholesome habits of cleanliness and activity; may be taught self-restraint in regard to food; may be encouraged in cheerful, enlivening pursuits; their minds may be awakened to useful observations, even by the simple exercises essential to the development of their bodily organs. These are the principal influences promotive of infant health and vigour; and by these a merciful Providence has rendered the welfare of childhood independent of the gradations in wealth and rank that are caused by the varying circumstances of civilized life. Thus mothers, employing wisely the means of good nursing which nature intrusts to all alike, may look with indifference, as mothers, on the useless appendages and luxuries with which they may be unable to surround their children: may they not also rejoice, if, while their condition denies their children privileges which affluence might yield them, it also screens them from snares and temptations most fatal to their best interests?

Without farther observations, we proceed to details regarding the rearing and management of infancy and childhood—subjects of deep interest to all who have the responsibility of parents.

Sect. II.—Arrangement of Nurseries.

6907. In addition to what has been said in Book III., "On Ventilation," we may add that *nurseries*, or any rooms appropriated to the use of children, should be lofty, airy, dry, light, and cheerful, if possible, and not on the ground floor, where the rooms would be more liable to be damp, and the air altogether less pure, than may be expected in the higher parts of the house. Whenever practicable, children should have their day nursery as well as that in which they sleep, that each room may be in turn thoroughly ventilated. [This and the accompanying suggestions, however valuable to the families of the English nobility, and to those possessed of overgrown wealth in any country, are adapted but to a very inconsiderable number in America. The luxury of both a day nursery and a sleeping nursery, distinct from the apartments occupied by the family, could be provided in few houses in this country, however large. And there are, moreover, valid objections of a moral nature to so complete a separation of infant children from the maternal eye and hand as such arrangements contemplate. The children of the humbler portion of the population, and even of the poor, with all their privations of separate nurseries, are more than compensated for their absence by maternal care, instead of having their nurture performed by proxy, even with the best qualified nurses, a blessing rarely realized, even among the rich. Without detracting from the excellent suggestions of the author, which are meritorious and valuable for those to whose position and circumstances so extensive and expensive a domestic establishment is practicable, we may, nevertheless, felicitate ourselves that, even without separate nurseries, the *ventilation*, *cleanliness*, and *temperature* of the apartments occupied in common for all the purposes of the family, as they are of necessity by multitudes in our crowded cities, may all be secured by the skill and ingenuity of our American housewives. Such mothers abound in our country, who, without "wet nurses, or head nurses, or under nurses, or nursery governesses," train up families of children, whose physical and moral training, and whose exemption from disease and death, would favourably compare with those of parents who can surround their children with this army of nurses, by reason of their wealth, and luxurious self-indulgence, often indulged by such mothers, at the expense of augmenting the fearful bills of infant mortality by the sacrifice of their own offspring.] On this one circumstance health during childhood much depends; for it cannot be preserved wherever fresh air is excluded. In children, impure air brings forward constitutional diseases, which might otherwise have continued latent. Fresh air invigorates and enlivens children; pent-up air weakens and depresses them. Day nurseries should be prepared for the children, by having the windows open early in the morning, whenever the weather admits of it. A short time suffices "to change the air" of the room, to use a common, but not very correct expression. When the children enter it, with its freshness it should brace their young nerves, perhaps relaxed by the pent-up air of their sleeping room, and they will appear in physical happiness to resemble all other young animals, free and sportive. But let them be brought out of one heated and close room into another, and they will evince all the lassitude of which bodily fatigue would occasion them, and that depressed state of their animal spirits which real weakness would cause. Such temporary effects of close-heated rooms would cease to be transient if the cause were to continue; settled indisposition and debility would ensue.

6908. Yet, desirable as fresh air is, there are some precautions to be observed in admitting it into children's rooms. To continued draughts of air no children should be exposed, unless they are running about the room, or in some way actively engaged. While sleeping in their cribs, or sitting down, they should be always sheltered from streams of air. When awakening from sleep (often in a state of perspiration), any sudden check occurring to them from a current of cold air might bring on some inflammatory attack of the lungs or bowels.

6909. *In foggy or rainy weather* nursery windows should be kept closed. In such a state of the weather the admission of air to children's rooms must be through open doors instead of open windows. Also, in the winter, at three o'clock in the afternoon, should every nursery window in day or sleeping room be closed. Night air cannot be safely admitted into nurseries scarcely at any time of the year. Children should not be permitted to sleep in smoky rooms, nor in rooms in which there are no open chimneys. The difficulty of ventilating the latter rooms is great. The air is gradually vitiated, and must be breathed several times, causing feelings of languor and general depression, and operating as a powerful and hurtful sedative to the animal system. (See Book III., "On Ventilation.")

6910. *The temperature of nurseries* is another point requiring regulation. In nurseries, extremes of heat or cold are equally to be avoided. Excess of heat in the air of rooms in which children chiefly live causes in them relaxation of the skin, irritation in the nervous system, extreme susceptibility to cold, and, in the end, general bodily debility. *Heat* constantly acting on the human frame is said to be more destructive to its vital powers than any other external agent. Sometimes children are suffered to remain, perhaps to sleep, in rooms recently scoured, or in which quantities of wet linen are hung to dry before large fires. The evaporation from the wet floors or linen going on more rapidly in an overheated room than in one of lower temperature, still more debilitating effects may be looked for than the heat without the moisture would have produced. A little moisture in a hot room may not be objectionable—it prevents the air from becoming too dry; but in excess, damp adds to the nervous exhaustion caused by overheated air, and renders children who live in such a state of the air not only more susceptible to cold, but even more liable to the diseases incidental to childhood, which are all, more or less, of an inflammatory kind.

6911. *Excess of cold*, on opposite grounds, is not without danger to children. Great heat over-stimulates, excessive cold depresses their nervous energies. The glands of children, who cannot take the vigorous exercise which adults may do, become by severe cold inactive and humid, and the fluids of the body all but stagnant; hence chilblains occur (see "Chilblains"), with other more serious diseases. These observations, if just, render the temperature of nurseries an important point in their management.

The temperature recommended for the sleeping apartments of children is from 60° to 66° of Fahrenheit. In a lower temperature than 60° the life of a very young infant could hardly be sustained. Living in a much higher temperature, its system would be for a time stimulated, and in the end debilitated.

6912. *To cleanliness in nurseries* great attention should be paid, both as it regards the health of children and the habits to be formed in them. *Nurseries* should be swept daily: damp tea leaves sprinkled on the floors before they are swept prevent the dust from rising much above the floor and settling on the furniture. Children, young infants especially, should be removed into other rooms while any sweeping in their nurseries is going on. It cannot be good for them to breathe air filled with particles of dust, nor are the eyes of infants uninjured if exposed to it.

6913. *Nurseries*, in very damp or cold weather, or in winter, should not be scoured weekly; instead of which, the floor should be merely wiped over with a damp flannel, and then rubbed with a hard brush. No children should remain in rooms damp with scouring, for reasons already stated.

6914. *Bedsteads and cradles* should be kept free of dust, and particularly the floors under them. Fleas or other insect annoyances increase whenever this cleanly process is neglected; and as they often cause children to be fretful, from the irritation their bites occasion, any neglect in daily collecting and removing the dust from beneath bedsteads and drawers should never be permitted.

6915. *Children's bedding, blankets*, and *sheets* should be exposed daily to an open window in fine weather, or to a fire in the winter. Bed linen should be changed at least once a fortnight; in many nurseries it is changed once a week. Carpeting in nurseries, it nailed to the floor, should be swept daily, tea leaves being previously sprinkled over them.

6916. *Nurseries, in their fitting-up and furniture*, can scarcely be too simple and plain. A boarded floor, provided it be not old and full of splinters, is in some respects better than a carpeted floor in rooms in which children play and run about.

6917. *Matting* is soon worn out by the incessant treading of children.

6918. *Carpets*, if used in nurseries, should be kept free from dirt, by being often taken up and shaken out of doors, or daily swept.

6919. *The walls of nurseries* are more generally papered than painted. Many persons, however, are in favour of finishing the walls of nurseries by painting them in distemper, that, in case of the infectious diseases incidental to childhood breaking out among children, the walls of their nurseries may be more easily purified from infection than if papered. In the case of scarlet fever, infection seems to linger for months, and even years, in the house in which it has been, and no means are more effectual in getting rid of this evil than that of whitewashing the ceilings, and, if the walls are distempered, of having them also done afresh. It takes but little time to do them, and but a slight expense; otherwise a papered room is, to the eye, preferable to any other mode of covering the walls of children's apartments, and in the present day the expense of papering rooms is as moderate as any other mode of finishing them. Health, however, is to be considered in every thing as the first object in rooms allotted to children.

6920. *Furniture of wood*, in nurseries, should be made as free from angles as possible; tables should have the corners rounded off, that an infant's efforts to run alone may be as little as possible discouraged; and that children may run securely about their nurseries is most desirable, for indolent nurses would often compel them into sedentary habits and pursuits when nature would incite them to active amusements, if there were any necessity to watch them constantly. Above all precautions should be those regarding open windows and fire-places. Nurseries should never be without bars to the one and guards to the other. The agility and caprice in the amusements of children (together with their inexperience of peril, which makes them fearless) often place them in imminent danger, allowing scarcely time for the most vigilant eyes to perceive, or for any one to avoid it; hence no preventive means should be neglected to preserve them from the effects of their own rashness.

6921. *A well-ordered nursery* should be furnished with everything requisite for children's use, distinct from those of the family. The nursery servants having these things in charge to keep clean and in order, much disputing and confusion among the servants generally are thereby prevented. Breakfast and tea things, spoons, tea-kettles, trays, candlesticks, &c.; tin or earthen-ware baths; *night lamps*, over which are suspended small pannikins, in which, at night, the food of weaning or dry-nursed children may be quickly warmed, though some condemn this practice altogether; washing-tables, made of a height suitable to young children; low chairs, and stools, are among the chief things really required in nurseries: additional conveniences and comforts might easily be named, but can scarcely be mentioned as requisites. See wood-cuts of many of the articles of "Furniture for the Nursery," in Book V., Chap. XIV.

6922. *Closets, cupboards, and shelves* should be found in every nursery, that there may be places into which every article not in use may be put away. It is remarkable how strong a love of neatness and order may be inculcated in childhood by neat, orderly habits in the nurseries in which it is reared, to say nothing of the comfort those habits impart to both children and nurses. When the nursery is littered with the things provided for its convenience, children can hardly play or move about without doing some mischief; and being often reproved for the injury thus done, they certainly suffer from carelessness and untidiness not their own.

6923. *Night nurseries* require little furniture beyond bedding and utensils for washing and bathing. *Carpets* many persons decidedly object to have in the sleeping nurseries, using such as may be easily taken up and shaken daily. In illness they should, in all general cases, be removed; hence it may be best seldom to have any but such as can be easily taken up.

6924. *Cribs*, or small bedsteads from three to four or four feet and a half long, and two feet and a half wide, and having rails at the sides, heads, and feet, put into frames which are fitted into grooves, so that they may be drawn out at pleasure, are at present more in use for children's beds, and for various reasons are preferable to the swinging cots. These last were introduced as substitutes for the rocking cradle of wicker-work formerly seen in every nursery; but which, with the swinging cot also, are now very little used. The objection to both arises from the power they give to nurses to overrock infants, according as their own convenience suggests to them, and renders them inattentive to those symptoms which infants evince when they have slept enough; the nurse will often be tempted to apply to the rocker to reinduce sleep in the infant under her charge before seeking into the causes which have disturbed it. But *if rocking cannot* be effected but in her arms or on her knees, it will be for her own comfort, as well as for the good of the infant, to ascertain, previous to any attempt to make it sleep again, whether its wakefulness arise from hunger or pain, from weariness of one posture, or from restlessness occasioned by too much heat of the room or weight of bed-clothing, or the reverse, for children cannot sleep well when either too hot or too cold. To remedy any of these inconveniences to the infant will be, in the end, less troublesome to the nurse than to hush in her arms the roused infant; but the case may be otherwise, and often has been, when the rocking cot has been at hand; the poor child has been then less considered than it ought to have been, and for such reasons the swinging cot, as well as the cradle of old, has almost fallen into merited disuse. Excess of rocking or swinging is on another ground objected to; it is supposed to induce in infants water on the brain; whether this supposition is well founded or not, the other objection previously observed will be sufficient to keep in disuse all rocking cots and cradles.

6925. *The bedding of cribs* should be soft and warm, and the covering as light as it can be consistent with the requisite warmth during cold seasons. After the first year a horse-hair or good flock mattress is better for children than feather beds, unless in cases of delicate, thin children, whose feeble circulation seems to stand in need of more indulgence in warmth than the more robust. But soft feather beds, with high bolsters or pillows, are supposed to admit of children lying in positions unfavourable to the spine, the feathers being too yielding: a mattress, on the contrary, does not give way to any curved position of the child. In mentioning this evil of feather beds, it is proper to remark that curvature of the spine is less the result of position than is usually imagined; and even admitting that feather beds favour it, they do so rather by contributing to a general diseased system than by any facility which they afford to what might be regarded improper positions. The bodies of young animals, left to themselves, never can suffer from such a cause. The superiority, however, of mattresses over feather beds for children is undoubted. In all cases, in hot weather, mattresses must be preferable for children's use to feather beds: in winter only may the latter be more desirable, as before observed, for feeble infants.

6926. *Blankets* for children should be light, soft, and woolly; of such are those which go under the name of Witney blankets. Those of Lancashire manufacture are heavy and close in fabric.

6927. *Sheeting* for children should be of soft linen or fine calico. The latter is now more frequently used than linen; it is less expensive in the purchase, but is not equally economic in regard to its durability. This can be of less moment in children's sheeting than in that for the family use.

6928. *Counterpanes* can scarcely be too light in texture. They should never be used for warmth, but merely as a protection of the blankets from dust and dirt during the day. When warmth is to be added to bed-clothing, it should be by means of additional blankets. The weight of counterpanes is an objection to them in all cases, and particularly for children, whose breathing should not be oppressed by any external covering either by night or by day.

6929. *Hangings and valances* to children's beds are not needful, if cribs are so placed as to be away from streams of air either from windows or doors. There should always be free circulation of air around the beds of sleeping children; and, so far from having valances to the bedsteads, their cribs should stand on legs about a foot and a half above the floor, that the lower currants of air may pass under, and prevent any stagnation of air beneath the beds.

Management of new-born Infants.

[The birth of an infant is an event which, in almost every family, awakens the liveliest interest and the keenest sensibilities of the human heart. Not only the parents and members of the immediate family manifest anxiety and concern for the safety and health of the little stranger, but the nurse is a most important personage on such an occasion, and her advice and opinions are listened to with oracular deference, especially if concurred in by the grandmother, if present, and the other matronly ladies who have been summoned as helpers in the emergency.

Hence it often happens that an infant child is subjected to a warm bath instead of being cleansed, as it should be, with cold water, except in very cold weather, and then it should barely be tepid; and next it is washed with rum, applied to its head, and sometimes to its entire body, by which its brain is intoxicated, and its outcries silenced by sleep, thus artificially induced by the outward application of some form of alcohol, within an hour of its birth. Next a spoon is thrust into its mouth with molasses and water, catnip tea, or, perhaps, salt and water, and some one of these doses forced into its stomach. Scarcely is the child dressed before spoon victuals are often in readiness, and on the least sign of wakefulness it must be fed, and if it cry under this savage handling, gin is added to the victuals until vomiting stops the process. Now it is pronounced to have the colic, and soot tea is thrust down its throat, and sometimes rue juice, or some other domestic remedy, to which Godfrey's cordial, Dalby's carminative, or some other anodyne is often added. Before the infant is a day old, and often before its lips have been allowed to approach the nipple of the mother, in addition to all this feeding and dosing, some *simple* medicine is given by the nurse, such as sweet oil, castor oil, magnesia, and often rhubarb, with the view of opening the bowels. Thus the child is often sickened nigh unto death, and then, when placed to the breast, the stomach is so nauseated that it loathes even nature's nutriment, and rejects even this when forced down with a spoon. Now the child is often fed again with spoon victuals, when it becomes thus early a victim of colic or griping, and the troubles of the mother with her breasts begin, which are often most afflictive and disastrous to her future health. Thus, the laws of nature being violated by the officiousness of ignorance and quackery, both mother and child suffer unnecessary and often untold mischiefs. Healthy children at birth are often sacrificed as victims to this shocking mismanagement, which is one among the prominent sources of infant mortality.

Instead of all this absurd and mischievous practice, new-born children should be placed within the folds of suitable clothing, and the light excluded from their eyes for half an hour after birth. They should then be cleansed with cold water, employing sweet oil as an auxiliary, if necessary. So soon as they are dressed they should be placed to the mother's breast, again and again, whether or not there be any secretion of milk, for their suction will soon invite it. The earliest secretion from the nipple is the only food or physic which should be allowed to enter the infant's stomach, nor should a spoon or its contents be ever placed in an infant's mouth. If mother and child are in health, the milk from the breast is the only food, drink, or medicine which will be called for during the first few months of infantile life, nor should such children be "fed" with aught else until they cut their teeth. The process of "teething" would then no longer be, as now, the fruitful source of those diseases which accompany its interruption, the chief of which may be ascribed to the feeding and physicking, rather than to the teeth. Children kept to the breast, and who have never had a spoon in their mouths, will cut their teeth without seriously suffering by the process, if previously healthy; but under the popular methods of feeding and dosing, the natural laws are perverted by impairing the general health, and hence the catalogue of diseases which are thus engendered.

Another equally prolific source of disease in children is found in the employment of anodynes by the nurse, often for the purpose of herself enjoying undisturbed rest, when from any cause the child is addicted to crying. For this purpose, paregoric or laudanum are often used, or, when these are prohibited, some vile compound of molasses and water with opium is substituted; as Godfrey's cordial, Dalby's carminative, American soothing sirup, or sleeping drops, all of which owe their effects to the opium in their composition. The effect of either of these is to produce costiveness, and pain in the bowels, which renders it necessary to repeat the use of purgatives almost every day. Is it wonderful that, under such constant medication, children should suffer from dangerous and fatal diseases? That this is another reason of the infant mortality so much deplored cannot be doubted.

It is true that feeble and sickly children from birth, or those especially who are from any cause obliged to be brought up by hand, are often of necessity sustained by the spoon or the bottle, and, if constitutionally defective, may also require medication. But very young children may have their bowels relieved by introducing a suppository of twisted paper, or a pencil of hard soap, in the way known to every nurse; and when something more active is required, a simple solution of manna may be given, which, indeed, is the only medicine called for, under ordinary circumstances, in young infants; nor can any more active article be used in such without hazard. Indeed, very many children are annually made the victims of medication, health being overthrown and life forfeited by this officious meddling of nurses and doctors.]

Sect. III.—Diet and Regimen.

Subsect. 1.—*Food allowed during Infancy and Childhood.*

6930. *The food of children*, in regard to its kind and quantity, must now come under consideration; and it is a subject of the greatest importance; for, although in subsequent periods of life health may continue unimpaired under deviations from the strictly wholesome diet—may be preserved in one case under too good living, in another by equal abstinence—may with impunity undergo any irregularity in regard to food which pleasure, convenience, or necessity may cause—yet in early infancy and during childhood such deviations and irregularities would be often fatal to life, and generally are injurious to the vigour of the digestive organs. The younger the child, the more urgent it is to take care that it has, at stated times, the food "convenient for it," but no more. To err in this respect, in the infant's case, is to run the greatest of risks in its rearing; and in regard to children of older growth, if not equally hazardous, it is often the cause to them of great suffering and of retarded growth.

6931. *Wet Nursing.*—The infant's food—that which nature provides for it immediately on its entrance into existence—must come first under consideration. When a mother has the power of suckling her infant, there can be no question that it is equally beneficial to her and her child. Only in particular cases, where some constitutional disease is apparent in the mother, can the abstaining from suckling be allowable; and this a medical man only can point out. In the act of sucking there are, to an infant, important effects. The mechanical action of the muscles employed in sucking—the labouring for food, as it has been called—is always regarded as causing most beneficial exertions in the infant, such as no other mode of taking its food can induce in it. In the act of sucking, the saliva, important to the process of digestion, is carried with the food into the stomach. The mere swallowing of food, given by the spoon to the infant, has not the same effect. The nutriment drawn by sucking from its source, and conveyed to the stomach, is of the very lightest nature; so much so that, if an infant take more at one meal than it requires, the milk instantly and easily, without pain or suffering, returns from the stomach, and the infant obtains immediate relief from the excess it had unconsciously committed—a relief rarely occurring when an infant's stomach is surcharged with other kind of food. Then the infant must undergo all the ills of indigestion, which, in its feeble state, are always serious, and often alarming. These ills of themselves afford a strong argument in favour of mothers suckling their children; or, if they cannot do it, the assistance of a healthy substitute should be procured. This first provision of nature for infancy nourishes it—as no other food has ever been found to do—*with certainty.* Every other food must always be given with the risk of its disagreeing. One kind may be too thick, and overload the stomach; another too meager, and deficient in yielding nutriment. Some kinds create acidity and flatulence; some relax, others constipate the infant's bowels; but, nourished by its mother's milk, such disturbances rarely occur, or, if occurring, are comparatively slight.

A thriving, happy infant is generally found to be the nursling of a healthy mother or nurse. To a hired substitute many mothers object; but do they object upon any very sound reasons? A careful selection should be made: the health of the individual about to be engaged for this purpose should be ascertained by medical investigation; the age of the milk, and its state, examined. To be thin and blue in appearance, sweet in taste, and abundant in quantity, are the best symptoms of good parent milk. When thick and yellow, its qualities may be suspected; and often it is, with such appearances, deficient in quantity. If the milk of a wet nurse does not suit a child, or is insufficient in quantity, the child ceases to thrive; its bowels become affected, and the skin of its neck and chest hangs loosely upon its little neck and limbs. These marks show something wrong in the suckling of the infant; they should have timely notice, and, if they continue, the nurse should be changed.

6932. During the first two months the baby should be frequently suckled; that is, as often as it seems to demand it; for, as it usually falls asleep while sucking, and, at first, often before it has had any sufficient quantity, it would be prejudicial to its thriving to attempt any great regularity in giving it its meals. When two or three months old, it will begin to take more of its nourishment at once; and then a more regular system may be, and ought to be, acted upon. At three months the intervals between its meals may usually extend to four hours; and during the nights these should be much longer—five or six hours. Its last meal at night should be given as late as possible; and then it should not have the breast again till early in the morning. We are speaking of a child of three or four months old—not younger. At night *excess of nursing* is injurious to both the mother (or nurse) and the child. A child suckled often during the night is sure to awaken often, and to require it more and more, until the nurse becomes exhausted in strength and unable to continue to suckle, and the infant also suffers. One meal succeeding another too closely, the coats of the infant's stomach become weakened and its bowels disordered.

6933. *Irregularity* in suckling is to be carefully avoided, as an infant gains strength to take a sufficient meal at one time. Proper hours for its meals should be fixed and observed: it is cruel to make the infant wait long beyond these periods; and hence mothers who cannot give up visiting while they are nurses had better relinquish this duty themselves, and in favour of a hired wet nurse, who must devote herself entirely to it.

6934. An infant should never be suckled immediately after it has been crying violently. Its agitation should be allowed to subside; or, if continued, it may proceed from pain in some part of its body, and this should be discovered before the breast is given to it. If in pain, it will be of no use to suckle it; it may, indeed, only increase its suffering.

When the mother has been, from any cause, agitated, she must avoid for a time suckling her child, or she may cause its bowels to be affected by the heat of her milk, and convulsions ensue. The same rule must be observed in regard to violent exercise; a mother must always avoid nursing her child while she is overheated by any excess of bodily exertion. The milk, like the blood, is equally affected by the emotions of the mind and the exertions of the body. At the same time, it may be here remarked, that regular and brisk exercise is always good for the mother who suckles, as well as for the child suckled; while violent exertions disturb and impair temporarily the qualities of the milk, activity renews it in quantity and improves it in quality.

6935. Every time an infant has been suckled, a cambric handkerchief or soft rag should be wrapped round the mother or nurse's finger, and the mouth and lips of the child should be gently wiped. The milk, if it remains in the mouth, soon becomes acid, and in this state causes a tendency to thrush.

6936. For the first four or five weeks an infant should have no food but that from the breast. If it be possible for the mother to continue the sole supplier of its nourishment, so much the happier for the infant; but where this cannot be done, other food must be allowed, the kinds of which usually given to infants will be found mentioned under the head "Dry Nursing."

6937. *Weaning and Dry Nursing.*—The period of weaning suckled children must depend on circumstances. Six months we should regard as the shortest time for suckling them—nine months the longest needful, unless there be, in any peculiar case, such delicacy of constitution as may render it desirable that the suckling should be continued to the end of the first year of a child's life; beyond this time we have never seen much good in suckling children, but the reverse. They are then arrived at an age in which they begin to require more substantial nutriment.

The use of the sucking bottle (see "Nursery Furniture," Book V., Chap. XIV.), if infants have been fed with it during the period of their suckling, should be continued for a short time after the weaning is begun. In no case would we recommend any sudden means of weaning; any sudden change of diet is trying to an adult, but it is hazardous to a delicate infant. A month at least should be given to the change; during which period every week should be begun with a diminution of the nourishment afforded by the mother or wet nurse, and a proportioned increase of the substituted food.

6938. *Cow's milk* does not always appear to agree at first with a suckled infant; when it does agree, no food can be better for children immediately upon weaning. By adding a little tepid water, in the proportion of one third water to three of *new* milk, this beverage might be often given with the best effect to children during their weaning. Whatever food they take should be very thin. To secure this important point, the sucking bottle is the best means, as before observed, by which weaned children should, in the first instance, receive their food. Care must be taken to keep it extremely clean, as well as the leather bag by which the baby sucks in the food. Whenever the bottle has been used, it should, after being washed, be suffered to remain in a basin of clean cold water till it is again wanted; the food of children, being either of milk, or mixed with milk, becomes so rapidly sour, if any be left in the bottle or in vessels employed in preparing and warming it, that too much stress cannot be laid on this one point of cleanliness. Sour food cannot fail to disorder the stomach and bowels of children.

6939. Children can hardly be fed too slowly, whether with the boat or the spoon; the former is now rarely used; it is more objectionable than the spoon, admitting as it does of the food being poured down an infant's throat, rather than drawn in by the child's own efforts. The boat is in form like the old-fashioned butter-boat, and was adopted as a means of avoiding the irritation to which a weaning child would give way (being used to sucking) on the spoon being withdrawn from its mouth to be refilled. But this imitation is better than *drenching* the infant, as it may be considered, with the boat. The effects of a large quantity of food suddenly entering the stomach by the boat or by any other means are seen in the child's oppressed breathing, and sometimes in more serious symptoms.

6940. *The kinds of food* to be given to weaning or dry-nursed children should be of the simplest description: of cow's milk we have already spoken: *arrow-root* and milk; *pearl sago* boiled in water till perfectly soft, and thinned with new milk; *rusks; biscuit powder; flour* previously boiled like a pudding in a basin till it is formed into a hard ball, from which portions can be grated into milk, and boiled in it till it thickens the milk, are the chief ingredients used as food for children either dry nursed from birth or weaned from suckling.

Rice gruel, barley and groat gruels, are also used in some cases, and with advantage; and as a change in the diet of children is advisable when they are occasionally indisposed, these kinds of gruel may be found useful varieties in the food of children.

6941. *Food* which contains milk should never be warmed over and over again, as is sometimes done; nor should it be suffered to remain, when cold, in metal utensils; if intended for future use, it should be put into earthen-ware basins, and set in a cool place; but no food thus set by for another day should have milk put into it; this should be added after portions of the food are separately warmed, previous to any of the child's meals.

6942. Of the consistence of food, it is necessary to observe that none should be given for the first three or four months in the life of a dry-nursed child, nor immediately to one being weaned, of scarcely greater thickness than the mother's milk. The great difficulty in observing this important rule is with nurses, who, regarding children as half starved if fed on food sufficiently thin, often counteract any wishes or commands mothers may express on this subject. They pretend children will not eat unless *they feel* the food on their lips, and they threaten the parents with all the ills of starvation if the children are to be so fed. Inexperienced and alarmed, many a young mother has yielded the point, and left the digestive powers of her child under the management of an ignorant and obstinate woman, until it has been needful to call in medical advice, and to threaten dismissal of the nurse upon her future disobedience to orders laid down.

6943. *The proper warmth* of food is also of great consequence to a fed infant; if it be given constantly hotter than the mother's milk, it is very likely to bring on that painful disease, the thrush—a disease more common and fatal to the fed than to the suckled child, owing, it is supposed, to the variation and uncertainty in the temperature of the food given to the dry-nursed.

6944. *In dry nursing* from the birth even more attention must be given to the above suggestions in regard to the use of the bottle, and to the degree of consistency and warmth of the food given to infants not suckled, inasmuch as the difficulty and risk are greater in rearing the dry-nursed child to health and vigour than the suckled infant. Its food should, in all respects, be made as similar as possible to the nourishment appointed for it by nature. In analyzing the human milk, it is found to contain some properties rather different from the milk of cows; yet it is probable that no substitute for the mother's milk can be found, in all respects, better than that of cow's milk; at first diluted, but, in the end, given as it comes fresh from the cow. Like the parent's milk, the properties of cow's milk are every day the same, or nearly so, while every other food is liable to many variations, arising from the uncertainty attending the preparation of it.

6945. *A dry-nursed child, brought up on cow's milk*, may require a change of diet rather sooner than would otherwise be thought of. On attaining its fourth or fifth month, one meal each day of more consistency may be given in moderate quantity by the spoon. At six months old, a light bread or flour pudding, consisting of bread crumbs (or one tea-spoonful of flour), the yolk of one egg, of milk as much as will fill a small basin; these, beaten well together and boiled in a small basin for ten minutes or a quarter of an hour, and, when turned out of the basin, sweetened with a little sugar, will generally be found palatable to a child of this age, and a safe gradation from its earliest food to one of more solidity. At nine or ten months old, meat panadas may be given; a few months subsequently, meat, merely minced, with mashed potatoes, or well-boiled cauliflower or brocoli. No one meal should consist of many things; meat and vegetables, without pudding, or pudding without meat, we would advise to be given on alternate days, till the child is a year and a half old.

6946. *The nutriment of children*, after the completion of their first year and a half, it will be necessary to increase in solidity, and, if their appetite seems to demand it, in quantity also. Their teeth begin now to aid them in masticating food, their limbs become firmer, and carry their bodily exertions often to a great extent; it is scarcely calculable the degree of exercise which healthy children voluntarily give themselves, but which stimulates the digestive organs, enabling them to receive and act upon more solid nutriment than heretofore given them. Having previously had animal food three or four times a week, children may, in the second year of their lives, safely eat it once every day—meats being chosen for them that are tender and nutritious. *Roast beef; mutton*, either boiled, roasted, or broiled; *chickens*; some kinds of *fish*; well-boiled *vegetables*, such as *brocoli, turnips, potatoes* (the latter are best for them when mashed with hot milk and a little salt); simple compounds of egg and milk; *fruits*, baked or boiled; *bread*, well made and well baked, with small portions of *butter*; these, with milk for breakfast and supper, with water as beverage, are the chief articles of wholesome food for children as long as they continue under nursery management.

6947. *The species of food we would not give them consists* of salted meats (beef, pork, or bacon); of rich stews, ragouts, and soups; of fried fish; of pastry and confectionery generally; of cheese; and of beverage, tea, coffee, beer, and wine. Of the two last mentioned, beer and wine, we may remark that, in cases of delicate health, they may be advantageously allowed; but they should always be given under medical direction, for the stimulus of fermented or spirituous liquids is not in every case of debility beneficial, sometimes the reverse; neither ought children to be allowed to drink much at a time of any liquid, however mild and innocent it may be. Too much liquid has a tendency to create flatulency, and to distend the bowels. It has been said that parents accustoming their children to drink water only, bestow a fortune upon them of the value of which they will be sensible all the days of their life.

6948. *The habits of children* at their meals should be attended to. We would let them use the spoon or fork early. It is keeping them too childish to feed them after they have strength enough to hold the spoon. At first the nurse or mother should superintend the child's attempts to feed itself; should place the spoon in its right hand; see that it is not filled too full, nor, when lifted to the mouth, forced awkwardly into it. The child should be prevented, when he seems to have satisfied his appetite, from throwing about the remains of his food, by his plate being removed to a sufficient distance from him, and his spoon taken gently out of his hand. This being uniformly done when he is inclined to scatter his food around him, will soon cure him of the trick. The use of a knife cannot, at this early period, be allowed him; he must not have it until he has sense to know the danger of misapplying it.

Children's meat should be minced as small as possible. If too much trouble is left to their feeble power of masticating, they will shun it by swallowing their food unmasticated. For children whose digestion is weak, it may even be desirable to have their meat pounded.

6949. *Children* should be encouraged to sit still at their meals; but these should be made as short as possible, that the patience of the children may not be tried too severely. Also, they should be encouraged in cheerfulness at meal time, and not in turbulence. Vigour in the digestive organs is said to be promoted by cheerfulness, but impaired by gloomy impressions, or by great anxiety of mind indulged in during meals. If this be the case, it must be desirable to keep children's spirits free from any depressing influences, and yet not forced into the opposite extreme of excitement.

6950. *In childhood, as with most young animals, activity after eating seems natural*, and we may thence infer that it is beneficial also, although in later seasons of life the reverse appears to be more generally believed. If, however, children are inclined to active sports after their meals, it is wisest to allow them, otherwise they will be fretful in their obedience, or altogether rebellious.

6951. *Greediness* is a disagreeable habit in children, too often encouraged by fruit, cakes, or other sweet things being given them as rewards, or withheld from them as punishments, and thus is an undeserved value placed on such things. Sometimes, if begged for with childish importunity or petulance, they are given to silence the bold beggar. The more timid child gains nothing by his opposite conduct, except, perhaps, to see justice and impartiality sacrificed to loud vociferations and tears. When children are really deserving of punishment, it is not a desirable way of inflicting it by any deprivation of food or dainties; certainly not to give to the brother or sister the portion forfeited by the offending party. Anger, on the one hand, is probably excited towards the favoured one, and pleasure, on the other hand, by the mortification experienced by the offending brother or sister. If any use in education be made of the natural love of sweet things, it should be to cement the social and relative connexions in life, not to dissever *them*; also, to discourage selfishness, and to forward the development of the generous and disinterested qualities. These moral benefits may be looked for when children are taught to sacrifice all enjoyments which end in self, to the higher pleasure of imparting enjoyment to others. To induce children to share with or give to brothers and sisters the things they like themselves, is the best use that can be made of the love of sweet things and dainties.

Greediness would be scarcely known in children if none but simple, wholesome food were placed before them. Such rarely tempts to immoderate indulgence of the appetite, but renders restriction almost needless. Tempt children with dainties, and restriction becomes needful, yet it does but increase the value of the things desired. Compulsory regulation of the appetite does not induce that most important of habits, self-restraint. The reverse is often more obvious. Those children whose appetites are strictly regulated by vigilant mothers and nurses more frequently transgress, when opportunity allows them, the rule of moderation than those do whose unpampered appetites are left to their own discretion. An infant almost uniformly expresses its satisfied appetite by pushing away the offered spoon, or by receiving its contents with indifference, that decided symptom of satiety which ought never to be unnoticed; no child, after such show of indifference to its food, should be urged to eat, even though it may not have cleared the plate or basin of its contents. It is safer to waste such remnants than to surcharge the organ of digestion. It is equally injurious to the child, whether the nurse forces it to take more food than it requires, or whether its own pampered taste induces greediness. Yet many nursery disciplinarians think it their duty to force children to eat up all that has been put upon their plates, forgetting how much they themselves might suffer from indigestion were they compelled to similar excess in eating. Neither is the subject of antipathies to particular articles of food always sufficiently considered. It is sometimes thought necessary to overcome them by forcing the child to eat what seems to be so very repugnant to it. Nature prescribes a different rule; what is thus disliked by any individual is often peculiarly injurious to that individual. Thus, in regard to the fat of butcher's meat; wherever it is much disliked we may believe that it is not only unpalatable, but prejudicial, and not to be forced upon any one. This aversion should not be regarded as caprice, but as arising from some peculiar state of the stomach that time or change may rectify, but not compulsion.

[It must be confessed that a luxurious mode of living often unfits a mother for being a nurse; and hence it is common among the wealthy, in imitation of her majesty, Queen Victoria, to substitute the breasts of a wet nurse for those of the mother. Nevertheless, both nature and philosophy teach, what experience confirms, that every mother should be the nurse of her own child whenever it is practicable, and this in view of her own health as well as that of her infant. Even in the case of consumptive ladies, experience amply proves that nursing will often relieve the affection of the lungs, and improve the general health. Such mothers, however emaciated, *if their appetite be good*, which is often the case, should be advised to suckle their children two or three times a day as the most likely means to restore their health. That those mothers who do not suckle their children are most subject to consumption, cancers of the breast and womb, &c., has long ago been observed: hence it has grown into an axiom that, if the mother be healthy, suckling will confirm her health; and if weakly, it will, in most cases, improve it. No other woman's milk can be so good for her own child; and as to *dry nursing*, it is unnatural and dangerous; very few of those thus brought up ever live a single year, and hence, when resorted to, it ought to be a measure of imperious necessity. When, however, a mother is unable to be the nurse of her own offspring, from disease or any other cause, or when, as is too often the case, the mother perishes in the act of giving birth to her child, in either case a wet nurse should be provided; and the choice of a woman for this service should be judiciously made. A middle-aged woman should be preferred, if she have previously borne children, for such will have more milk than the young, and more and better than the old. She should be one who has not been confined with her own infant more than three months; nor is any woman fit for a wet nurse six months after delivery, the milk being found to vary in its specific quality according to its age; and, moreover, as nature never intended a mother to nurse her child longer than twelve months, the milk will seldom continue good after that period, and hence all children ought to be weaned when they become a year old.

The nurse's food should consist of fresh meat and vegetables, bread, broth, milk, &c., without any strong liquors; and, in the absence of the first secretion of the mother's breast, which is always sufficiently purgative, the nurse should take some laxative medicine, which, through the medium of the milk, is found to operate upon the child.

As, however, children are often condemned to be brought up without the breast either of the mother or wet nurse, in such cases very different management is required, and to regulate the quality and quantity of the food becomes a subject of great importance. It is for lack of judgment in these particulars that such children suffer so much from colic and griping. It is a common mistake to suppose that whenever the child cries it wants victuals, while the acute pain and spasms, by over-distention of the stomach, is by far the more frequent cause. Indeed, healthy children seldom cry except from pain, and hunger does not cause pain unless it be very protracted. The nurse often forces down food to quiet the outcries of a child suffering already from an excess in quantity. The generation of acids and gases from the fermentation of the spoon victuals remaining undigested, by producing irritation and spasms in the stomach and bowels, gives rise to what are called inward fits, convulsions, and, not unfrequently, inflammation of the bowels. Children that are fed only four or five times in the twenty-four hours are more healthy, active, and cheerful than those who are never suffered to be hungry. Milk from the cow, goat, or ass will be the best substitute for human milk, when this is not to be had; and, in addition, potatoes, arrow-root, bread or rice flour, sago, or tapioca, and, if necessary, as the child grows older, thin and light broth, free from fat, may be superadded. Until the child cuts its teeth, however, potatoes boiled and mashed, being then mixed with fresh milk, unboiled, will be found to be preferable to most other articles, and afford ample nutriment. Children should always be fed in a sitting posture, that swallowing may be more easy to them; and if the child be not accustomed to night feeding, it will not become over-fat and bloated, but will contract the habit of sleeping the greater part of the night. When the bowels become irritable, from acid or flatulence, the best corrective is limewater, a spoonful or two being added to the food, with a little essence of peppermint or anise seed. The custom of giving spirits of any kind in children's food cannot be too highly reprobated. Strong liquors of all kinds should be avoided; and, though some children have been known to thrive under their use, it is only when the vigour of their constitution has been sufficient to counteract their usual pernicious effects.

But none of these instructions for feeding children are called for where the mother survives, and can, by possibility, perform the duty of nurse to her offspring. If the nipples be short, they may be drawn out by the nurse, or by some form of nipple-glass; and this is often needful in young mothers. When they are tender, they should be washed with brandy or a solution of borax: the poisonous preparations of lead used by nurses and recommended by quacks are high mischievous. If the nipples be small, tender, and ulcerated, there are various contrivances to enable her still to suckle her infant, the best of which is the prepared nipple, or the teats of calves, which will be found well adapted to the purpose. And for washing ulcerated nipples, a solution in water of the seeds of quinces, or some similar bland mucilage, will be found most useful.

Inflammation of the breast is another frequent obstacle to nursing by which young mothers are afflicted. Leeches early applied to the part, and some spirituous lotion, with a free purgative, will often prevent the formation of matter. Where these fail, however, and an abscess forms, it should be opened early and freely, after which a linseed poultice may be used until the matter is all discharged, when the adjacent skin may be washed with brandy two or three times a day, and dry lint applied until it heals. All oily liniments and ointments are hurtful.]

Subsect. 2.—*Sleep of Children.*

6952. "*Infants can scarcely sleep* too long at a time" for the first four or five months of their existence. During this period it is natural to them to spend their chief time in sleep. A merciful provision this, in the most helpless portion of infancy's existence; and for these reasons, while an infant's body is in a horizontal position and during sleep, the circulation of the blood proceeds more equably and calmly, the respiration is more easy, the function of digestion more steady and effective, the nutrition resulting from its processes more perfect than when the infant is in an upright position. Thus this tendency to repose is a protection against infancy's own feebleness, which might render every casualty that presented itself a real danger, an obstacle to the healthy operations of its delicate functions. The calm, steady sleep of an infant for three or four hours at a time is the mother's warrant that all is going on well with it. Were it otherwise, its rest would be broken, its crying frequent, and its bodily development and vigour would be evidently retarded and imperfect. It has been said by a German medical writer of the last century, Professor Hufeland, that twenty-four hours of perpetual *watchfulness* would be sufficient to destroy an infant of two months old. Whether this notion be well or ill founded, it conveys to us his conviction of the importance and value of long and undisturbed sleep at the earliest period of human existence.

6953. For the first three or four months of infancy any strict regulation as to habits of sleeping can scarcely be observed, no more than with regard to the meal time of infants.

6954. By the time they attain their third month some steps may be taken towards the regulation of these infantile habits. For instance, young infants often begin their lives in sleeping more by day than in the night, a very troublesome and inconvenient habit, but which it is difficult to alter; yet as soon as an infant begins to take notice, his nurse should endeavour to keep him lively and awake as the evenings draw in, by rousing his attention to everything around (for at this period his observations will be commencing their operations), and by nursing him actively in her arms. Thus, by slight fatigue and longer wakefulness, she will be preparing him so settle early in the evening. As soon as possible, suckling or feeding a child at night should be discontinued, as before remarked. Sleep at night will now be more salutary to the child than food. Now the inclination for food at night should be repressed, and the habits of sleeping equally encouraged.

6955. From its birth to the age of five or six months an infant should have two sleeps in the day, one in the fore, the other in the afternoon, each of an hour's length, if it can be obtained.

6956. At the period of the sixth month the afternoon sleep may be dispensed with; the morning sleep should be brought into midday, and should be continued till the end of the second year of a child's life, and sometimes it may be continued with advantage for a longer period.

6957. All children should rise early in the summer; there is no air so refreshing to their young nerves and muscles as the early morning air. The sun has not then given out its full heat, nor drawn upward arid, humid, or impure exhalations from the earth; it is in its best state for imparting vigour to both young and old. In the winter there are reasons for admitting of later morning hours. Children, especially very young ones, can gain little by rising in severe weather before the fires are lighted, and the air of the rooms into which they are to go is sufficiently warmed to save them the suffering which severe cold always inflicts upon them, and which is expressed by them in crying and fretfulness. Let them remain an hour longer in their warm beds, and they will show their thankfulness for the boon in their countenances and tempers. The active natures of children will always incite them to early rising as soon as their limbs are strong enough to carry on any exertion of the body sufficiently stimulating to their feeble circulation.

6958. Laziness in the morning is a bad habit of a later growth, not then to be indulged; yet still some limitation there should be in regard to the number of hours given to repose. In duration, a child's night should neither be more nor less than ten hours. When children, from habit, sleep longer than this, it may be proper to awaken them at one uniform hour, and thus destroy the wrong and establish the better habit.

6959. *But in rousing young children* the gentlest means should be employed, not violent shaking or loud speaking. It is extremely hazardous to startle or shock children when they are awake, but to rouse them from the unconsciousness of sleep into a state of terror is still more erroneous and dangerous. A boisterous, rude, or harsh nurse may in this way make an impression of horror on a child's mind that no subsequent measures of gentleness and kindness may be able to efface. Very opposite should be the mode of waking children we would prescribe. They should never, could we prevent it, open their eyes from their easy slumbers on gloomy or angry countenances. A smiling face and gentle voice should be the medium of a child's transition from the peaceful state of sleep to a cheerful, happy reality.

6960. *Sleep, to be salutary*, should be naturally procured. During dentition, or by occasional disturbances of the alimentary function, the sleep of young children is sometimes disturbed. The irritation becoming excessive, a medical man may see occasion to administer small and suitable opiates, and thereby sleep is obtained which may be absolutely requisite; but as an habitual or frequent measure, no medical man in the case of children would advise opiates to be resorted to. The immediate but transient effect of opiates on an infant is to still its nervous irritability; the subsequent consequence is to increase it as soon as the power of the opiate has passed off. When opiates are frequently given, a child's muscular vigour decreases, its countenance becomes pallid, the growth of the body is checked, the whole system is debilitated; convulsions sometimes ensue. These symptoms are here stated as warnings to mothers and nurses who, from ignorance of their danger, may be incautious in administering opiates to children; such as Dalby's carminative, the American soothing sirup, paregoric elixir, medicines which may be occasionally safely given, but not frequently without serious risk.

6961. *The best plan for getting children to sleep* is by laying them down to rest at stated hours, when, from habit, the inclination to sleep becomes the strongest. A child accustomed to be laid down awake is seldom restless or fretful, but often closes its eyes immediately on being laid down, and is asleep at once. When any deviation from this occurs, and the child, instead of composing itself, is restless, it may be inferred that something is amiss with it, that it is in pain or otherwise indisposed. Its state should be examined into, and judged of as well as it can be, before any attempt is renewed to make it fall asleep. When a child is indisposed it may be difficult to keep it in its crib, or get it to sleep in the usual mode: it must then be taken on the knee, and gently soothed to sleep by the motion of the nurse's knees; but, as a habit, this rocking to sleep is not to be encouraged: when, from the age of a child, it becomes necessary to break through it, it often proves a painful struggle to both child and nurse.

6962. *A child's position in bed* is of importance. Its pillow or bolster should be scarcely raised above the surface of the bed (see Med. Art. on the "Spine"). An infant should be laid down to sleep on its side, with its mouth and nostrils clear of the bed-clothes, as well as the whole of the face; for, while currents of air should be guarded from a child's head, there should be free admission of air to its mouth; and if infants incline to sleep better on one side than the other, the nurse, observing it, should endeavour to counter act the habit by laying it down to sleep on the alternate sides. From the day of its birth this precaution should be employed.

6963. *Infants require* warmth in their bed-clothes, and will neither sleep comfortably nor for any length of time unless it be afforded them; but the degree of warmth allowed must not be such as to cause perspiration, and which would weaken and render a child too susceptible of cold. No doubt an infant will sleep more soundly on the nurse's arm than in its own bed; and a sickly, delicate child is often comforted, nourished, and lulled by the warmth so imparted to it. The infants of the poor have always this comfort, whatever else they may want; many delicate infants in the houses of the poor would perish but for the warmth thus imparted to them during the night. For the infants of the affluent, who can envelope them in flannels and blankets, and keep them in apartments of a regulated temperature, there is less weight of argument in favour of their sleeping on the nurse's arm, and some seasons there are which render it undesirable. It frequently induces profuse perspiration in the child, and sometimes, especially when the face is covered, brings on that relaxed state of the mucous membrane which occasions the complaint called by nurses the *snuffles*, from the disagreeable noise made by the child in breathing through the nostrils.

6964. An infant lying *on* the arm of its mother or nurse is in no danger of being *overlaid;* but if, by any movement of the nurse, the child's head slips off the arm during her sleep, very distressing consequences may ensue. If her body press against and cover the mouth and nostrils of the infant, its struggles may be too feeble to rouse her from sleep, and its suffocation would then soon occur.

6965. *Children* of two or three years of age will require, if they are healthy, less bed-clothing than during their earlier infancy: their circulation is become stronger and quicker, and perspiration more easily induced in them, which, if frequent and profuse, is extremely debilitating; yet insufficient covering in cold weather would be equally prejudicial to them, and would prevent them from sleeping soundly.

Subsect. 3.—*Exercise of Infancy and Childhood.*

Exercise during infancy and childhood is the next subject of importance to which maternal attention should be given.

6966. *The muscular organs*, on which bodily activity depends, and on activity strength in the limbs and health in the functions of life, are themselves acted upon, invigorated by exercise, provided it be progressive and uniform: no overstrain upon them one day, nor disuse allowed them at other times. Either excess of exercise or the want of it would alike debilitate them. Thus, muscular power, which varies in degree in men and women, and equally so among individuals of either sex, may yet be, in each individual case, improved or impaired by exercise, according to the use or abuse of it.

6967. In this chapter, which relates to the physical treatment of infancy and childhood only, there seems no reason for prescribing different rules for the treatment of boys and girls. To the age of five or six they must be, in all material points, brought up alike. As they progress towards youth, modifications in the bodily treatment of girls will occur, in contemplation of their future position in life, which will require from them sedentary employment, and deny them indulgence in any but gentle exercise, suited to the part they have to fill in their social life.

6968. From birth to maturity, nature, by progressive, and not sudden measures, gives strength to all organized beings; hence this rule must be observed by those who conduct the physical education of infancy and childhood. Exercise proper for infancy is, at first, but the gentlest of movements in the nurse's arms, on her knee. Afterward, when three weeks or a month old, an infant may be carried out of doors, but always in a recumbent posture, for in that posture an infant should be principally kept for the first six weeks or two months of its existence.

6969. Night and morning, after being washed, the limbs, back, and stomach of an infant should be gently rubbed by the nurse. This friction may scarcely be termed exercise, but it acts as such on the delicate vessels of the skin, sending through them that degree of circulation which renews the warmth of the body, and promotes the healthy action throughout the skin, the body's covering, which it is most important to the animal economy to preserve in health.

6970. *An infant of three months old* should then begin to have active nursing in the arms. At this period a child may be permitted to be carried about in an upright position. Every nurse-maid should accustom herself to carry children on either hand; if this be done alternately, a child is in less danger of acquiring any habitual position of the body, which might end in a curvature of the spine, especially if there be in the infant any constitutional weakness. To vigorous children the mode of carrying may not be of the same consequence; but it is often very distressing to those who have maternal feelings to see fine children carried about for hours together, on the left arm generally, their bodies bent forward, their backs forming a bow; unnoticed by their nurses, their countenances are overcast, and the benefit the air and exercise might afford them is lessened by the weariness they evidently experience from this continued, painful position on the same arm. Children, after illness, being carried about in this one position, often become deformed. Besides being at this period carried, the child may be tossed in the air (though not too violently) with good effect; it may be laid on its back on the floor, or on a mattress, and suffered to kick out its legs, and to stretch out its arms, but it ought not to be kept long in any one position. The moment it begins to wail it should be taken up, and some other motion tried, to keep it lively, and its muscles in gentle play. In doing this we are acting in concert with nature, who did not give this untiring inclination to active occupation without some end. It is manifest that the progressive development of both the physical and mental powers is the object for which activity and curiosity were given to infancy and childhood; and whenever we circumscribe their range, we do but defeat nature's purposes.

6971. *An infant of six months*, if very vigorous, sometimes will begin to bend forward out of the nurse's arms, impelled by the desire to be on the ground, and on its feet. It is rather early to begin to walk, but vigour in the infant is the impelling cause, which it may not be well altogether to frustrate. If an infant be encouraged to put its feet thus early to the ground, it should at first only be allowed to do so for short intervals at a time: the nurse should endeavour to amuse her charge with other exercises as soon as she thinks he has been long enough on his feet. If she can teach him to crawl, she will give him a more beneficial mode of exercise; one which brings the muscles into easy play, and removes the weight of the head from the spine. A weakly child, however, will not attempt any permanent exertions; it will be content with the ease it enjoys in the nurse's arms. In this case, no forcing to activity should be allowed; the infant may be laid now and then on its back, and on a carpet, but unless it attempts to crawl of its own accord, it will not be wise to urge it to do so. By slower degrees the muscular action must be obtained and invigorated, probably by adopting measures to improve the infant's general health.

6972. Children are sometimes allowed to sit long, either on chairs or tables, or in little nursery swings: the pressure on the spine is then too continued, the muscles of the legs and thighs waste rather than increase, and sometimes these limbs become crooked in consequence. If children fall asleep while fastened in their chairs, their heads bend forward, and their respiration is impeded by the position of their bodies.

6973. *Children advancing to the term* of their first year will begin to exercise themselves spontaneously, and this is far more salutary than any exercise can be which is forced upon them: their own efforts will never harass or over-fatigue them; they will involuntarily relinquish them as weariness grows upon them.

6974. *Before encouraging children* to use their feet, we should look to their actual strength, not deciding how far they should be urged to walk by the actual number of months they have lived. It was not long ago considered as a reproach to a nurse if her nursling could speak before it could walk: to avert this supposed proof of bad nursing, many a child's real good has been sacrificed. Before its strength allowed, it has been urged to totter on its bending limbs, when it should rather have been reposing on the floor, or only making its own natural movements proportioned to its strength. When a child's limbs are not sufficiently strong to support the body, the consequences of urging it to walk upon them will be curved legs and weakened ankles. All artificial means of inducing children to walk, such as the go-cart and leading strings, are happily in disuse. They were, when much employed, fatal to the healthy growth of a child. If a young child once acquires the art of crawling, it will soon do more, and try to use its legs; it will first raise itself by the support of a chair or stool, will then totter from one side of it to the other, holding itself up, and by repeated exercises of this kind the limbs will acquire the requisite power, and the infant will gain courage to trust to that power; then it will walk alone. Many a fall it will have, but these will add prudence to its growing power. Let it be here observed that it is wiser, when a child has slight falls, not to run hastily to it, raise it up, or try to soothe it. Instead of going to its assistance too precipitately, it is better, if it be not really hurt, to let it help itself. This it will very soon do; and better, also, than any one can do for it. We are now alluding only to the many trifling accidents in a child's life; not to those of a serious nature, to which humanity, as well as necessity, prompts to immediate attention whenever they occur. We only recommend the discouragement of children's cries at small difficulties; aid given to these cries too promptly and too soothingly deprives children of that independence of spirit which eventually we seek to inculcate in them.

6975. However, in beginning to walk, a child must have some assistance. This should be given by holding it firmly *under*, not *by the arms*. It is frightful to see a child, held by one arm, swing its body round, in the eagerness of its exertions. Were the joints of the arms less limber than they are in childhood, such movements would nearly dislocate them.

6976. Scarcely is any sight more delightful to parents than that of the first setting off of their child; nor do *they* only feel delight; the happiness of the child, to all appearance, exceeds their own; when first it is conscious of its independence, its state of ecstasy is almost enviable. Arrived at this happy epoch in its life, something farther is yet to be done to give the child greater steadiness, and greater freedom of step and carriage. For this end *long walks* must be avoided. Children from a year and a half to two years old should scarcely even walk more than a quarter of an hour at a time; if longer, the muscles of the legs will be weakened rather than strengthened, and the child's step will be unequal and unsteady, and its carriage awkward and waddling: were it possible, a child for the first three years of its life should rarely take a walk, but rather be turned into a garden, be it ever so small; there it can run, stop, walk slowly or fast, can stoop down to pick up pebbles or flowers, then rise up; in each movement different sets of muscles are employed, one set being the safeguard to another of any overstrain upon it, by coming into play according to its rise in different postures and movements of the body. In walking at a uniform rate, in streets or on roads, one set of muscles are chiefly used, which soon tire, and give feelings of lassitude to the child it would never have experienced in the more varied change of the garden.

6977. *As children grow older and stronger*, athletic sports may be introduced among them, equally advantageous to girls as to boys, such as games at ball of various kinds, of battledore and shuttlecock, whipping tops, prisoners' base, tennis ball, and hooping, with other running games. Such sports as these will bring into healthy action the whole muscular system. The skipping rope gives excellent exercise to older children. The running and racing games should not be encouraged when children have coughs, or show any symptoms of diseased lungs. In such cases, the rapid urging of the blood into the lungs, caused by the exercise, would be very prejudicial, and might bring on inflammation of the lungs. And the same caution will apply to children troubled with temporary bowel complaints. Children with delicate bowels should never be allowed to take long walks, and violently active sports they should indulge in very moderately.

6978. In all ordinary cases of children, outdoor amusements are the best. The only precaution needful is with delicate or diseased children, in whom exercise should be as regular, but not in degree the same, as with the healthy. There are but few children who would not be the better for constant outdoor exercise, were it properly proportioned to their strength and years. When town children are taken for health to the coast, they are often made ill by the immediate injudicious degree to which their outdoor exercises are allowed to extend, while those who are under more prudent direction in this respect often derive the utmost benefit from the more measured enjoyment of their absence from towns and cities. It has been remarked that, among all the public institutions of European cities, none have provided for the innocent pleasures of children. In cities where private gardens, if there be any, can only be secured to the affluent, how beneficial would be, to the humbler classes, airy grounds, into which their children might be turned, safe from all the hazards and accidents of the streets, their only play-ground. Such would, indeed, be pleasure-grounds, and would conduce more to the welfare of rising generations than even the infant schools.

6979. It may be said that children would soon be tired of such play-grounds. The enjoyment seen among the flocks of children resorting to the open parts of the Regent's Park during the greater part of the year contradicts this objection; were such places multiplied round the town, and free access allowed to children, disease would find fewer victims among the poor than at present is the case.

[Children should be early trained to exercise their limbs, and, if healthy, they should be taught to walk by the time they are a year old. Weakly children, and even those whose legs are bent or crooked, may be essentially benefited, and their limbs made strong and straight, by frequent walking; and it is a vulgar as well as pernicious error to allow of the disuse of their limbs from a groundless apprehension of any possible injury by exercise.

So soon as children are able to walk, they should be trained to bear exercise without fatigue, by gradually increasing the length of their walk, until, by the time they are three years old, they are able to go two miles without weariness: thus, a dull, heavy child may be made playful and sprightly, and a weakly one healthy and strong, by regular habits of exercise. The cold plunging or shower bath is a valuable additional exercise for delicate children, which, during warm weather, should be repeated every morning.

Cradles are often relied on to give exercise to children by rocking—a barbarous and mischievous error; for the effect of rocking is to produce vertigo, and a species of intoxication of the brain of the child, which, being often repeated, predisposes to diseases of the head.

When children are old enough to take exercise upon a rocking-horse, this will be uniformly salutary. Swinging the dumb-bells, though often recommended, will produce deformity in some cases, and hence jumping the rope is to be preferred, especially for female children; but, after all, when, under the impulse of their own active vigour, they are impelled to running, leaping, and other sports of agility, these will be found better than any modes of exercise which may be prescribed merely for health.]

SUBSECT. 4.—*Clothing of Infants and Children.*

6980. *The clothing of infants should be warm, light, and loose.* Warm clothing is essential to infants during the early period of their existence, in which their organs and functions are so feeble that any excess of cold would quickly destroy the vital principle within them. Life in infancy is, more than at any other period, at the mercy of external influences. Sudden transitions from warm to cold check, in an infant, the circulation previously going on on the surface of the body, and drives the blood internally, so hastily as to cause some immediate evil, which would come under the general term "inflammation." Either the bowels, lungs, windpipe, or head may be attacked; hence, in the choice of an infant's clothing, that kind should be employed which may seem best adapted to secure the equal and tranquil diffusion of the blood throughout the system. Although sufficiently warm, it should be also light. If overloaded with its dress, especially in apartments in which the temperature is high, profuse perspiration may be induced in an infant, a state which is as carefully to be avoided as that caused by extreme cold. Frequent and copious perspirations impoverish the blood and enfeeble the internal organs.

6981. *By warm clothing is meant* the use of such materials and textures as best retain, when in use, the heat imparted to them by the body; such materials are called *non-conductors* of heat, and consist of flannels, woollen fabrics, and furs. In these heat accumulates, and is recommunicated to the body of the wearer.

6982. *Cool clothing*, such as *linen*, conducts heat; and even to a certain degree *muslin* and *cotton* are conductors of heat: the warmth they receive they as easily part with, and it is carried off into the atmosphere.

6983. *Flannel* worn next the skin acts upon it like a gentle flesh-brush, warming the surface and stimulating the nerves and fine vessels of the skin; soft and light, as well as of a warming quality. Flannel cannot, in this country at least, be dispensed with as an article of infant clothing. Most of the infant's under garments are of this material, although immediately next the chest and arms a fine linen or cambric shirt is worn. Above the flannel is a light petticoat of muslin, and above this a loose dress with long sleeves, and made to draw tight on the chest. As it is not well to fatigue a young infant with needless change of clothes, the dress above mentioned is, for the first fortnight or three weeks, seldom changed more than once in twenty-four hours. At the end of a month or six weeks the infant is strong enough generally to be dressed and undressed morning and night, when a difference is made between the day and night clothing; in the latter a sort of flannel wrapper is worn instead of a flannel petticoat.

6984. *Infants, for the first three or four months, are clothed in very long petticoats.* There is some utility in having the clothes of very young children of a considerable length; they help to keep the extremities of the infant safe from cold air, which would otherwise chill an infant very severely; and long clothes do also give a nurse a good hold of a child, who, without sufficient clothing, would be apt to slip out of the arms; but to have them so long as to trail on the ground, or to float with every move made by the nurse, so as to reach the bars of the grate, is preposterous, and even dangerous, and the good sense of mothers ought to be exerted to lay aside this worthless fashion, and adopt a more moderate manner in this respect. The only really essential points in infant clothing are warmth, simplicity, ease, and cleanliness.

6985. *Ease* ought never to be sacrificed to appearance; no dress that is made so as to compress or bind the person of an infant should be allowed; the use of all bandages, swaddling-clothes, tight ligatures, is most carefully to be forbidden. Every article of an infant's dress should be made as loose and easy as if it could, if needful, be made to slip off the shoulders. Too much stress cannot be laid on this subject. Tight bandaging, tight lacing, or any compression in the dress of children, if continued, injure the respiration and the action of the heart; the spine also often becomes turned by inducing children to put themselves into the posture in which they find most relief, and from the pain arising from any tight ligatures. There should be nothing in the dress of children that can restrain the free movement of all their limbs and muscles. To boys, tight waistcoats and bands are very seriously injurious, causing in them undue pressure upon other and very delicate parts of the body. In regard to the stays of girls, worn in after life, every medical man can explain to mothers the main grounds of objection to them; and no sensible or affectionate mother but would immediately make war with fashion rather than consign her young children to the sorrows and calamities of ill health.

6986. *To keep the head cool and the feet warm* may be a modern axiom, but is a good one. Caps, it is well known, are not an essential in the dress of a young infant. If born with hair, the infant can very well spare the artificial covering usually provided for it. If a cap be not worn by day, neither should one be worn during the night. This plan of dispensing with the use of caps it is very desirable to adopt, if there be in young children any tendency to water on the brain. For the same reason, heavy beaver hats and velvet bonnets, graced with plumes of feathers are the worst coverings for a child's head that can be selected. While the mother is admiring the face and curly hair beneath the heavy hat or bonnet, she is not conscious that the heat and the weight are acting forcibly and prejudicially on the delicate vessels of the head, often causing headache, if not tendencies to severe diseases. The age of the child denies him the power of expressing his suffering except by fretfulness, which alike surprises and vexes the poor mother. A lighter covering of the head might remove this annoyance.

6987. *The feet of children* should be kept warm and dry. A young infant should, in the winter, wear soft woollen socks; and children of all ages should, in this climate, wear woollen socks during three parts of the year.

A different notion and practice were formerly adopted in regard to children. They were seldom seen in socks or stockings; and even some writers on education, Locke for instance, recommend that children should have leaky shoes rather than such as would exclude the wet, as the best means of hardening and inuring them to the changeable climate in which they were born. Modern opinion and practice are the reverse of this; and the consequence is, that more children are reared now than were under the former mode of treatment: then the healthy children only survived; the delicate sunk under the hardening system. To keep the feet dry and warm of infants and children generally is the uniform advice of all medical men of the present day, and also of all persons whose observation has been principally exercised, and their experience gained, in the management of young children.

6988. *Tight shoes*, next to tight lacing, are among the domestic tortures that might generally be spared young children. It is not so much small shoes as ill-made shoes that produce injury to young feet. Shoes that do not fit well are soon worn down at the heel; a child's ankle seems to give way also, and to bend towards the defective part of the shoe; and its step becomes thus, with the use of ill-made shoes, both unsafe and awkward. To avoid this inconvenience, many mothers have boots made for their children; but to wear these constantly has its ill effects also. The ankles become accustomed to the support of the boot, and, when left off, the child appears to have weak ankles, and to be easily fatigued when walking without the support of his boots. Some persons advise for children the use of heavy shoes, as strengthening to the muscles of the ankles. If proper attention could be given by parents to this subject, and the weight of the shoe very properly adapted to the strength of a child's ankle, it might not be an unsuccessful means of adding to the muscular power of children; but when we consider that the strongest in limb among the Irish and Scotch are those who go entirely without shoes and stockings, the importance attached to the wearing a heavy shoe as a means of strengthening the ankles diminishes. To prevent children from sitting or standing long in wet shoes is a much more necessary precaution.

6989. The evaporation constantly going on, from the moisture of the shoe and from the warmth of the foot, withdraws so much warmth from the circulation as is extremely weakening, and especially to children of delicate constitutions. Chilliness is the immediate consequence, often succeeded by inflammatory attacks either of the lungs, throat, or bowels. It is, perhaps, needless to add that children, as a rule, whether the weather be dry or moist, should always change their shoes when they return from outdoor exercise, and are going to remain for some time in the house. Those who have the charge of children's shoes should always attend to their being well dried after they have been used in wet weather.

[A new-born infant is naturally warmer than an adult, and should, therefore, be less burdened with clothing; and this should be *loose*, so that no considerable pressure may be made upon the bowels or upon the limbs. This free motion of the body, and the absence of all compression, are necessary for comfort and health, so that the circulation in the superficial vessels may not be hindered. Malformations and unnatural swellings are often produced by *partial* compression, particularly in female or delicate children, resulting in distortions and deformities, as a consequence of tight clothing. The greater or less amount of clothing should be proportioned to the climate and season. In general, however, all that will be required will be a flannel waistcoat without sleeves, made to fit the body and tie loosely behind, with a petticoat not quite so long as the child, and a frock over this, a little longer, both of some light, thin material, and loosely secured to the body, avoiding any pressure which shall confine the motion of the ribs. All swathes, bandages, and stays are mischievous, and should be prohibited. If any covering for the head is insisted upon, it should be only a thin cap; but it would be far better if the practice of putting caps on young infants were utterly abandoned, as it is by judicious nurses. The friction of the cap wears off the hair, and, besides keeping the head warm, it proves a source of irritation which often results in eruptions upon the scalp and behind the ears, which are seldom or never met with in children who have never worn caps by day or night, in winter or summer. Indeed, there is good reason to believe that a predisposition to head complaints is very often produced by wearing caps, and this of itself is a sufficient objection to their use. Shoes and stockings are unnecessary and injurious, for the former cramp the feet and interfere with their exercise and growth, and the latter keep the legs wet and filthy, unless changed several times a day. Their night dress should be less than that worn by day, say only a loose flannel shirt, else the child will be liable to cold and affections of the bowels. Tape should be used, not pins, in securing the clothing, especially the napkins.

The negro children in slave countries are suffered to lie and tumble about on the floor from their earliest infancy in a naked state, and yet a deformed negro is very rarely seen. This is mainly to be ascribed to the absence of any pressure, such as made by the clothing common among the whites.

Children should be thus loosely dressed from their birth until they are three years old, when the effects of pressure from the clothing will not be so apparent. The only exception to this rule is in the case of weakly children, who, when they begin to walk, require the bowels to be gently supported. This should be effected by a thin flannel waistcoat, made to lace behind, from below upward. Beneath the laced part a slip of flannel may be placed to defend the skin, and which will afford support to the back This serves, in such cases, to prevent the relaxation and obstruction of the contents of the belly, and obviate a disposition to rickets and bowel complaints.]

SUBSECT. 5.—*Cleanliness, and Bathing of Children.*

6990. *Cleanliness, beneficial and wholesome as a habit generally, is especially requisite* in those who have charge of children, whose health and personal appearance are improved or otherwise, according as they are kept clean in their persons and habits. Bad food and bad air may weaken children, and deprive them of their elasticity of body and vivacity of spirit; but, if their skins are kept clean and wholesome, they will escape that squalid appearance which the poor children exhibit who are brought up under the combined evils of bad air, bad food, and uncleanliness. Inactive, perhaps vicious mothers (for such are always wanting in cleanly and orderly habits), neglecting to wash daily their children, to change their body linen, or keep their bedding as clean as, even in their poverty, might be done, must not be surprised if their children are subject to disagreeable eruptions, or more liable to the epidemic diseases of certain seasons of the year than the children of women of better domestic habits. But of such extreme cases of wretchedness we trust there is no need to speak here, except it be to point out that some of the great evils of life have a more aggravated character where cleanliness is wanting than where it exists.

6991. Of *tepid water*, rather than cold, we would advise the use in washing infants night and morning; and, especially if such children be of thin and delicate habits, washing in warm water is not only pleasant, but even nourishing.

6992. *Warm water*, therefore, we would not only employ at first in washing an infant, but continue to use it till the second year of his life. Any sudden use of cold water (we mean during cold weather, for, in the summer, water need scarcely be artificially warmed) we would carefully avoid, in order to prevent that distress at being washed into which some infants appear to be thrown whenever this needful business is in operation. When children cry during their washing, it leads one to think they are suffering either from the awkwardness of their nurses, or from the recollection of some former painful sensations attending this business. We would always encourage nurses to wash young infants very tenderly, in order to spare themselves the pain of hearing them cry, and the reflection that may be made upon their mode of handling and rubbing them. We know that much depends on the skill and carefulness of the nurse; she can do much towards making washing a pleasant or a vexing daily circumstance to herself and charge.

6993. *The best way of washing an infant of six weeks old* is to put it into a pan of tepid water, and, with a soft sponge slightly soaped, to gently rub the whole surface of the body and limbs: three minutes are enough time to effect that, when the child should be taken out, laid on the knee of the nurse (who on such occasions should wear a soft flannel apron), and rubbed gently, yet perfectly dry, with a soft linen towel. We must here insist as much on the benefit of the friction of the body and limbs as on the warm water; and while it is going on a child is often as happy and quiet as if the greatest pains were being taken to amuse it.

6994. *In the morning washings* the head, as well as the body and limbs, should be washed; in the evening it would be scarcely prudent to wet the head, especially if the infant has much hair. It takes too much time to dry it thoroughly in an evening, when the child is probably tired and wanting rest after the day's fatigue. To leave the hair insufficiently dried might incur the risk of giving the infant cold in its eyes or ears.

6995. *In drying* a child, friction should be less applied under the arms or in the bend of the knee than on the back, stomach, or limbs. Under the arms and behind the ears the towel should be gently pressed rather than rubbed: in those parts the skin is extremely thin and tender, and might be excoriated by much friction.

6996. *A child, after it is three or four years old*, may, in all general cases, be safely washed, night and morning, in a tub of cold water, except it be in the severe part of the winter, when a little warm water should be added to this bath. When these morning and evening washings are employed, there can be little necessity for using the plunging bath for children—formerly the panacea for all their infantile maladies; for rickets, scrofulous diseases, cutaneous affections, and emaciation, from whatever cause arising

How the shock and alarm caused invariably by a plunge into cold water could effect so much good it is difficult to imagine, except it was productive of that cleanliness without which the skin cannot perform its duty to the rest of the body.

6997. *Of cleanliness* in the clothing of children little need be said, since all are convinced of its importance to health. Yet, as some persons are fastidiously nice, and others too poor to be so, no rules can be well laid down as general guides in this branch of cleanliness. Mothers and nurses must regulate the use and change of linen according to their own judgment, applied to their own respective situation and means. Cleanliless sufficient for health is not extravagant in its requirements; and in the word health is implied moderation in the use of all the privileges of life.

SECT. IV.—NURSERY ATTENDANTS.

6998. *The head nurse*, one who has the entire charge of the infants of a family, should have health of body, vigour of mind, a well-regulated, yet cheerful temper, and undoubted integrity of heart. So important a post as this in a family should not be lightly intrusted to any one; for, in a household of domestics, which among them has equal power with the head nurse to work good or evil to those who employ her?

6999. *Whenever there is a head nurse* in a household, it is probable there is but little maternal superintendence of the nursery. To have such a domestic implies a rank in life in which minute attention to, or active occupation of, the mistress in domestic details is rarely found. In such rank, mothers see their children chiefly at stated hours, and generally in their drawing-rooms, not in their nurseries, where more might be known of their treatment. A lady frequenting her nursery at unusual seasons of the day, or for any length of time, will no longer lose caste in the eyes of her household. But should mothers of that kind still exist, the importance to them of having for their deputy in the nursery a trustworthy, sensible, good woman, not with eye-service, but in her heart performing the duties with which she is charged, is evident.

7000. *To the head nurse the exclusive charge of the infant* in a family always belongs. She washes, dresses, feeds it, carries it about, and in every way, as time advances, she attends to the development of all its powers. In all respects she ought to take upon her the mother's duties, and it is well for the infant when she discharges them faithfully.

7001. It will be needless here to enter into any detailed account of the treatment the head nurse should adopt in the rearing of infants committed to her care. In the foregoing section most of the important points are there given and discussed; and in all, even in the cutting out, making, and repairing of children's clothing, she will be expected to be skilful and diligent. We have said nothing respecting the making of children's clothing, because its style, and the materials of which the outward dress is formed, are in a constant state of change from the variations in fashion, and with which almost every nurse is as soon acquainted as the ladies whose children they have charge of.

7002. *The chief perquisites of* head nurses consist of the cast-off clothes of children, which should be done away with for very obvious reasons. Their wages are generally, in the high classes, from twenty to twenty-five guineas per annum.

7003. *The customs they are* obliged to observe are those of constant attendance in the nurseries, day and night. A head nurse having an infant under her care is never permitted to leave it, nor to allow under nurses to attend to it more than is absolutely unavoidable. When they can leave the nursery, it is only at night, when they resort to the housekeeper's room at the supper hour.

7004. At christenings, as a privilege, the nurse holds the infant; also, she always carries it into the drawing-room whenever it is required there, and again receives it when it is to return to its nursery.

7005. *Under nurses* are generally at the command of the upper, under whose superintendence they wash, dress, and attend, in every way required, to all the children in the nursery, except the infant, the exclusive charge of the head nurse. Under nurses do all the cleaning of the nurseries, make the fires and the beds, keep clean all the nursery furniture, and the various requisite utensils of earthen-ware. They bring the meals from the kitchen, and wait upon the children while they are at table. Sometimes they are required to assist in washing and getting up some of the children's clothes. In the evenings they assist in making or repairing the children's clothing. Good temper, cleanliness, activity, and a love of truth are important qualities in under nurses. Their usual wages are from eight to ten guineas per annum.

7006. *Of a nursery governess* we may venture to express a preference for an intelligent young person to one of great accomplishments, whose talents might be scarcely called forth, and who might better sustain her part in a family of older children. But although neither great accomplishments nor much learning can be requisite in the nursery governess, something more uncommon in her qualifications is in the highest degree important. We are not accustomed to regard the way in which the first seven or eight years of human existence are spent as unimportant, but very much the reverse: we therefore would seek in a nursery governess for a lady with such powers of mind and such excellent disposition as would enable and dispose her to call forth infantile observation; to fix it on suitable objects; to open and enlarge the infant capacity; to govern with gentle influence the wayward in temper; to encourage and give moral strength to the timid; to cultivate truthfulness to the very nicest degree, brotherly love, and consideration for all. Skill in the mechanical part of education (so to speak) is comparatively of no moment in the qualifications of the governess of early childhood, provided she can teach how to observe and inquire. Unfortunately for children, most parents think otherwise, and undervalue the rousing power, while they overrate the mechanical. It is true that reading, writing, arithmetic, means of acquiring future learning, *must* be taught to children, and there are times in each day which they could not better employ than in acquiring these arts. There are few ladies employed in early tuition who cannot cleverly instruct in even more than these. Yet they may not succeed in obtaining that influence over the minds of children, imperceptible, yet felt, by which their intelligence may be quickened, and their ductile affections regulated and directed. When such power exists over childhood, no deficiency in minor acquisitions should impair the value placed upon it.

[In America, as has been already remarked, this array of nurses is not deemed desirable, nor has it ever become fashionable, even among the wealthy, thus to multiply supernumeraries in the household. The housekeeper, a matronly lady, usually performs the office of "head nurse," by superintending both children and domestics. A wet nurse is employed, not for luxurious self-indulgence on the part of the mother, but as a measure of necessity in the cases in which the health of the mother, or her death, renders it imperative. Dry nurses are seldom relied on for rearing infant children, as but *little* confidence is felt in the safety of raising children by the hand; their services are therefore usually secured only for the older children, and as an assistant to the housekeeper. A child's nurse is very frequently employed among the domestics of the household, whose chief duties consist in holding the infant in her arms, carrying it out into the open air for exercise, and accompanying the mother in visiting, so as to relieve her from the fatigue of attention to the child, except at the intervals necessary for giving nourishment from the breast. As to the *nursery governess* here represented as indispensable, these duties ordinarily devolve on an elder sister, or other female relative who may be an inmate of the family. Indeed, it is found in most households that the multiplication of servants, or "helps," is to be deprecated, and especially in view of the difficulty of procuring trustworthy domestics in this country, which is much greater than in England. There multitudes aspire no higher than to be good servants, and such aim to excel in their several departments, and with the wages of such service they are content, and seek no higher condition. But here servitude is looked upon by most of those employed as degrading, and, however incompetent, they are wont to regard their condition when at service as beneath them, and to be submitted to only under galling necessity, and to be escaped from at the earliest opportunity. Indeed few servants can be found in America, unless among African slaves, who do not aspire after bettering their condition, and securing deliverance from a lot of servitude; and this, however eligible their home or liberal their wages. The fewer the servants, therefore, competent to perform the duties of the household, the better is it regarded by those who have had experience in housekeeping, for they are else liable to corrupt and spoil each other.]

CHAPTER II.

SICKNESS IN THE NURSERY.

SECT. I.—GENERAL OBSERVATIONS.

7007. The following suggestions regarding some of the diseases incidental to childhood are of a practical nature, and intended only for experienced mothers, nurses, or for any others who have the charge of the first few years of childhood. Among this class of individuals some are always to be found who indulge in an excess of apprehension when variations occur in the health of the children they have in charge. Others evince a different feeling; are either unconscious of, or supine when alarming symptoms of disease in children are really apparent. In the former case medical aid is often needlessly called for, in the other that aid is sometimes fatally neglected.

The following pages offer instructions to both descriptions of persons having this desirable end in view—the allaying of needless or the awakening of timely apprehension: herein no instruction or suggestion will be given that in its application would prove dangerous. The line beyond which the *non-medical* superintendent of the health of children should *not* pass is strictly defined, and the moment medical advice should be sought for is as accurately stated as the nature of the subject will admit of.

7008. *The common and simple* affections which attack the majority of children will be found in these pages plainly but briefly detailed, together with the symptoms of some of the more serious diseases, to carry out the object we have stated, namely, that trifling complaints may not cause unnecessary alarm, nor important cases easily escape observation.

7009. We would here remark that were much time expended in describing symptoms and treatment of severe diseases, however lucid and comprehensive such description might be, they could never qualify parents on such occasions to supply with safety the place of medical men. On the same ground, it will be useless to describe the complaints of the first few days of a child's life, because a medical man is at that time always in attendance.

7010. *Before* describing any particular disease, certain alterations in the natural actions of the child must be noticed, which, as denoting the occurrence of disease, are particularly important; they may be easily observed by the mother or nurse, and when noticed, they should be immediately mentioned to the physician or other medical man in attendance.

SECT. II.—ALTERATIONS IN NATURAL ACTIONS WHICH ARE TO BE OBSERVED BY THE NURSE.

7011. These deviations from accustomed action may be comprised under the following heads: Alterations *in the countenance* of an infant; in the gestures; in the cry; in the manner of sucking; in sleep; in the mode of breathing; in the skin.

7012. *Alterations in the Countenance.*—These are not lightly to be passed over. When there is pain in the head the brows are contracted, the eye is generally heavy and somewhat anxious: when in the bowels, there is an elevation and retraction of the upper lip.

Again, if pain be spasmodic, at the moment of seizure the brow contracts, and the child utters a cry; but the brow is not constantly knitted, as it is when continual pain is present.

In convulsions too, before the attack, a change in the countenance occurs, difficult to be described, yet peculiar, and well known to experienced nurses; for example, slight twitchings of the mouth, and unsettled rolling or else fixed gaze of the eyes.

Again, any, the most inattentive nurse, can scarcely avoid noticing any unusual flushing, or pallidity, or blueness, or yellowness of the face.

7013. *Alterations in the Gestures.*—Thus, a child will be observed to hang its head over the nurse's arm, as if too heavy for it; or to throw its head back or to the side, or to be constantly putting its hand to its head or neck; or rolling its head on the pillow. Such symptoms should never be overlooked.

A child may suddenly start, and this happens during attacks of spasmodic pain. In colic the child draws its legs up to its body; in debility, the extended position of the body indicates languor.

7014. *Alterations in the Cry.*—It should be noticed whether it be feeble, or its note altered from the usual pitch; whether there be moaning and sighing. In inflammatory diseases the child often abstains from crying, for fear of increasing the pain by movement. In commencing croup the cry, as well as the cough, is harsh, ringing, and metallic. In very severe cases of thrush the cry may become husky, but such cases are always under the care of a medical man.

7015. *Alterations in the Manner of Sucking.*—In thrush, in dentition, in fact in all cases in which there is soreness of the mouth, the child sucks feebly, with caution, and not long at a time, often leaving the breast for an instant, and then returning to it. The manner of sucking affords a tolerable estimate of the general strength of an infant.

7016. *Alterations in Sleep.*—The alterations particularly to be noticed, and reported to the medical attendant, are, sobbing, sighing, starting, knitting of the brows, drawing of the mouth, grinding of the teeth, quickened breathing, increased perspiration, or heat and flushing of face or skin generally.

7017. *Alterations in the Mode of Breathing.*—It is to be observed whether it is quickened or difficult, or more on one side than the other, or accompanied by moaning or rattling in the throat; whether the breath be fetid, or whether there be a cough.

Under this head it may be worth while to mention, that sometimes from a violent fit of crying, from passion, the child's face gets quite livid, and it almost seems as if it would be choked: a simple and generally successful remedy is plunging the child's hand suddenly into cold water; this induces a convulsive sob or sigh, and air immediately passes into the lungs.

7018. *Alterations in the Skin.*—These consist chiefly in eruptions of various kinds, which should always be attentively noticed; any unusual coldness, dryness, or, on the other hand, heat or much moisture of the skin, should not be allowed to escape notice. A singular purple streak at the verge of the eyelids was considered by Dr. Dennan as distinctive of the disease called "morbid shuffles," which usually appear after the first month. We have said nothing of alterations in the motions, the tongue, or the urine; these are too obvious to be overlooked. We have said thus much on these alterations from the natural state, because we are convinced that the importance of early noting them cannot be overrated. They mark, in some instances, the commencement of diseases, which, easily arrested by treatment in their early stages, may be in their developed attack intractable and dangerous in the highest degree. Again, they are much more easily discerned by the mother or nurse than by the physician, because the former knows the natural state of the infant, of which the latter is necessarily ignorant; and it is not the *mere presence* of these symptoms, but their presence as *alterations*, which should excite alarm.

Sect. III.—Diseases of Children.

Subsect. 1.—*Slight Diseases.*

7019. In addition to diseases common to all, children are liable to some peculiar affections, as croup, water on the brain (*Hydrocephalus acutus* of medical writers): there are also some affections more common in them than in adults, and which few children escape.

7020. *The arrangement we shall adopt* is recommended only by its convenience, and it is void of all pretension to technicality. We shall consider, under three heads, 1, a few simple complaints which are seen every day in the nursery; also, dentition and its consequences; 2, the early symptoms of certain serious diseases peculiar to, or more common in childhood, such as croup, convulsions, water on the brain, and the disease commonly called at the present day "remittent fever," and its consequence; 3, the commencement of certain diseases which commonly attack every one, as measles, scarlatina, smallpox, and hooping-cough.

The first disease we shall notice is an extremely common disease of the skin; it is generally called, in common language, "*red gum.*" It is often seen a week or two after birth; red spots are seen on the breast, back, loins, &c. It is generally of little consequence, and will frequently disappear with a dose or two of aperient medicine, or often without anything at all. In older children, and when more obstinate, it may sometimes be suspected to depend on an acescent, or, at any rate, altered state of the milk.

Another skin affection of little consequence is a blush of redness, with perhaps a little excoriation (*Intertrigo*), caused by neglect of proper cleanliness, and in parts rubbing on each other; it is easily cured by cleanliness, and the use of some simple ointment to diminish friction.

7021. *The next affection we shall notice is vomiting in the first months of life.* This often arises simply from repletion, or from temporary alteration in the milk of the nurse: the matter vomited is like milk, generally curdled, if it has been for half an hour or so in the stomach, and in colour white or slightly yellow. If it be hard, darkish, very yellow, in fact, much altered from the natural appearance of milk, then probably the cause is to be looked for in insufficient evacuation of the bowels (which should always after birth be acted upon), or perhaps the infant has been incautiously exposed to cold. In the first instance (when the vomited matter is simply returned milk), a little dill or anise seed water may be given; but often nothing more is required than to take care that the child does not suck too much at a time, or too greedily after fasting. If the vomited matter be dark and hard, and if the child be old enough, it is often necessary to give an emetic; a grain of ipecacuanha is a safe and gentle emetic for children of a month old; two grains may be given when the child is a year or more old. Should the vomiting still continue, a more dangerous cause than those now mentioned is to be apprehended, and no time should be lost in seeking medical assistance.

7022. Another extremely common and slight affection is *colic.* The child cries, starts when moved, and lies with its legs drawn up upon its bowels; there is much flatulence, the bowels are probably confined; when motions are procured, instead of the natural yellow, they are green or dark. In treating colic, the cause should always be attended to; too much healthy milk, or acid milk, or improper spoon meat, or insufficient evacuation, or exposure to cold, are among the most common causes: if the milk be in too great abundance, its quantity must be lessened; if it be acid, or if the spoon meat be improper, its quality must be altered; cold must be avoided; the bowels must be opened by calcined magnesia, with or without a little castor oil; rhubarb is too stimulating for very young children; warm fomentations should be applied by means of flannels, wrung out of warm water.

If the bowels are not moved, then medical aid is generally requisite, as sometimes, though fortunately rarely, colic passes into a dangerous disease, in which a portion of intestine slips down into the part immediately below it, and thus closes the passage (*Intus susception* of medical writers).

7023. *Diarrhœa.*—Induced often by causes very similar to those which are active in colic is a relaxed state of the bowels, or diarrhœa. It may often be traced to repletion, unhealthy milk, sudden changes of temperature. It often occurs in older children, from injudicious attempts to wean, from previous costiveness, and it is commonly said, also, from dentition, particularly of the double teeth. The motions are watery, and generally greenish, or, at least, altered from the healthy colour. Although often a very trifling affection, it should never be neglected, as sometimes it is difficult to check. The treatment depends upon the cause. If bad milk has irritated the bowels, it must be given up, and ass's milk, or the milk of a fresh nurse substituted, or a little beef gravy, rendered palatable by a little sugar, may be given: another tolerable substitute for the nutritious milk of the mother is the mucilage of barley or wheat mixed with a little gravy. If the diarrhœa result from change of diet, the infant should be fed only with the simplest food, as milk, the mucilage of wheat, &c. A gentle aperient will generally be sufficient to effect a cure; should it not, other measures become necessary, and a medical man should be consulted.

7024. *Worms.*—The following are some of the chief symptoms generally enumerated as characteristic of the presence of worms: irregular appetite, which is sometimes voracious, at other times languid; there is often a craving for food after a full meal; the bowels are sometimes costive, more generally loose; the motions are slimy and pale; often there is a little colic, and sometimes feverishness; the breath becomes fetid; there is often a livid circle round and under the eyes; after a time the child gets amaciated, and the abdomen becomes enlarged; the upper lip often becomes thickened, and sometimes also the nose; the child often picks its nose, and during sleep grinds its teeth. It seldom occurs that all these symptoms happen at the same time; and there is not one peculiar to and distinctive of worms. The most unequivocal are the irregular appetite; the craving for food after a full meal; the bowels at one time costive, at another relaxed, and the slimy characters of the motions: when these symptoms are present, worms may be suspected; but the only proof of their existence is seeing them in the stools. Such are the symptoms of two kinds of worms, the round and the tape worm (*Lumbrica Tænia*); into the treatment we do not intend to enter, as we are of opinion that in every severe case medical assistance is necessary. If aperients fail, the remedies, more particularly vermifuge, must be prescribed by the medical attendant. One remark may be made about the diet of children labouring under worms; it should be very simple, and not too saccharine. Sugar itself, when taken in excess, seems in certain habits to produce worms. A nutritious diet is generally necessary, for in these cases the health is often impaired, as evidenced in the pale, bloodless face, the white tongue, feeble pulse, and languor of body; indeed, such a state is often the precursor and the cause of worms; and removing it removes its sequence. Some practitioners suppose that neglecting to take salt with the food has some share in producing worms; and, whether this be correct or not, it is advisable to take the usual quantity, or perhaps even a little more. There is another kind of worm, called, in common language, the

7025. *Thread-worm* (*Ascarides; Oxyuris* of medical writers).—This worm makes its abode in the lowest portion of the intestinal canal; it seldom produces the severe effects ascribed to the round and tape worms. On examining the stools, it is easily seen; it is from a quarter to half an inch long, and, as its name denotes, of slender frame. These worms are easily removed for a time by injections of warm water, and their reproduction may generally be checked by injections of the infusion of the seeds of the *Santonica* (*Artemisia Santonica*), or of the solution of salt and water; or a good and popular remedy is solution of aloes in water. The best method of preventing them from increasing is to strengthen the frame generally, especially by the administration of the salts of iron, and a generous diet.

7026. *Thrush.*—Under this name popular opinion classes several distinct though allied diseases. We shall not attempt to discriminate these, but merely describe the disease in a superficial manner. By the term "thrush" is commonly understood small white vesicles, situated within the mouth, on the tongue, and inside of the cheeks; accompanying these there is generally a little derangement of the digestive organs; a little loss of appetite, or diarrhœa; the mouth also is sore, and the child sucks with pain and difficulty. It is more common in weak and sickly children, but it may appear in the most robust. All that is necessary for its cure is a gentle aperient; and in mild cases a lotion for the mouth, composed of borax and water, or honey, or a weak solution of nitrate of silver in water; this should be painted on gently with a camel's-hair pencil; not rubbed on roughly with the finger, or with flannel, as is sometimes done by nurses. In more severe cases, emetics are often useful, but to these cases a medical man should always be called in. Among the ill-fed and neglected children of the poor, and also sometimes in densely-crowded lying-in hospitals, a malignant and dangerous fever accompanies the thrush; or, to speak more correctly, of the intestinal derangement accompanying which the thrush is but a symptom. This complaint, however, is not common, and we shall not occupy any space by a description of it, as it should never be treated except by a medical man.

7027. *Dentition and its Consequences.*—It is customary among medical men, and those whom they attend, to attribute the majority of infantile diseases to this natural process. There can be no doubt that certain diseases do arise during the progress of dentition, and appear to be referable to it; but indiscriminately to lay to its account all the complaints of childhood, as some do, is little else than a confession of ignorance. The words of a French writer, Guersent, on this subject, may be quoted in support of this opinion. "On attribue," says he, "dans la monde, la plupart des maladies de l'enfance au travail de la dentition. La difficulté d'observer les maladies du premier âge, et le peu de connaissances positives que nous avons sur cette partie de la pathologie, ont contribué à emaciner cette opinion, et ce préjugé, resultat de notre ignorance, est ensuite devenu populaire comme tous les autres préjugés du médecine."—*Guersent, à l'article* "Dentition," du "Dictionnaire de Médecine."

Before enumerating and briefly noticing the diseases commonly ascribed to dentition, we shall make a few remarks on the appearances presented during the cutting of the teeth. It occasionally happens that one or two teeth are through even at birth, as was the case with Louis XIV. and with Mirabeau (*Billard*, "Traité des Maladies des Enfans:" Paris, 1833, page 260); however, the first tooth seldom appears before the seventh month after birth. About this time the child is observed to be fond of putting its fingers, or any hard substance it can get hold of, into its mouth; during sucking it will sometimes suddenly throw its head away from the breast; there is an increased discharge of saliva, which trickles down from the corners of the mouth; on looking at the gum it is seen to be swollen and rounded, and no longer to present the horny edge it possessed at an earlier period of life; by degrees the white colour of the tooth can be seen shining through it, and finally the thinned and yielding gum is entirely removed, and the tooth rises from its socket.

This process is often assisted by lancing the gum, which operation seems to be useful, not by dividing the gum, and thereby giving freer exit to the tooth, but by cutting through a little sac, in which originally the tooth was generated, and which, by becoming thickened, hinders the rising of the tooth. If the useful part of the operation be the division of this little sac, then it is evident that the lancet should always cut deep enough to grate upon the tooth. It may be that the lancing is beneficial by taking blood from the inflamed and painful gum. The statement which some have made, that, if the divided gum unite, it makes a firmer barrier than before against the tooth, appears to be unfounded; cicatrices are always more yielding than original tissues. In addition to the symptoms enumerated above, and which are always present, there are some others less common, and which may therefore be referred to unnatural dentition. These are, swellings of the glands in the neck, swelling of the hands and feet, feverishness, a difficulty in passing the water, &c.

7028. The diseases commonly referred to dentition as their cause, are, 1. Eruptions of the skin; 2. Emaciation; 3. Vomiting; 4. Diarrhœa; 5. Cough (inflammation of lungs); 6. Croup; 7. Convulsions; 8. Water on the brain; 9. Ophthalmia. Some of these complaints have been already noticed, as far as is consistent with our plan. One remark may be made about the diarrhœa attending dentition. It is an observation of Hippocrates that those children cut teeth fastest whose body is lax: common opinion has fully confirmed this remark; it has also gone still farther, and considered every diarrhœa during dentition as of use; and some writers direct such diarrhœa not to be arrested. Without entering into this question, one may safely say, that, if it arise from this cause, parents need not be alarmed about a diarrhœa, even if it be very considerable.

7029. *Rashes attending Dentition.*—One common rash is the red gum already mentioned. Very often the eruption has little watery heads, or resembles flea bites, but without the red point seen in the centre of these latter.

Another rash is one which sometimes leads parents to dread the accession of measles or scarlatina. It is a red blush, most observable on the extremities, but attended with little fever. Measles is preceded by running from nose, and a peculiar cough, and *scarlatina* by sore throat, and running from the eyes; and the absence of these symptoms in the rash now mentioned generally points out its real nature.

Another rash, presenting dull, red patches, chiefly on the legs, with here and there small swellings, is also sometimes seen. This is said to be more common when the eye teeth are cutting.

There are several other rashes, but less common than these, and which, therefore, need not be adverted to.

7030. The emaciation attending dentition is a consequence usually not immediately of the dentition, but of some of its products, as diarrhœa, fever, &c.

7031. The other disorders, as convulsions, croup, &c., will be noticed afterward.

7032. In all these cases it is, of course, difficult at once to put down the disorder to dentition; but as this *may* be the cause, it is proper in every instance to lance the gums well; and we may conclude this short account of the sequences of dentition by mentioning a remark made long ago by Dr. Underwood, that to effect permanent good it is often necessary to do this, not once merely, but many times, and on successive days; and with this remark the experience of most practical men will lead them to accord.

SUBSECT. 2.—*Early Symptoms of severe Afflictions most commonly seen in Children.*

7033. The first disease we shall notice is *convulsions, or fits*. A child is said to be in a fit when there are involuntary spasmodic movements of the muscles; the hands are clenched, the thumbs drawn in across the palms; the arms are bent and drawn to the side, or across the body; the feet and legs are drawn up; the muscles of the face distort the mouth, about which there may be a little froth; the eyes roll upward and inward, and the face becomes purple from a difficulty of breathing. After a short time the muscles relax their spasm, the eyes shut, the mouth resumes its customary appearance, and the child breathes easily, and seems quite recovered, or perhaps a little drowsy and heavy.

We presume that no parent would ever dream of treating such a disease herself; medical aid should always be promptly obtained. Very little assistance can be given in the fit itself; the head should be raised, everything removed from the neck, and, if the tongue be protruded and bitten, bits of cork must be inserted between the teeth, so as to prevent them from completely meeting. Throwing a little cold water in the face has appeared to some persons to be useful. The warm bath should be used, both in the fit and in the intervals.

Although we shall not enter upon the treatment of convulsions, we shall make a few remarks on some of the more common causes. Dentition certainly produces fits, and lancing the gums repeatedly often removes them. Too much food, and improper food, also, is a usual cause. After eating very largely, children have been known to die suddenly in convulsions. Again, too thick food in children who are brought up by hand without doubt produce convulsions: even after weaning, too much bread or rusk seems hurtful, by irritating the lining membrane of the bowels; the diet, therefore, should always be most carefully attended to, even if the fit should have proceeded from some other cause. Before the accession of smallpox, and sometimes measles, one fit or more will occur; and so far is this from being dangerous, that popular opinion regards it as favourable, and as indicating a mild attack, and certainly there is no reason for thinking that it foretells any particular severity of disease. In these cases the feet may be bathed in warm water, and a warm water injection may be given. In mentioning this, we may take this opportunity of recommending the warm water injection as a most useful assistant in securing a due regulation of the bowels in children.

We conclude this short account of convulsions by recommending in all cases the free use of mild aperients, particularly of castor oil, in doses proportioned to the age of the child.

7034. *Croup (inflammatory).*—Were medical aid sooner sought for in cases of croup, the mortality from this formidable disease would, no doubt, be very much lessened; but, unfortunately, few parents or nurses are sufficiently acquainted with those slight, yet often distinctive, symptoms which mark its early stage. At first the symptoms are those simply of a common cold; and at this time the dangerous sequence cannot always be perceived; but very often, in addition to the quickened breathing, there is an unusual resonance in the cough, something like a little metallic sound or barking; and when the child draws in its breath, there is a roughness in its sound, heard distinctly by the nurse when she places her ear close to the mouth of the child. Even in this stage the windpipe is often painful; the child raises its hand to its neck, as if to invite attention to the seat of its uneasiness. If proper measures could be taken in this stage, most children would doubtless recover; but if the parents wait till the breathing becomes much hastened and hoarse, and the cough hard and brazen, and till fever has set in, then the disease is much less easily subdued. It is much better to be deceived half a dozen times than once to overlook a case of croup; and we earnestly recommend all parents, immediately they perceive a roughened breathing and a resonant cough, and particularly if there have previously been symptoms of a cold, to lose no time in sending for medical advice. One of the best remedies in the early stages is an emetic; and this may be given without waiting for the physician: for a child of a year old, two grains of ipecacuanha is a proper dose; for two years old, four or five grains; for three years old, six grains; for four years old, seven grains; for five, six, and seven years old, eight or nine grains. An aperient may also be given, and the child should be placed in the warm bath. The other treatment must be left to the medical attendant.

Croup is more common on the eastern than on the western coast of England: it prevails most in damp situations, and in those exposed to the keen east or northeast winds. It is rarely met with before one or after eight years of age.

Before leaving this subject, we shall notice one circumstance in the history of croup which is calculated to excite fallacious hopes, and to lessen the assiduity with which remedial measures are employed—we allude to an apparent alleviation or remission of the disease which often takes place; for example, in the evening the child may be very feverish; the voice extremely hoarse; the cough violent, and loudly ringing; the neck swelled and puffy; the eyes watery; the head thrown back; in fact, all the symptoms of severe croup present: these things last through the night, but in the morning a great improvement may seem to have commenced; the fever has subsided, and the restlessness and anxiety have disappeared; the cough is lessened, and the breathing, though still roughened, is easier and more tranquil. But this improvement is temporary; with the evening all the severe symptoms return with augmented violence, and if the necessary measures have been omitted, much times is lost, which, in so rapid a disease, can never be regained. After an attack of croup, much care must be taken in avoiding cold winds and damp places; change of air is often beneficial: from time to time there may be a little recurrence of the cough and hoarse breathing, but these symptoms seldom continue, and need not generally excite alarm.

7035. *Inflammation of the Brain* (*Hydrocephalus acutus* of medical writers).—The observations made on the early recognition of croup are applicable also in this place. This disease, perhaps the most formidable and dangerous of all the diseases incidental to early life, and in its developed stage intractable in the highest degree, presents a short period only in which remedial measures can be used with any great chance of success. Fifty years ago recovery was rare; in the present day perhaps half of those attacked recover. This alteration is to be attributed, in part, to a more correct knowledge of the nature of the disease, and in no inconsiderable degree to the minute attention now paid to its early symptoms. Inflammation of the brain in children is generally seen between the second and tenth year: it is said to be most frequent in those distinguished for premature development of the intellect; certain constitutions seem to be more liable than others to its attack, for sometimes it affects every member of a particular family. In cases in which two or three children of one family have suffered from it, every, the slightest symptom must be noticed, and the signs which we shall presently enumerate carefully attended to. Inflammation of the brain in children may attack *suddenly*, but in the greater number of cases there are certain *warning* or *premonitory* symptoms, to which we particularly invite attention. These symptoms indicate derangement of the digestive organs: the child is noticed to have partially lost its appetite; seems dull and heavy; sleep is disturbed; and during sleep there is much sighing, and occasionally there is starting and crying; it seems as if the child were dreaming; the bowels are irregular, or more frequently there is costiveness, which is overcome with difficulty. When motions are procured they are seen to be scanty, dry, of a white, or, on the contrary, of a very dark colour, slimy, and fetid. Soon afterward there is feverishness; the skin is hot, the mouth dry, the child picks its nose and lips; there is thirst, and perhaps the breath is fetid. Very shortly afterward the child, if old enough, complains of pain in the head; the brows are continually knitted; the hands are raised to the head and back of the neck, and occasionally there is tottering in the walk; the child raises its foot as if to step over a threshold, as if there were some obstacle in the way; the eye presents a peculiar appearance, the expression is dull and heavy, but the eye itself physically is light and sparkling; there is often vomiting, and particularly on raising the child from the recumbent to the erect position; the tongue is dry, white, yellow, or brownish. If the child be too young to express itself, it may often be seen to hang and droop its head over the nurse's arm, as if it felt too heavy for it; the brow is knitted; there are occasionally fits of crying, and the expression of suffering seems often to have given a premature and melancholy appearance of age to the countenance. These symptoms are truly "*warning*;" but they do not always occur, or they may be slight and overlooked by the nurse, although evident enough to the eye of the medical man, who has been taught to observe them. Again, all are not usually present in a single case, and there are several diseases which resemble, in many of their characters, the early stage of inflammation of the brain. For instance, if the symptoms caused by worms are looked over, a great similarity is perceived in both diseases. There is loss of appetite, restlessness, grinding of the teeth, starting, sighing, irregularity and depraved condition of bowels, picking of the nose and lips, and feverishness. It is true that there are often certain differences; in one case the bowels are more often relaxed, in the other constipated (though this does not always hold good); the expression of the countenance is different, and, in worms, there is often craving after a full meal; and there are some finer distinctions, which the practised eye will alone recognise; but a nurse can hardly be expected to make these somewhat minute distinctions. Again, one form of a disease which we shall have occasion briefly to describe (gastric remittent fever of infants) presents many points of similitude to the warning stage of inflammation of the brain; and there are some other diseases which are somewhat similar. Dentition produces symptoms somewhat similar in young children. But supposing these more tractable disorders *are* mistaken for inflammation of the brain, and unnecessarily alarm, is it not better that this should occur twenty times than that a true case of inflammation should be once overlooked? And, moreover, inflammation sometimes succeeds to these, and is, as it were, ingrafted on them. We will presume, then, that when some, or all of the above symptoms occur, the prudent mother will endeavour to remove them; she will, perhaps, call in medical assistance, and this is the safest plan; but, for the sake of those who cannot always command immediate attendance, we will enumerate the chief measures to be adopted:

1. *Diet.*—Nature often points out, by the loss of appetite, that food is unnecessary, perhaps hurtful. If some appetite remain, food may be given; but it should be of the lightest and most simple kind, farinaceous and milky; its quantity also should be lessened.

2. The warm bath should be used once or twice a day; the child should be kept quiet, and not excited in any way; should take moderate exercise, but not too much: cold must be carefully avoided.

3. Aperients must be given. Now, although we are no friends to the indiscriminate employment of mercury in infantile diseases by parents, and wish to condemn in the strongest terms the use of calomel on the slightest occasions, we think that in the present case an exception may be made to our general rule. A mild preparation of mercury with chalk (*hydrargyrum cum cretâ*), known often by the name of "gray powder," is extremely useful in improving the condition of the bowels in the disease we are now considering. For a child of three years old, four or five grains may be given; for a child of seven or eight years, seven or eight grains; it should be taken at night, and followed next morning by a dose of castor oil, two, three, or four tea-spoonfuls, according to the age of the child. The mercury and chalk may be repeated on the following night, and the castor oil again the next morning. The mercury should not be repeated again without medical advice. The child perhaps may improve under this treatment, and the serious symptoms may disappear; but still, for some time, castor oil, the warm bath, and a careful diet should be used, and a recurrence of the constipation and disordered bowels must not be overlooked. If the disease does not yield, and the bowels get tender, and the headache and restlessness increase, no time should be lost in getting medical aid; it becomes necessary to apply leeches to the head and bowels, to give mercury in a more active form, and, in fact, to employ energetic treatment. Supposing that the warning symptoms we have described are overlooked or do not occur, certain symptoms ensue which indicate more directly the affection of the brain: the head gets hot, particularly at the front and back of the head; there is constant vomiting; increased heaviness; at times the child cries violently; the light seems to hurt the eyes; the pupil of the eye is contracted; soon afterward there is complete stupor, squinting, screaming, perhaps convulsions; the pupil is now dilated, not contracted; the pulse is irregular; the feet and hands become cold; the child seems sinking. Sometimes after this there appears to be a great improvement: the pulse rallies, the hands and feet recover their warmth, the extreme drowsiness and stupor disappear; the child sits up, recognises the by-standers, speaks rationally, takes its medicine, and hopes, unfortunately unfounded, are excited in the breasts of all but the medical attendant; for speedily the stupor returns, the pulse grows weaker even than before, a deadly paleness spreads from time to time over the drawn and emaciated countenance, cold perspirations bedew the skin with a clammy moisture; the convulsions, which may never have entirely ceased, augment in violence, and cease only with the increasing stupor, or terminate with life. This "lightening before death," as it is called in some parts of England, is, however, not very common; more generally the symptoms of stupor and convulsions never pass off, and death ensues suddenly in an attack of convulsions. The treatment of this advanced stage of the disease of course will not be described. Medical men should always be in attendance during the whole of the disease.

7036. *Remittent Fever in Infants.*—Our space compels us, somewhat reluctantly, to shorten our remarks on this very common affection. It is a disease most frequently seen between the ages of two and six. There are two chief forms in which it appears; in one case its attack is sudden, in the other gradual. In the first, or sudden form of attack, the child goes to bed apparently in perfect health, but in an hour or two is found with a burning, dry skin, a flushed face, and a quickened pulse; there is headache; the eyes seem red, and turn away from the candle; the child is very thirsty, restless, even a little delirious; there is pain in the stomach, and perhaps vomiting of a sour greenish or yellow liquid. Such an attack may generally be traced to over-eating, or to the assumption of rich and highly-spiced food, or, perhaps, after a meal of the usual kind the child has been exposed to cold and damp. If the attack seems to originate from a surfeit, then an emetic of ipecacuanha should be given, the dose the same as that mentioned under the head of "Inflammation of the Brain." After this an aperient of castor oil is useful. The warm bath should be used once or twice. The next morning the child may appear quite recovered, and sometimes really is so; but more frequently the feverish symptoms return in the evening, although, perhaps, not in so intense a degree. A few days' abstinence, mild aperients, and the warm bath will usually set everything to rights; but the attendance of a medical man is generally necessary.

The gradual form of remittent fever presents symptoms strikingly similar to those described under the head of "Premonitory Symptoms of Inflammation of the Brain;" and, indeed, there is no doubt that these two diseases are convertible into each other. This form of disease is often left after measles, scarlatina, hooping-cough, or any affection which exhausts the strength of the child. There is loss of appetite, a furred tongue, and fetid breath, costive, or, more generally, loose bowels and feverishness, increased, it may be, at some particular periods of the day. After a time the abdomen becomes enlarged, the child gets emaciated, and the skin hangs in folds, giving an aged appearance to the aspect; there is a hacking cough, restlessness, and perhaps great thirst, and, it may be, even a great craving for food, and much irritability if it be not immediately obtained; but more commonly there is loss of appetite; there is also very generally a propensity to pick the nose, upper lip, and any sore place or spot upon the skin. Treatment is often very successful; it is, however, diversified, and the attendance of a medical man is always necessary. The bowels should be kept open by rhubarb and castor oil, gentle doses of the gray powder (mercury with chalk) given every night, and the warm bath be used regularly twice a day. The diet should be very mild; barley water, thin arrow-root, and, when convalescence is approaching, chicken or veal broth. After a time tonics become very useful; but these at first must be of the mild and unirritating kind. In more severe cases of infantile fever the treatment is somewhat different; leeches and other lowering measures become useful; and medical attendance is necessary, to prevent the disease from running on into a chronic and dangerous form.

SUBSECT. 3.—*Commencement of some Diseases which few Children escape.*

7037. *Smallpox.*—The symptoms, in an unvaccinated individual, which would lead one to believe that an attack of smallpox is about to occur are the following: There is for some days after exposure to infection a degree of languor and lassitude, feebleness of the limbs, restlessness at night, and, it may be, a little loss of appetite, and nausea after taking food. In a few days more the patient feels chilly, and there is an undefined sensation of indisposition; shivering fits occur from time to time, and soon afterward pain in the head, back, and limbs, and at the pit of the stomach; in children a convulsive fit, or several fits, may occur, and these are seldom dangerous, and certainly do not indicate a particularly severe attack. There is often sickness and vomiting. Then, in about forty-eight hours after the first shivering fit, minute pimples are discoverable on the face and forehead; the sides of the nose, chin, and upper lip are the parts first affected; then the rest of the face, the neck, the wrists, and ultimately the rest of the body. These pimples may be far apart from each other, or set close together, so as to unite each other; from this two varieties have been made, the *distinct* and the *confluent.* The pimples increase in size, and a liquid is effused into them; in medical language, they become pustular, or, as the common people say, they acquire "heads." The fluid is at first clear, but it becomes, after a time, turbid and yellow. The majority of the pustules have a depression in the centre, which is characteristic of the smallpox eruption. After seven days the eruption is at its height; it then "turns," and yellowish or brownish scabs form, and drop off in the course of a few days more.

Immediately before the turning of the pustules there may be an increase of fever, the pulse becomes quicker, and there may be considerable delirium. The face swells; the eyes are closed; the feet and hands are swollen; there is considerable itching of the skin; and the child picks the scabs till they bleed, and form perhaps quite a sore place.

Such is a description of many of the milder cases; it would be here impossible to give an account of the many different and severe varieties which may occur.

It is impossible for any one to say with certainty, from the first symptoms only, that smallpox is impending; but the mother cannot do better than give an aperient of castor oil, the dose of which must be proportioned to the age of the child, and the warm bath may be used once.

During the course of smallpox the diet should be of the mildest kind; cooling drinks are very useful, and are taken with eagerness. The advantages of cool air and cleanliness are now universally acknowledged. It is, however, a practice among many old nurses, when they are engaged to attend children, to endeavour to "throw out the pock," as they term their object, by stimulating remedies, particularly saffron and aromatic waters with a little spirit. It is necessary in many cases to keep strict guard over nurses, lest they give more to their charge than is recommended by the medical attendant; and the old heating regimen was scarcely more injurious than the practice of giving saffron, spirits, and "Godfrey's cordial" in the first few days of smallpox. Any cough, or breathlessness, or hoarseness at an early stage of smallpox should be especially noticed and reported to the physician. The motions also should be observed every day; sometimes they are dark and slimy, but more frequently, perhaps, they are whiter than natural, and watery; in either case the circumstances must not be overlooked.

Various plans have been tried to prevent the "putting" of smallpox, a thing of great importance, on the face. From the structure of the smallpox pustule, we do not think any measures likely to be of much benefit. Sometimes letting out the fluid with a needle has appeared to be of service; medical men often try some other plans, such as covering the face with a mask of mild mercurial ointment, applying a solution of lunar caustic, but with little benefit. Drying powders, as of calamine or starch, may be used when the fluid from the pustules is very profuse. To lessen the itching, cold cream or sweet oil is often used, and the fingers of children should be covered with cotton wool, secured on by a linen glove, to prevent excoriation from continual scratching. In convalescence, nutritious diet must be very cautiously given; change of air, particularly at the seaside, is extremely useful.

7038. *Vaccination.*—In the present day, the advantages of Jenner's great discovery are everywhere felt, and universally acknowledged. Just conceptions of its value have superseded, on the one hand, the opposition of ignorance, and on the other the extravagant expectations of benefit which many of its early supporters entertained. Although in many cases its protective influence against smallpox is perfect, yet in others it fails; the causes of its failure are sometimes not obvious, but certainly this occasionally results from the vaccine eruption not running its proper course, but being deficient in some important particular. Our object, at the present time, is to portray its necessary changes, in order that any deviation from these may be noticed, and lead to a renewal of the vaccination.

It is customary to vaccinate children a few weeks after birth; unless the child be remarkably sickly, there seems no reason to prevent its being done when a week or a fortnight old; but as young children are not very susceptible of the smallpox contagion, it is often delayed for several months. The vaccine matter is inserted by means of a lancet, on the outside of the upper part of the arm. On the third day after its insertion the little wound or wounds, for several punctures are commonly made, appear red and a little swelled. On the fifth day a little vesicle is seen, filled with a transparent fluid; this vesicle is circular or oval. On the eighth day the vesicle is seen to have considerably enlarged; in colour it is yellowish or pearly, with a depression in the centre; the skin around its base is reddened, and this redness extends for a variable space, from a quarter of an inch in breadth to two or more inches; there is also some little swelling and pain; the child is often feverish and irritable, refuses the breast, and the bowels are a little deranged. The redness increases in degree, or, at least, continues in an intense degree till the eleventh day; it then begins to fade. The vesicle by this time has generally burst, and, drying up, forms a circular scab, of a brown or mahogany colour, which falls off in about seven or ten days afterward, and leaves a round scar marked with indentations. The glands in the neck are often swelled, and frequently a number of reddish spots appear over the body; they are of no consequence, and die away without any treatment.

It is of great importance to note these consecutive changes. If the vesicle, instead of being round or oval, tinged and depressed in the centre, is angular, pointed, with little or no redness round it, and if its contents are opaque and very yellow, instead of being pearly and transparent, the vaccination has not succeeded perfectly, and no security against an attack of smallpox can be reckoned upon. Or again, if the scab is a light yellow instead of brown, and falls off in a day or two, instead of sticking on for six or eight days, the process has not succeeded. Or if the redness round the vesicle has extended up to the shoulder and neck, or if the vesicle itself become converted into a sore, revaccination is necessary. In fact, any deviation from the regular and successive changes should be regarded with suspicion, and, as a matter of simple precaution, the child must be vaccinated again and again, till a proper and complete visicle be formed.

7039. *Scarlet Fever* or *Scarlatina.*—The degree of danger attending scarlatina, as in the cases of smallpox and measles, is very different in different cases. Sometimes the affection is so mild that it appears unnecessary even to confine the little patient in bed; at another time it is so severe that it is highly dangerous to life.

In the symptoms indicating an approaching attack, usually denominated "feverish," the child is first cold and then hot; complains of headache and pains in its back and limbs; feels sick, and perhaps actually is so. So far the case resembles smallpox, or the commencement of common fever; but, in addition, there are certain peculiar features, particularly in the severe form. One of these is sore throat, which may be exceedingly severe, pain about the jaws, difficulty in swallowing, running from the eyes, which look red and inflamed; and at this time the skin is often exceedingly hot, the face flushed, and there is intense pain in the forehead, or all over the head. We do not intend to assert that every feverish attack attended by sore throat is a commencing case of scarlatina; feverish symptoms accompany sore throat alone, as every one knows; but if with first chilliness, and then a hot and dry skin, headache, sickness, and loss of appetite, be conjoined sore throat, and if there is also running from the eyes, scarlatina should be suspected, and the case treated accordingly.

If it be a case of scarlatina, then on the second day after the accession of the febrile symptoms the rash appears on the face and neck, and gradually extends to the rest of the body, so that on the third day it spreads over the whole frame. It is of a strawberry red colour, and the tint deepens towards evening. Between two portions of the rash one may often remark a part of the skin of its natural colour. On the fifth day after its first appearance the rash gradually fades away, and as it does so the outer layer of skin in most cases peels off, or, in medical language, desquamates. Throughout the course of scarlatina the tongue is red and furred, the papillæ of it are elongated, there is thirst, quickened breathing, increase of fever towards night, and during the night perhaps even delirium; the nurse should notice whether there is any cough with the quickened breathing, and, particularly, whether any sharp, cutting pain is complained of in the chest or bowels—a circumstance which is often denoted by sudden screams, repeated from time to time, particularly when the child moves in bed; it should be observed, moreover, in what way the child ordinarily lies, whether more on one side than on the other, or whether on the back, with the legs drawn up or extended. The drawn-up limbs indicate pain in the abdomen; the extended, great debility

Treatment.—Supposing scarlatina is apprehended, the administration of an emetic is often of essential service: ipecacuanha should be given when the child is under four years of age; when above four years old, either ipecacuanha powder, or a preparation of antimony, commonly called tartar-emetic, may be used. The mode of giving this is the following: one grain, weighed very carefully, is dissolved in six ounces of water, and half an ounce, or about a table-spoonful, is given every half hour; in two doses the child is generally sick, and then the medicine may be continued every two or three hours, in the same doses; or, what is perhaps safer, discontinued till the arrival of the medical attendant. If the skin be very hot and dry, sponging with cold and slightly tepid water is very useful and agreeable to the child; cold cloths may be applied to the forehead to lessen the headache, and inhalation of warm watery vapour, by holding the mouth over a jug of boiling water, sometimes relieves the sore throat, if this be severe. Cool air and drinks are necessary, yet chilliness of the surface of the body must be carefully avoided, especially towards the end of the attack. It is, however, during convalescence more than at any other period that the well-directed attention of a parent becomes of the greatest value; too often with returning health come relaxing precautions; the danger is supposed to have passed; and yet at this time, as every medical man can certify, there is more real peril than during the height of the eruption; that is to say, more peril than in common mild cases, which are undistinguished by any malignancy of character, or any inflammation of internal organs. Exposure to cold draughts of air must be carefully shunned; the skin at this time is usually very susceptible of impressions; and by no means an unfrequent follower of scarlatina is a kind of dropsy, appearing chiefly in a swelled face and enlarged hands and legs; this almost always arises from exposure to cold and over-eating, and, as after mild cases little care is taken, it is more common after slight than after severe attacks. The diet, therefore, must be judiciously regulated; fermented liquids should not be given to children, from a mistaken notion of quickly restoring strength; the food should be nutritious, yet simple; country air is, after a time, very useful. When one member of a family has been attacked, immediate separation of the remainder of the juvenile part of it gives them the best chance of escape. A child will communicate infection to another after the eruption has disappeared, and sometimes even after the throwing off the skin has ceased. We shall make some remarks on purifying and fumigating rooms after smallpox and scarlatina when we have finished the subject of measles.

7040. *Measles.*—For several days before the appearance of the peculiar eruption of measles, there are certain symptoms which often excite a suspicion of the impending disorder. The child labours under a severe cold; there are watery discharges from the eyes and nose; accompanying these are irregular chills and shiverings, with general languor and appearance of illness. In the course of a day or two there is frequent sneezing, and a cough is generally heard of a hard, metallic, somewhat croupy character; the eyes are red, the tongue furred, and the breathing is often considerably oppressed. It will be easily observed that these symptoms differ considerably from those attending the early stages of scarlatina and smallpox: in the former, there is fever, with sore throat; in the latter, there are the peculiar and severe pains in the back, stomach, and head; but in neither is there the hoarse cough, the sneezing, and the discharges from eyes and nose which prevail in measles. On the fourth day, usually, after the commencement of the attack, when the symptoms above detailed are at their height, the rash appears. It is first visible around the head, behind the ears, and about the temples; it then appears on the rest of the face, then on the throat and neck; on the rest of the body a few spots, like flea bites, may often at this time be noticed; but the eruption has not reached the hands and feet until two days after its appearance on the face. The colour is less bright than that of the eruption in scarlatina; the rash, also, is not so universally diffused, is more patchy, and the patches will frequently be observed to have a crescentic or somewhat semicircular shape. On the day after its appearance on the hands and feet, the rash on the face begins to fade away; there is itching and scurfiness of the skin: at this time the eyelids are often swollen, but this soon abates, and the watery secretion from the eyes ceases.

The chief danger in measles arises from the occurrence of inflammation of certain parts of the lungs, and this is more frequent at the decline of the eruption; therefore, all throughout, but more especially at this time, any increase in the cough, shortness of breath, or symptoms of fever must be carefully looked out for, and their occurrence reported without fail to the medical attendant. At the close of measles a diarrhœa is extremely common.

7041. *In the treatment* very little can be done by the parent. Many writers advise an emetic, as in scarlatina; and if the child complain of sickness, it may be given. The cold sponging the body, so agreeable and efficacious in scarlatina, is not allowable in measles without medical advice. An aperient of castor oil or rhubarb may be given, with one or two grains of calomel, according to the age of the child. The apartment must be kept cool, but free from currents of air, and cooling drinks may be allowed in abundance.

7042. *Fumigation of Bed-rooms after the foregoing Diseases.*—We refer to the article on "Fumigation," for the detail of this subject. We may mention that during the course of the fever pure air should be freely admitted; and in bad cases it is often expedient to sprinkle a little solution of chloride of lime, or "bleaching liquid," as it is often called, upon the floor and in the utensils. After recovery, rooms are fumigated in various ways; some put a certain quantity of nitre in a hot saucer, and pour over it an equal weight of oil of vitriol (sulphuric acid). A more powerful means is the extrication of chlorine; this is done by placing in a vessel, heated to a considerable degree, equal weights of common salt and of the black or binoxyde of manganese, and pouring over them some sulphuric acid; all metallic furniture should be removed from the room, else it will be rusted. Nevertheless, often, after every means have been taken, the infection of scarlatina will adhere to a room for several months, even for a year; therefore, if possible, the room should be used by some one who has previously had an attack; as, on the whole, one attack certainly exerts a protective influence against a recurrence.

7043. *Hooping-cough.*—Many children escape hooping-cough, whereas few persons pass through life without having laboured under scarlatina and measles. In the present disease the child for some days seems to be effected with severe cough and cold; by degrees the cough takes on the hooping character; there is a series of little coughs which exhausts the breath, and consequently the succeeding inspiration is a long one; and, on account of certain structures being in a state of spasmodic contraction, a peculiar sound is produced; that is, *hooping.* During the coughing the child's face becomes very red; it seems struggling for breath, and as if it would be suffocated; but in a moment or two after the hoop is out, it is often running about as if nothing were the matter with it. The contents of the stomach are often discharged during the cough. Although hooping-cough is not a dangerous disease, it may become so at any time; in every case there is more or less inflammation of certain parts in the chest. This may become aggravated, or the head may be affected, and inflammation of the brain result; or in young children convulsions may occur, and be very troublesome and alarming; therefore, early medical aid is always necessary. We shall not describe the treatment, as we are of opinion that medical men alone are competent to understand this disease, and to treat the different stages of it with advantage. In convulsions the warm bath should be used. During convalescence, also, a change of air is signally useful, often removing immediately the remnants of the cough, and producing a most beneficial influence on the general health.

CHAPTER III.

CIRCUMSTANCES FAVOURABLE TO THE PRESERVATION OF GENERAL HEALTH IN THE FAMILY.

SECT. I.—DIET.

7044. *As a general rule*, the diet may have some variety; it must not be confined to one or two articles; there should be a mixture of animal and vegetable food. With regard to kind and quality, appetite and taste point out the best course; but then appetite and taste must not be perverted by condiments and spices.

7045. *The hour of meals should be regular*, and the meals themselves should not be more distant from each other than four or five hours; after a meal no exercise should be taken for at least half an hour or an hour; for if strong exercise be taken after a meal, the blood which would have been sent to the stomach, and from which the solvent fluid, the gastric juice, as it is called, would have been formed, is forced by the muscular contraction into other parts of the body; the food remains undigested, causing a load and weight to be felt at the pit of the stomach, and in a few hours often producing headache, a sour taste is felt in the mouth, and sometimes sickness. In such a case, if the sickness continue, an emetic of ipecacuanha (fifteen grains of the powder) is the best thing, and this should be followed up in a few hours afterward with an aperient mixture; but a short abstinence is preferable.

7046. *With regard to the taking of liquids*, cold water, the beverage provided by nature, is the best that can be taken; those who can be satisfied with this ought certainly to be thankful for it. Many persons accustom themselves, however, to take one or two glasses of wine every day, and, in some instances, such a practice seems beneficial; but if the quantity exceed this, the evils which the habit brings with it, in the long run, are not inconsiderable: the stomach appears to lose its power of secreting gastric juice without the ordinary stimulus; a degree of inflammatory dyspepsia is produced, and if, as is often the case, the individual increases the quantity of wine in order to get rid of the unpleasant sensations which torment him, he increases, at least in an equal ratio, his digestive disorders. Such a state seldom remains long uncomplicated; various gravelly and other disorders occur, and render life miserable.

7047. *All the evils which wine produces are caused in a still greater degree by spirits*; the most pernicious spirit is English gin, and one cannot be too thankful for any agency which seems to diminish in any degree, however slight, the consumption of spirits.

those who decry temperance societies should remember that, though total abstinence may not be needed in the middle classes, among the lower it is the *only thing* which is likely to reform them, for it is well known among medical men that the chance of curing a disposition to drink is much greater when the individual restricts himself to water alone than when he allows himself in a degree the use of fermented or spirituous liquors.

With regard to ale and porter, the same objections apply to these as to wine, though certainly with much less force; porter is often adulterated with compounds which make it heady; and ale, on the other hand, contains a large quantity of sugar and mucilage, which are digested with difficulty, and often produce acidity and heartburn.

[The preservation of general health in the family being the object of this chapter, the foregoing observations upon drinks are behind the times, and, besides, in some respects erroneous. That "one or two glasses of wine every day seems beneficial," and that the mischiefs of wine drinking are only "when the quantity exceeds this," is a dangerous doctrine. Men in health, it is proved by the experience of millions, are never benefited, but always injured, by the habitual use of wine, even in the quantity here prescribed. Nor is it found in practice that "one or two glasses of wine every day" will long be indulged without an uncontrollable inclination for more, and habitual wine drinking becomes intemperate drinking by a kind of physical necessity.

So, also, the use of spirits as a beverage is here commended to men in health, by the admission that "total abstinence may not be needed in the middle classes," and less needful, of course, in the higher classes, while "among the lower it is the only thing that will reform them." This is most pernicious doctrine, besides being unphilosophical and absurd. In America, "medical men" reason upon physical agents and their effects upon the animal economy, irrespective of "classes," only recognising cause and effect, as exemplified in invariable sequence. We do not admit in this country that English gin, or any other form of alcoholic spirit, can be taken into the stomach habitually with impunity, either among the "middle classes" or the higher, any more than the lower classes, and hence total abstinence is recommended from such drinks to all classes, as the best preservative of health.

Nor is it less exceptionable to represent the objections to the habitual use of ale and porter as applying with less force than to wine, for, apart from the "compounds" used to make these liquors heady, their alcohol is the worst compound they contain, and is never necessary to men in health.]

SECT. II.—REMARKS ON THE PRACTICE OF SMOKING.

7048. It is difficult to conceive on what grounds this practice can be defended; it produces indolence rather than excitement of the mind; it blunts the appetite, and, in some cases, it brings on an obstinate form of indigestion.

Tobacco contains a large quantity of volatile oil, which has a powerful sedative influence, often evidenced in the giddiness, sickness, and depression which follow the first attempts to smoke; after a time the system seems to accommodate itself, and to suffer little or not at all from this agent, but it would be against all reason to suppose that its effect ceases because less perceptible; on the contrary, the pale, bloated face, the indigestion, and loss of appetite, and the heaviness of mind soon point out that the habit is exerting a pernicious effect. It is true that some persons are able to smoke all day, and preserve their usual health; but this is no more an argument for smoking than the health and great age of a man who has taken his bottle of wine every day is an argument for drinking.

7049. *Smoking with a pipe*, moreover, causes sometimes a disease of the lower lip, which may become cancerous; at least this is not uncommon among the lower class of smokers in this country, who use the same pipe for a long time together.

7050. *Taking snuff and chewing tobacco* are also objectionable practices; the former blunts the sensibility of the lining membrane of the nose, destroys its susceptibility for odours, and thickens it often to such a degree that the person cannot breathe through the nose; besides, some of the snuff usually passes down into the stomach, and produces there the same effects as smoking.

Snuff-taking excites the mental faculties more than smoking does; at the same time, it is a still less cleanly habit.

7051. *Chewing tobacco* is a common practice, chiefly with seamen and travellers; it lessens the appetite very considerably, and is employed for this purpose by travellers, and others who have to endure long abstinence of food; its bad effects are, if anything, more strongly marked than those of smoking and snuffing.

SECT. III.—CLOTHING.

7052. This is a subject so well understood, that our remarks upon it will be very brief. In weak and scrofulous people, good clothing is one of the most efficient protectives against the consequences which exposure to cold brings with it to these persons. In cold and damp weather they should always wear flannel next to the skin, not merely over the chest, but all over the body from the neck to the feet; in summer, linen may be substituted for the flannel. (See Book XVII., "On the various Fabrics for Clothing.")

7053. One of the worst habits of clothing in the present day is the immoderate tightness with which some articles of dress are worn; tight cravats, when they were in fashion, not infrequently produced apoplexy; tight garters often cause enlargement of the veins of the leg and foot ("Varicose Veins"), by stopping the proper flow of the blood; tight stays, again, prevent due respiration, by hindering the movement of the ribs, and by pressing the lower ribs inward they distort the figure, and sometimes displace the organs in the abdomen. Supposing the arms to be separated from the body, the shape of the chest is a cone with a base or larger part below; but when tight stays have been worn for some years, it is not uncommon to find the chest small as usual at the top, then enlarging, and then again narrowing considerably, and giving a contracted and small, and what is by some considered an elegant, waist to the individual; but to those who know the true formation of the human body, a very narrow waist is not only inelegant, but is as displeasing as any other deformity of the person.

For information respecting the various articles used for clothing, see Book XVII.

Sect. IV.—personal cleanliness.

7054. The skin pours out continually a quantity of watery vapour, with a little saline and gaseous matter; this *secretion*, as it is called, is generally in so small a quantity, and so gradually formed, as to be imperceptible, and then it is known by the name of "*insensible perspiration.*" At certain times, however, from the effect of exercise, of clothing, of heat applied in any way, or of particular medicines, this insensible perspiration is increased so much as to form drops of fluid obvious to the eye, and then the secretion is designated by the term "*sensible perspiration.*" The quantity of water got rid of in twenty-four hours by insensible and sensible perspiration is very great, perhaps on the average as much as a pint and a half in round numbers. It is obvious at once how necessary it is to keep in a proper state the organ from which this vast quantity of fluid is constantly draining; if, in regard to cleanliness it be neglected, it becomes dry and harsh, and unfit for its functions; some other organ must then supply its place; but this other organ may have too much to do, thus working for both, and may become diseased; in fact, neglect of cleanliness of the skin is a most fertile source of disease, both of the skin itself and other parts. Cleanliness in our habitations is as necessary to health as personal cleanliness; all exhalations from decomposing animal and vegetable substances produce themselves certain complaints, and also increase the violence of other diseases in a very great degree. But this subject has lately attracted so much of the public attention that it is needless to enlarge upon it. On this subject, see farther in Book XIX.

Sect. V.—bathing.

Subsect. I.—*General Observations.*

7055. In every age, and almost in every country, even among uncivilized nations, the value of bathing appears to have been acknowledged. The perfection and luxury of baths among the enlightened nations of antiquity excite our admiration, and in many parts of the world public baths still form remarkable features. Bathing may be considered in a twofold point of view: as hygiene, or as a means of preserving health, by keeping the skin in a state fit for performing its functions; and as a therapeutic agent of great power, or for the cure of diseases. In a general sense, it means the immersion of the body in a fluid different in kind or temperature from the common air. Water is the ordinary medium employed for baths, but vapour and heated air are likewise in use for the purpose.

7056. There had long existed in this country a prejudice against bathing, or at least a degree of apathy rather surprising, indicated by the almost entire neglect of providing means for public bathing. Bathing was in the last century considered rather as a pastime and luxury than with a view to the improvement of health; but at present this is considerably altered; medical writers point out its value, and the public is beginning to be awakened to its importance to all, and particularly to the working classes. Still we are far behind in those conveniences which are essential to its general practice; and the expense and trouble attending bathing prevents its being so much employed as it might be. In France, advantages are placed within the reach of the poor to which the rich alone can aspire in other countries. The number of gratuitous baths which are given at the hospitals of St. Louis and La Charité is truly prodigious; in 1822 it amounted to 127,752 for the out-patients only of the hospital of St. Louis. In Paris the habit of bathing is so general that the public baths are extremely numerous and cheap. We are only beginning to imitate what has been long established in that way in other countries. Bathing machines at the seaside, which are but of late origin, have diminished the difficulty at the various watering-places; but the use of baths is not yet of sufficiently easy accomplishment except to the wealthy, who can have them in their own houses.

The great use of bathing must be obvious when we consider that the skin is not to be regarded as a mere covering of the body, but as an organ, the healthy condition of which is of vast importance to the well-being of the whole frame, but especially of the stomach and lining membrane of the lungs, with which, as mucous membranes, it has the closest sympathy. Taking the lowest estimate by Lavoisier, the skin appears to be endowed with the power of removing from the system, in the space of twenty-four hours, twenty ounces of waste. The retention of this, from neglect of changing the clothes or other causes, is productive of much injury to the system.

7057. *The most important circumstance respecting baths of every kind is their temperature:* various subdivisions of baths, according to their temperature, have been adopted by medical writers; but it must be obvious that every classification of this kind must be in some degree arbitrary, it being impossible to limit the degrees of warmth in each with perfect accuracy; still it is convenient to have distinct expressions for baths of different degrees of heat. The simplest division is into *cold* and *hot* baths; the former comprehends all those which communicate the sensation of cold, the latter all which occasion the feeling of warmth: all baths below 88° of temperature may be denominated cold; all above, warm. Medical practitioners subdivide them still farther into, 1, the cold bath, from 33° to 60°; 2, the cool bath, from 60° to 75°; 3, the temperate bath, from 75° to 85°; 4, the tepid bath, from 85° to 92°; 5, the warm bath, from 92° to 98°; 6, the hot bath, from 98° to 112°.

Subsect. 2.—*Cold Bath.*

7058. *The temperature of the human frame* in a state of health continues nearly the same in whatever circumstances it is placed. This in an adult is generally from 97° to 98°. In some cases of disease the temperature is above this standard, even as high as 106°, while in others it sinks far below this standard. The functions by which the body is enabled to preserve this uniformity of temperature are intimately connected with the nervous system and the respiratory organs by which heat is developed. The skin performs the function of regulating it, especially in reducing it when too high. When the body is placed in a medium or lower temperature than itself, the heat is abstracted more or less rapidly from the surface, which would have the effect of chilling it were not this counteracted by the internal development of heat. When surrounded by an aëriform medium much higher than itself, the exhalations from the surface both of the skin and lungs are greatly augmented; that from the former being thrown off in the form of perspiration, that of the latter in the form of vapour; the evaporation attending these processes occasions a reduction of temperature. *The cold bath includes* immersion in cold water, or that of a temperature from 33° to 65°, whether in the open sea, rivers, ponds, &c., or in large or small baths under a roof.

7059. *It is proper first to consider the usual effect of a cold bath* on a person in good health, who uses it only as a measure of hygiene. On immersion, there is first felt a general sensation of cold, proportioned to the lowness of the temperature of the water, and if the immersion be sudden, a peculiar impression on the nervous system is felt, forming a shock to the whole system, which is one of the most important circumstances belonging to the use of the cold bath; the skin shrinks, becomes cooler and paler, and the respiration is more hurried than before; but this is almost immediately succeeded by an equally universal sensation of warmth, which increases rapidly to a certain point, so as to cause the surrounding water, though actually cold, to feel comfortable; and this feeling is sooner produced, and continues longer, in proportion as the person is in full health and naturally possesses a vigorous circulation. By degrees, however, if the body continues immersed, it becomes chilled; violent shivering comes on, the extremities become numb and pale; sometimes sickness takes place, and at last the animal powers are exhausted by cold and fatigue. In this process, the most remarkable effects are those which occur first, and are directly consequent to the shock of immersion; and it is only when it occurs that the cold bathing should be suffered to proceed.

7060. The sensations of returning warmth which take place directly after the cold of the first immersion constitute what is called the *reaction of the system.* Medical writers explain this reaction by stating that the almost instantaneous result of the shock is the excitement of the nervous system to increased activity, in virtue, no doubt, of that general principle of self-conservation bestowed in a greater or less degree on all living, organized beings. The fluids are repelled from the surface to the internal organs, which are thus stimulated and roused to action; in consequence of which the blood is propelled through the whole capillary system, more particularly of the surface, carrying with it life and renovated energy.

If the bath is left before the second attack of shivering, or before this has continued too long, the bather generally experiences, on dressing, a renewal of the reaction which had followed the shock of immersion; and this having now nothing to counteract it, becomes more vivid and permanent: the pulse becomes fuller and stronger than before immersion; the skin recovers the plumpness it had lost; all sense of oppression and langour vanishes, and is succeeded by a feeling of buoyancy, and an agreeable consciousness of increased animal power. No second glow ever succeeds the second chill above mentioned, but the debility increases with the length of the immersion.

7061. *The whole effect may be distinguished into,* 1, the shock, the effect of which is stimulating; 2, the cooling effect; 3, the counteracting or astringent effect; and, 4, the reaction. Cold bathing may be applied so as to ensure one or other of these actions over any of the rest, according to circumstances, when all are not desired.

7062. *The cold bath, when used by persons in health*, increases the tone of the habit, strengthens the digestive organs, and by diminishing the sensibility of the whole system, and particularly of the skin, renders the body less susceptible of atmospheric impressions from cold, wet, and sudden changes of temperature—thus contributing to the production of what is termed a robust or athletic constitution; hence the beneficial effects of using the cold bath daily, and that early in the morning when just out of bed, have been experienced by persons engaged in such service as the ordnance survey, where they have to ascend high lands, and are thus exposed to a frequent change of climate.

7063. *Where the shock, as a stimulus to the nervous system* in cases of debility, is the principle desired, the water should be very cold, and the time of remaining in the bath should be only momentary; and after the first plunge the bather should leave the bath, and be wiped dry with towels in order to bring on the reaction. The water may be even dashed on, in the manner called the *douche*, which see.

When the object is to obtain the refrigeratory action of the bath with as little as possible of the nervous shock or vascular reaction, as in the case of febrile diseases and local inflammation, the water should not be applied, at first, at a low temperature, nor suddenly; it should be only cool, and applied with a sponge, repeating the application till the desired effect is produced.

7064. *It is chiefly in chronic diseases* that the cold bath is employed for a length of time; and it is then principally the secondary effect, the glow or reaction, which is desired. The rules to be observed in order to obtain this effect are founded upon the strength, which is generally inferred from the age of the individual. The degree of reaction is, for the most part, dependant upon the coldness of the water, and the length of time the person remains in the bath. Very cold water, in which the person remains but a short time, will, in general, produce a greater degree of reaction than a more moderate temperature in which he remains longer. But here much depends upon the general power of the individual, the state of his system, especially of the skin at the moment of immersion, and the nature of the bath according as it is fresh or salt water, and also the season of the year.

7065. *The effects of the cold bath have been described very differently* by physicians; some have considered it as a stimulant, others as sedative or tonic, or even debilitating; but the truth is, that its operation varies according to circumstances, namely, the mode of using it, and the condition of the patient. It may be debilitating in a case where the strength of the patient is exhausted, yet tonic in the highest degree in another when properly applied. As the reaction is commonly proportioned to the vigour of the circulation, particularly that on the surface, and to its warmth, it should be a rule, that persons with a feeble circulation and cold extremities should endeavour to invigorate the circulation and increase their temperature previously to going into the cold bath. Many imagine that, when they are made a little warm by walking, they ought to wait till the body is quite cool before they go into the water; but this idea has been shown to be erroneous; and Dr. Currie has recommended that a little exercise should be taken previously to cold bathing.

If, after coming out of the cold bath, the person feels dull and chilly, or complains of headache or tightness across the chest, it is a proof that it disagrees, and it should accordingly be discontinued.

7066. *With respect to the length of time to remain in the cold bath*, from ten to twenty minutes is sufficient even for the strongest constitution, and is too long in very cold weather. A cold bath in a cold place is far from being comfortable; and after coming out of the bath, the body should be dried in a room or place tolerably warm, that the reaction may be encouraged.

7067. *The morning is generally the best time* for the employment of the cold bath, the temperature of which should bear a relation to the time of year and the temperature of the weather, as well as to the strength of the person using it. It is an error to use cold water at night; the frame, after the exhaustion of the day, is more in a state for the soothing influence of warm water. In some cases, however, it may be proper to use tepid water in the morning, and to avoid the relaxing effects of warm water in the evening. For persons of delicate constitution it is best to fortify the habit with a good breakfast, which should be taken at least an hour or two before bathing.

7068. *The reaction is increased* by using some motion or exercise when in the cold bath; swimming is, therefore, advisable when the bather has sufficient skill and the bath is sufficiently large; but care should be taken that the stay in the water should not be too much protracted. Friction of the skin after the bath conduces to a beneficial effect, by producing a healthy glow.

7069. *The cases of disease for which cold bathing is a valuable remedy are*, morbidly increased irritability and sensibility, accompanied with general debility. When there is a tendency to colds and rheumatism, the cold bath is an excellent preventive; for this purpose, it should be used continually throughout the year, and the chest should be sponged with cold water, or vinegar and water may be substituted in winter, when there are not facilities for using the complete bath. Delicate and feeble persons of all ages require a higher temperature of the bath, and a shorter stay in it than others. It is proper for such persons to begin a course of cold bathing by the use of the tepid or temperate bath, lowering the temperature gradually ; or perhaps a glass of wine or a cup of coffee may be taken before entering the cold bath. It is a good rule to wet the head previous to taking the plunge.

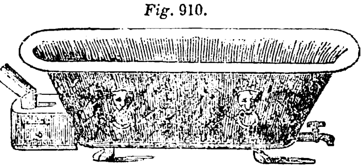
The cold bath is improper in chronic inflammation of the mucous membranes of the bronchi and intestinal canal, except when these are very slight ; but it is beneficial in certain cases of chronic catarrh, attended with little or no inflammation of the bronchial membranes, particularly in the dry catarrh, and in those forms which seem to depend rather on a relaxed than an irritated state of the bronchial membrane. In no disease is the cold bath more beneficial than in the intervals of asthma, when the system is in other respects proper for the remedy ; its principal action in this case is, no doubt, as a preventive of catarrh or cold, which is by far the most frequent exciting cause of the disease.

Neither is this remedy suited to those who have a tendency to consumption, nor to such as are constitutionally liable to bowel complaints. Before attempting cold bathing, careful investigation of the state of the mucous membranes of the chest and intestinal canal should be made, as it will certainly prove hurtful where chronic inflammation of these organs exists.

7070. *The size of the bath* is of some consequence. It is observed that bathing in the open air is of a more tonic or bracing character than bathing in a confined apartment. In the domestic bath the patient can seldom have the advantage of a complete and sudden immersion, and exercise while in the bath is almost totally precluded. It would be desirable that a room for bathing should be constructed in every house ; and though this is scarcely possible in the present condition of society, yet a bath should be considered as indispensable in every mansion of considerable size. It may be lined with marble slabs set in Roman cement, which is the most elegant and cleanest ; it may also be constructed of brick coated with cement, or with tin plate painted. The bath should have a supply of cold and hot water by pipes and cocks, together with a pipe for emptying the bath, steps for descending, &c. Baths of this kind have been frequently constructed of great elegance ; but what is most wanted is a convenient bath of small expense, so as to be within the acquisition of persons in moderate circumstances, and such baths are most conveniently placed in the bed or dressing room. In some of the London club houses and hotels, by means of the back boiler of the kitchen range, hot water is made to ascend to the baths in an upper story without any mechanical means being employed ; but this requires that the water in the boiler should always be kept boiling. In many houses in the west end of London the water rises to the bed-chamber floors by the high-service pipes of the water companies. Water may likewise be raised to the upper part of a house by a well-constructed force-pump ; and it would not be difficult to heat it in the bed-room floor. Although it would not require any great exercise of ingenuity to contrive baths in the bed-chamber stories, yet scarcely any houses of an ordinary class are furnished with so valuable an addition, the chief difficulty being the regular supply of water. It would be exceeding our limits were we to say anything on the subject of public baths farther than to point out their great utility, and to express a hope that the increased attention to the means of preserving health, which must be the result of the diffusion of knowledge, will, in no very distant period, produce all that can be desired.

7071. *Portable baths* of various kinds are made and sold in ironmongers' shops. *Fig.* 910 represents a full-sized bath of tin plate painted. Other portable baths which may be used for cold water are represented in *fig.* 911, shower bath ; *fig.* 915, hip bath ; *fig.* 916, leg bath ; and *fig.* 917, foot bath. See child's bath under "Nursery Furniture."

Fig. 910.



SUBSECT. 3.—*Temperate Bath.*

7072. This is analogous in its effects to the cold bath, but in a less degree. The Buxton water, which is of the temperature of 82°, is the best natural example of this class of baths. It may be prescribed in cases where the shock of the cold bath would be too violent for the patient ; and it may sometimes serve as a proper preparation for the cold bath.

SUBSECT. 4.—*Tepid Bath.*

7073. The tepid bath is more important for the purpose of cleanliness and the general preservation of health than as a remedy in disease, although in the latter case it is often very valuable. The range of temperature extends from 85° to 92° ; and it is sometimes employed previous to the cold bath, the bather lowering the degree of heat gradually each time until he arrives at that of the cold bath. The shock of this bath at the lowest temperature is slight when compared with that of the cold bath, but on that account is better suited to certain invalids, while its highest temperature partakes of the nature of the warm bath. For the mere purposes of ablution, the occasional use of the tepid bath of about 85° to 90° is the best, choosing the particular degree that is most agreeable. The best time is noon. Brisk exercise in the open air should be taken afterward. It is very refreshing after fatigue and travelling, and is equally serviceable occasionally to persons of sedentary habits. It is not proper immediately after a meal, nor when the person is much excited by wine; before using it, the heat of over-exercise or much excitement of mind should be suffered to pass off. Water by itself, warm or cold, is but imperfectly cleansing, as the perspiration cannot be readily dissolved and carried off by water alone; hence the advantage of employing soap of some kind when mere cleansing is required.

Subsect. 5.—*Douche Baths.*

7074. The douche bath is a powerful agent, and consists of a stream of water, cold or warm, directed with considerable force from a tube upon some particular part of the body, and varies in its power, according to the diameter of the stream, the temperature of the water, and the force with which it strikes the body. The cold douche is employed in inflammatory diseases, such as that of the brain, and in mania. The water is sometimes made to fall through a pipe from a reservoir placed at some height; and pouring water from a large tea-kettle or other vessel may be used as an inferior kind of it. The douche is much employed in the Oriental vapour and Russian baths in conjunction with vapour. There are natural douching baths of warm water in many parts of the world, as Aix les Bains in Switzerland, which are well described by Mr. Bakewell in his "Travels in the Tarentaise." The water, at a temperature of 110°, but somewhat reduced before it reaches the patient, descends upon the patient in columns as large as the arm, from a height of eight to ten feet. This is described as an operation unpleasant and exhausting, but it produces a profuse perspiration on the patient being put into a bed. It is found to be relaxing and beneficial in chronic rheumatism, sprains, and stiffness of the joints.

It is supposed that much of the advantage derived from the douche depends upon the percussion upon the part affected by the descent of the stream of water, since the height of the fall is important. When a sufficient height cannot be obtained, it is stated that the effect may in some degree be imitated by striking the part of the body to be douched with a hammer made of caoutchouc while the stream of water is acting upon it; but it is evident that this process can be practised only under the immediate direction of the medical attendant.

Subsect. 6.—*Shower Bath.*

7075. The most convenient form of cold bathing is the shower bath, already much in use. By this the water may be easily adjusted to the necessities of the bather as to its temperature and quantity, and whether it be fresh or salt. The bath takes up little room, and it may be placed in the bed-room or dressing-room.

The effects of the shower bath are, upon the whole, nearly similar to those of the plunge bath, but there is some difference between them. The shock from the shower bath is, in general, felt to be greater than that from simple immersion, particularly if the quantity of water be great, its temperature low, and the fall considerable. It sometimes happens, too, that a patient can bear one better than the other. Its effects are more speedy, and extend more to the internal organs than those of the common bath; consequently when recourse is had to it, the patient should withdraw immediately after the shock; the glow felt is almost immediate when it is beneficial; if its use is prolonged, it quickly lowers, and at last destroys, the sensibility, being then highly injurious. It should seldom be resorted to without medical advice, and it may be used either cold or tepid.

When cold water is used, the effect as a tonic is very advantageous, provided the habit is sufficiently vigorous to produce the proper reaction and glow on the surface immediately after the shower; but for delicate persons the tepid shower bath is preferable. Salt added to the water is an improvement. In certain affections of the head the *cold* shower bath is found useful; if required, the feet may be immersed in warm water while cold is applied to the head and body. Some recommend promoting the reaction by the friction of horse-hair or coarse flannel gloves. The best time for using the shower bath for hygiene purposes is immediately after rising in the morning; but in weakened habits an hour after breakfast is better.

7076. *Fig.* 911 represents the form of a shower bath as it is usually sold by ironmongers. The water is forced up into a cistern, *a*, with a perforated bottom, by a syringe, *b*, and the bather, by pulling a string, opens a valve, which causes the water to descend suddenly in a shower on his head and body through the perforated bottom. A receptacle at the lower part receives the water, and curtains confine it from splashing about.

To prevent the dampness in the room occasioned by wetting the curtains, they may easily be made to take off, and may be dried elsewhere. The whole is made of tin plate painted, one of the upright supports being hollow, to allow the ascent of the water. The usual price is from £3 to £5.

Fig. 911.

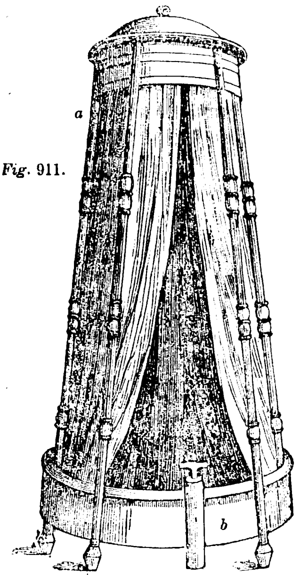
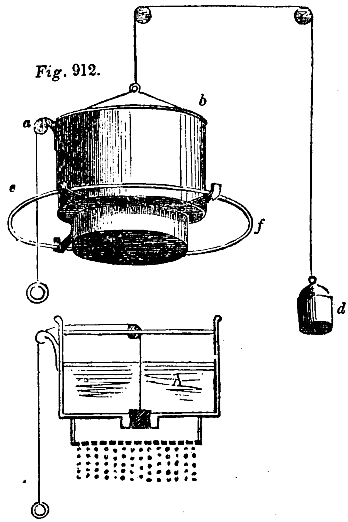


Fig. 912.

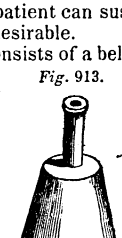


7077. *An apparatus for this purpose*, *fig*. 912, much cheaper, and answering nearly as well, has lately appeared in the shops. *a b* is the cistern to hold water, and it is suspended from the ceiling by a line, *c*, and balanced by a weight, *d*. The valve in the interior is on the same construction as in the upright shower bath, *fig*. 911, and is shown in the section A. An iron ring, *e f*, is attached to the cistern, from which the curtains hang, and another iron ring, but larger, keeps out the bottom of the curtain. The price of this apparatus is only from twelve to sixteen shillings.

7078. *When economy is an object*, a shower bath may be easily made on a cheaper plan. A wooden tub will do for the lower receptacle, to the side of which may be nailed two or three uprights of wood, having at the top some kind of pail with a perforated bottom, or a large tin colander would answer, into which an attendant, on a pair of steps, might pour water; a hoop at the top of the uprights might support a curtain of calico. Even simpler forms may be contrived by persons of ingenuity. The small quantity of water required by the shower bath is a circumstance of great convenience. If the cistern is contrived so as to hold considerably more water than is necessary, the patient can suspend and renew the shower at pleasure, which, in some cases, may be desirable.

7079. *A shower bath for children* has been lately brought into use. It consists of a bell-shaped tin vessel, *fig*. 913, the bottom of which is pierced full of holes, a hollow tube rising from the top, the aperture of which can be closed by the pressure of the finger. To use it, the bell must be sunk in a pail of water, and when it is full the forefinger is to be pressed hard upon the top of the tube, so as to close it perfectly. The bell may now be raised out of the water, and by means of the pressure of the atmosphere, as in the case of the barometer, it will continue full until it is lifted over the head of the child; when, by withdrawing the finger from the tube, the water is discharged in a sudden shower through the numerous holes in the bottom of the bell.

Fig. 913.

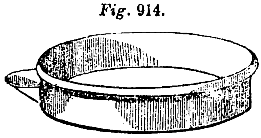


7080. *Cold affusion*, or throwing cold water on the naked body in disease, to reduce its temperature, is a rude form of the shower bath, and is more sudden and decisive than it. It is sometimes used in fevers by the advice and under the superintendence of a medical man, and should seldom be intrusted to others.

Subsect. 7.—*Sponging*.

7081. *Sponging the body* with cold or tepid water may be enumerated as one of the modes of bathing. In cases of febrile diseases, the object in sponging is to reduce the heat of the surface; but as its action is powerful, it should not be employed in this case except by direction of the medical attendant. It is sometimes performed while the patient is still in bed; the night dress being stripped down, and a large cloth tied round the waist to prevent wetting the bed-clothes, while a wet sponge is passed over the body; or a wet flannel is applied to the skin, after which the body should be dried by a gentle or brisk friction. In other states of the patient, he may sit up in a chair, while two or three persons rub his whole body with large sponges wetted, after which he is to be wiped dry and put into bed. The process should not be attempted while there is the smallest tendency to perspiration. Sponging is likewise used successfully as a tonic to ward off disease. It is found particularly serviceable when a person is disposed to asthma, or the disease of the lining membrane of the bronchial, or air tubes leading to the lungs, commonly known by the name of a *cold*, or common *cough*. For that purpose, the chest may be sponged daily, and afterward well rubbed and dried, so as to cause a glow on the surface. In some cases, salt and water, or vinegar and water, are preferable, and then much friction is not necessary. The best time for sponging is immediately on getting out of bed in the morning, when there is no perspiration. The effect is nearly similar to that of the shower bath, rendering the habit less susceptible of cold; and, when followed by exercise in the open air and proper regimen, increasing the appetite and digestion. Sponging with this view is said to be as efficacious as the shower bath, and is more proper for delicate habits. *Fig.* 914 is a shallow vessel used for sponging; and to prevent taking cold during the operation, it may be performed under a loose dressing-gown.

Fig. 914.



SUBSECT. 8.—*Warm Bath.*

7082. This strictly includes the warm water, vapour, and air bath, but the effects of these are different, and we shall first consider the warm-water bath. The effects vary with the temperature, which ranges from 92° to 98°. When the heat is about 92°, though the first effect is slightly stimulating, yet, when time is given for that influence to subside, it is gradually succeeded by soothed and tranquillized sensations, which generally allay slight degrees of local irritation of the nervous system. At a higher temperature, but under 96°, it has sometimes been imagined that the warm bath relaxes and weakens, whereas it produces a contrary effect; it is found to raise the spirits, to mend the pulse and appetite, and to refresh and invigorate the whole frame. In consequence of its soothing and agreeable impressions on the surface of the body, it produces very beneficial effects in certain disordered states of the alimentary canal originating in diminished action; but if the heat is considerably greater, or above 98°, the feelings are even painfully excited, and the temporary stimulus is followed by a proportionate degree of exhaustion. The warm bath modifies the texture of the skin; it increases the frequency of the pulse, and excites the superficial capillaries to increased action, and it also equalizes the circulation of the blood. By relieving pain and irritation, it acts as a sedative, and, by restoring deranged functions, it is an indirect tonic. The warm bath is seldom necessary, or taken, in perfect health, but it is very beneficial after fatigue or muscular exertion: in these cases the body should be allowed to rest and cool before the bath is taken. It is an invaluable remedy after travelling, which with persons of delicate or feverish habits, even in the easiest carriage, for several successive days, is apt to produce defective secretions, and general irritation of the nervous system, more particularly if there be any tendency to chronic inflammation. It is likewise useful after long mental excitement, from whatever cause, and in a variety of slight disorders of the system, such as nervous and spasmodic affections. It is effective in softening the skin, and enabling one to detach the scales which are on the surface in a state of partial decomposition, by which the function of perspiration becomes freer, and hence it is often beneficial even to the healthful.

7083. When the body is immersed in the warm bath, an agreeable sensation of warmth is perceived, the veins on the surface swell, the bulk of the body is increased a little, and the skin becomes redder than usual; the action of the heart is increased, and of course the pulse is quickened. In cases of disease, the warm bath should never be employed, except by the advice of the medical practitioner. It is perilous to persons of full habit, who are liable to a flow of blood to the head, which the warm bath promotes. When used for the preservation of health alone, the salt-water warm bath is preferable to the fresh. In a warm bath it is essential that the original temperature, whatever that may be, should be kept up the whole time that the patient remains in the bath; the temperature is best ascertained by the thermometer, of which a kind is made for this purpose.

7084. *The time of immersion in the warm bath* should be varied according to the temperature of the water and the feelings of the patient. In a bath of 94° to 96°, a person may remain fifteen, twenty, or thirty minutes; much longer time will prove relaxing: many persons prefer 95° or 96°; few lower than 93°. In a bath of 98°, or more, it will not be proper to remain so long, and, indeed, there are few persons that can bear to remain beyond ten minutes, and, in the generality of cases, not so long. Persons labouring under chronic rheumatism or palsy bear the highest degree of temperature best: these often require the hot bath. When sweating is desired (which will seldom happen except in cases of local inflammation), the warm bath should be used in the evening, and the patient should be immediately afterward put into a warm bed, and remain there until late in the next morning; but in all other cases where perspiration is not required, or in which it would be hurtful, the best time for using the warm bath is in the forenoon, about two hours after breakfast. In this case the bathers should not retire to bed, and it is not absolutely necessary to confine themselves within doors; but if the weather is cold, it will be prudent not to go immediately into the open air, but to remain quietly in the house for an hour after the bath.

7085. *Springs of water, in a state of nature*, are found at various degrees of temperature, even boiling; some of them, when of a moderate temperature, constitute warm and hot baths. In this country the only natural warm spring is that of Bath, the temperature of which is from 96° to 106°, although the water issues from the spring at 116°: on the Continent there are many warm and hot springs; those of Vichy and Barège are 120°; of Borset, 132°; of Aix-la-Chapelle, 143°; and Carlsbad, 165°.

7086. *With respect to the form of the bath*, though the common portable bath answers every purpose for which the bath is usually administered, yet in some cases, particularly when the stay in the bath is prolonged, a large open bath is much to be preferred, as the constrained position in a small bath cannot be borne long. Indeed, Bath is the only place in England where the warm bath can be taken with the greatest benefit. Our usual warm baths are necessarily artificial, and are to be found in the public establishments for the purpose. Besides these, there are portable baths, of the full size, sold by ironmongers, of tin plate painted, and of copper, as *fig*. 910.

7087. *Fig*. 910 represents one of these baths, with a fire and flues beneath to heat the water. It is scarcely necessary to observe that the bath must be placed near the chimney, that the smoke-pipe may go into the chimney-flue. The convenience of this construction of bath is very great, the labour of filling a bath with warm water being considerable.

7088. *The hip bath*, *fig*. 915, is fitted to receive the hips only, and to affect those organs that are contained within the pelvis. It has the advantage of requiring very little water, as the bulk of the part immersed raises the water on each side so as to cover the hips, and it is sloped so as to afford a support to the back. In using it a pillow or blanket should be placed on the slope.

Fig. 915.

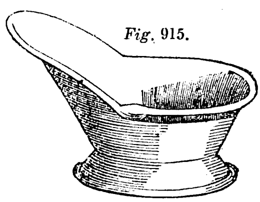
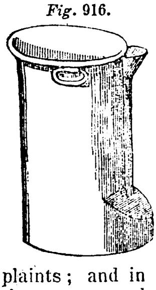


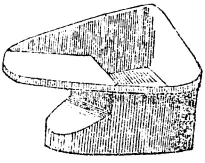
Fig. 916.



7089. *The leg bath*, *fig*. 916, should be deep enough to allow the water to rise as high as the knee. The projection at the bottom is to permit the foot to find room without increasing the diameter of the upper part.

7090. *The foot bath* is generally an oval pan of tin or earthen-ware, of sufficient size to admit the feet with ease. *Fig*. 917 is an improved kind, with a rest for the foot in drying it. After getting the feet wet, plunging them into warm water will often prevent any ill consequences; and this is found of great service in the chill and slight shivering which usher in colds, fevers, and other inflammatory complaints; and in inflammatory diseases, where the head and throat are much affected, the employment of a foot bath at a later period often gives great relief, by causing a revulsion of blood from the upper to the lower part of the body.

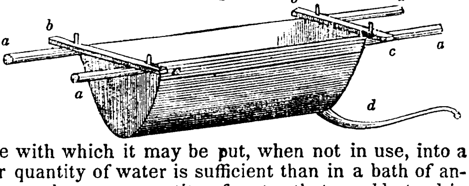
Fig. 917.



The warm douche bath has been already mentioned, p. 1192.

7091. *Dr. A. Thomson's portable bath* consists of a piece of water-proof cloth made up into the form of a sailor's hammock (*fig*. 918), and kept extended by two long poles, *a a*, *a a*, passed through a broad hem on each side of the hammock, and also by two other cross pieces of wood, *b c*, *b c*, fixed to the long poles by thumb-screws. The apparatus is supported by placing the long poles on two tressels or chairs. The advantage of this contrivance, besides its portability, and the ease with which it may be put, when not in use, into a convenient place, is, that a smaller quantity of water is sufficient than in a bath of another form; the bottom being narrow, the same quantity of water that would stand in height in an ordinary bath only three inches, is sufficient to cover the whole body of the bather. The water is drawn off by a hose or flexible tube, *d*.

Fig. 918.



SUBSECT. 9.—*Vapour Bath.*

7092. The vapour bath is more powerful than the warm-water bath in exciting perspiration, and is often very efficacious in cases of gout and rheumatism, and likewise in stiffness of the joints; also in diseases affecting the skin, in nervous complaints, dry catarrh, and recent affections of the lungs, provided there be no active inflammation. If employed in time, it is found to ward off the bad effects of exposure to cold; but it is improper for persons in a state of great debility. The vapour is certainly the most complete as the means of purifying the skin, combining the full effects of transpiration and opening the pores with ample lavation afterward; yet it exerts so powerful an agency on the system as to be actually injurious and debilitating when frequently used. The Turkish baths, which have been freequently described by travellers, possess a completeness and luxury unknown elsewhere; but they prove enervating, and are said to produce early senility. In this country the vapour bath is seldom used except medicinally.

7093. *Warm and vapour baths have been used* from time immemorial, either for purposes of hygiene, of luxury, or as remedial. By the Eastern nations, in warm climates, they were, and still are, in high esteem; and, as a means of preserving health, were wisely enjoined by the laws of Moses and of Mohammed. Among the Greeks and Romans, who wore sandals and woollen garments, the use of the bath for mere ablution was more necessary than with the moderns, who practise a frequent change of linen; and the magnificence and luxury of the public baths of Thermæ, and even of the private baths of Rome, are attested by ancient authors, as well as by the ruins that remain of the baths. A description of these ancient baths may be seen in Vol. II., "Pompeii," published by the Society for the Diffusion of Useful Knowledge. Traces still remain at Bath, and other parts of England, of such baths, on a similar construction, erected by the Roman colonies in Britain. In modern Europe the use of baths in general, and in particular that of warm baths, had declined and almost become extinct, though it has of late been partially revived. Turkey and Russia form exceptions: in these countries the vapour bath is still used nearly in the ancient manner, and in Petersburgh the baths are on a scale of great magnificence; there almost every one, poor and rich, bathe at least once a week.

7094. *There are two principal forms of the vapour bath:* 1. The free vapour bath, or steam chamber, as employed in Turkey, the Eastern countries, and in Russia; 2. The confined or solitary vapour bath, as commonly used in this country. The first consists of a close room filled with vapour from water at a temperature varying from 160° to 180°, in which the bathers move about at pleasure. In these chambers there are benches along the walls, arranged so as to rise one above the other as in an amphitheatre, on which the bathers sit, the heat being greatest on the uppermost seat. The vapour, or steam, is produced by throwing water from time to time on red-hot stones. The bathers first enter an anteroom, in which they undress. On coming into the bath, they take their places first on the lowest benches, and move to the higher, according to the length of their stay. During the time of their remaining in this bath the body is gently beaten with fresh birch twigs, and *shampooed*, by having the muscles gently pressed and kneaded; they are likewise rubbed with soap-suds, wheaten bran, &c. Cold water is also thrown upon the body by a douche tube. After being thus operated upon in various ways in the vapour by the attendants, they retire to another apartment containing only warm air, where they put on a flannel dress, and having drunk some warm fluid, they lie down to perspire; after sufficient time, they return to the anteroom, and dress. It is a remarkable fact that the Russians, after having been subjected to the influence of the vapour bath, on coming out expose themselves fearlessly to the cold, and even plunge into the snow without injury, which is supposed to restore the tone of the skin that had been relaxed by the hot vapour.

7095. A very simple kind of vapour bath, nearly resembling that used by the Hindoos, is common in this country. The patient is seated naked on a chair, *a*, *fig.* 919, and a vessel full of boiling water is placed at his side; a large blanket is thrown over his body and head, together with the vessel of hot water: this confines the vapour that rises from the latter when the vapour is to be breathed, or it is turned under his chin when it is not to be breathed. Perspiration is soon induced, and if it be necessary to keep up the action of the bath for any length of time, this may be done by dropping into the water bricks heated in the fire.

7096. A more elegant apparatus is formed by having a small steam boiler, *b*, *fig.* 919, placed so that the smoke may be conveyed by an iron pipe into the chimney-flue. The boiler must be furnished with a safety-valve, and the fire is made below it; a small tube with joints, *c*, conveys the steam to the patient; and a basket, *d*, is fixed at the top of the chair to give room for the patient's head, and prevent the blanket from collapsing. In some public bathing establishments a vapour bath is formed on a larger scale, and is supplied with steam from a boiler in another apartment. Besides artificial vapour baths, there are natural ones in several parts of the Neapolitan states, Ischia, and Switzerland.

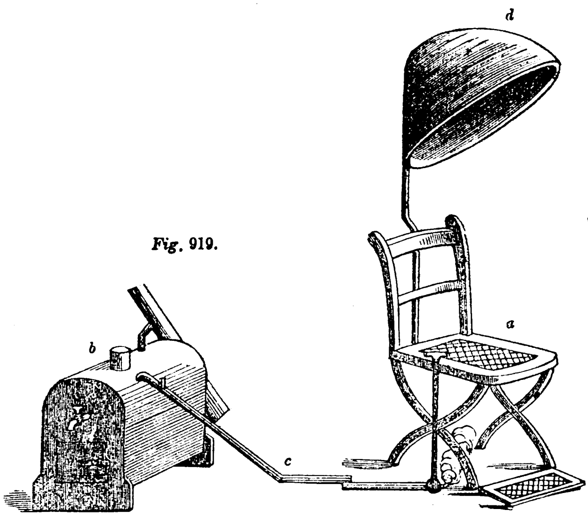


Fig. 919.

7097. *Various establishments of baths in London* are well known, and where almost all the modes of bathing may now be employed at a reasonable expense: we shall only particularize two, one belonging to the "Royal Portable Bath Company," in Oxford-street, from which warm water and a bath are sent to any part of London in the manner practised at Vienna, Baden, and other cities on the Continent; another is the Oxford and Cambridge baths in the Edgeware Road, where vapour baths are sent out. Various public large swimming baths have likewise been lately established; but this subject is beyond our limits.

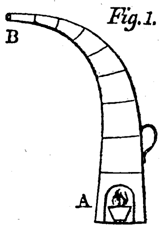
Subsect. 10.—*Warm-air Bath.*

7098. Common air, above the temperature of the body in a state of health, has been used as a kind of bath in particular cases. Warm-air chambers were employed even as luxuries by persons in health among the ancient Romans, and in Russia they are now occasionally used previous to the vapour bath. Its effect is to produce perspiration, which it does more rapidly than even the vapour bath, to which its operation is very analogous, though it differs from that in producing all its stimulating without its relaxing and soothing effects. Like the vapour bath, it is of two kinds, according as the warm air is breathed or not breathed. The latter mode is now commonly practised.

7099. The most convenient kind of warm-air bath is that introduced by Dr. Gower in 1819, under the name of *Sudatorium.* This acts upon a part of the body only. The apparatus consists of a semi-cylindrical frame-work, or oblong arch of wicker covered with blankets, and laid over a part of the patient in bed. The air is heated by means of a lamp connected with the apparatus, and may be raised to different degrees of temperature as may be required. It does not appear to be necessary to have a high degree of heat; air heated to 85°, or from that to 90°, produces, in general, a profuse perspiration, and has been found to relieve greatly in chronic rheumatism, and other pains and stiffness of the joints; also in various diseases of the skin, and in fevers. Some physicians speak in terms of high approbation of its advantages, but it is seldom employed, and it would not be advisable to try it, except under the direction of a medical practitioner. In very low constitutions of the habit, hot air above 100° may be productive of great mischief.

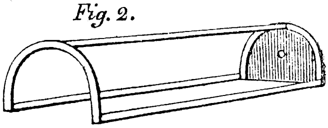
[The merit of the invention, here ascribed to Dr. Gower in 1819, is due to Dr. Samuel K. Jennings, formerly a practitioner in Virginia, but since a Professor in the Washington University of Baltimore. Many years before 1819, under the name of Jennings's vapour bath, this "Sudatorium" was employed as a domestic remedy very extensively in the southern states, and there can be little doubt, from the identity of the apparatus described as Dr. Gower's, that his knowledge of it was obtained in some way from the patent office of the United States, where Dr. Jennings had filed both a model and drawings, with the view of securing the proper application of the remedy, and preventing the indiscriminate use which might bring it into disrepute. Moreover, he had published, as early as 1818, a pamphlet on the importance of the skin, as a means of diagnosis in pathological investigations, and the value of heat externally applied as a therapeutic agent, which pamphlet had an extensive circulation, and will be found to anticipate this invention of Dr. Gower. For convenience in applying the warm-air bath where this is indicated, as it often is, in chronic diseases, Dr. Jennings's invention cannot be surpassed.

Fig. 1.



The apparatus, in its simplest form, consists of two parts, viz., *fig.* 1, a cylindrical tube of tin, sheet iron, or copper, about four inches wide at the bottom, A, and tapering until it is only one inch in diameter at the top, B. This constitutes the stove, a window being placed at the bottom, A, within which stands a small moveable cup, which, being filled with alcohol, is set on fire, the heated air then rises and passes through the stove, while the vapour of the alcohol is condensed or diffused as the operation goes on.

Fig. 2.



In *fig.* 2 is shown the semi-cylindrical frame-work, which, being placed over the body of the patient in bed, sustains the weight of the superincumbent blankets, quilt, &c. The small end of the stove-pipe being inserted into an opening seen in the closed end of the frame-work, and the alcohol inflamed below, the heated air soon surrounds the body, and speedily produces a general and profuse perspiration, which being effected, the stove is taken away, and the frame-work is drawn out from the foot of the bed, leaving the patient beneath the clothes as long as it may be desirable to keep up the perspiration.]

Subsect. 11.—*Hot Bath.*

7100. *The hot bath has a temperature* from 98° to about 112°, or the greatest heat that can be borne. It is a powerful stimulant, and should never be used by persons in a state of perfect health, but is employed only in cases of disease, and this should always be under the direction of a medical practitioner. As the object is to rouse the nervous and the general vital action, the bather should never remain long enough in the hot bath to produce exhaustion; the average time for using it is from ten to fifteen minutes. The few cases to which the hot bath is suited are chronic affections of the nervous system, such as paralysis, when all vascular fulness of the brain has been removed. The waters of the King's Bath, at Bath, and some of the hot baths on the Continent, are beneficially employed in such cases.

Subsect. 12.—*Medicated Baths.*

7101. Medicated baths are those in which medicinal substances are added to the medium of the bath. Some of these are very efficacious in certain diseases, but their use is very limited. *Sulphurous vapour baths* are found useful in several diseases affecting the skin. The *nitro-muriatic bath* of Scott is serviceable in chronic inflammation of the liver contracted in warm climates. The *ferruginous baths* in Nassau and the Hartz are more tonic than the simple cold-water bath. Many others occur in different parts of the world, but are little known, as the mud baths of the Italians; and there are various baths of mineral waters, some of which are highly praised. Carbonic acid gas issuing from the interior of the earth has been applied to the formation of air baths at Marienberg in Germany, and found useful as a powerful sedative. But the description of these various baths, however important under the direction of a skilful physician, does not come within the limits of a work treating only on domestic economy.

Subsect. 13.—*Sea Bathing.*

7102. Although the most important effects produced by bathing depend upon the temperature of the water, yet there can be no doubt that the effect of simple fresh water and that of the sea are very different. When the object is to produce reaction, and to stimulate and brace the system, sea water, which is the form of cold bath in most general use in this country, is to be preferred. When a tonic effect is required, the water of the open sea is more bracing than that in a confined apartment. Of all the substitutes for the open sea, the *swimming baths*, such as that at Brighton, are the best; and they have this advantage, that they are accessible in every kind of weather, and at any time of the day.

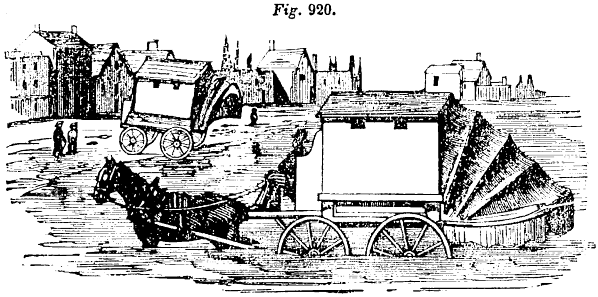
7103. *The manner of going into the bath*, and the time of remaining in it, must depend upon circumstances, chiefly on the condition of the bather. Some plunge at once, in order to have the full advantage of the shock; others, again, are recommended to take at first only one or two dips, to ascertain the power of reaction, and gradually to prolong the stay in the water. Moving the body and limbs while in the water is highly advisable, and the exercise of swimming is good, if the patient has sufficient skill and power. The body should be quickly and well rubbed, and dried with a somewhat coarse towel, and the clothes put on without any unnecessary delay; though this precaution is not so necessary as in bathing in fresh water, as the particles of salt that remain in the skin after evaporation stimulate it more than rubbing. A common error in the practice of sea bathing is, that the patient remains so long in the water that the animal heat is lowered below the proper degree, and the consequence is a subsequent sense of chilliness that is injurious.

7104. *It is recommended that the invalid should take some gentle exercise* previous to going into the cold bath, with the view of rendering the circulation more vigorous, but not so much so as to induce fatigue, or much perspiration. It is not proper to enter the water with the slightest sense of coldness.

7105. *When the bather is in delicate health,* the temperature of the water is an important consideration. In that case, from 11 to 12, after breakfast, may be preferable to the early morning; but in some parts of our southern shores, sheltered by high cliffs, the sun is too powerful in the middle of the day for invalids, and then an earlier hour may be more suitable. It is often a common error, but one oftener committed by those who bathe for laxing than by invalids, that they remain so long in the water that the animal heat is lowered below the proper degree: to boys of a feeble constitution the mischief from this is considerable. In order to obtain the full degree of salutary reaction, immersion in the cold bath should cease just before the temperature of the body is sensibly diminished; and a proof that this point has not been passed will be, that the glow or reaction is felt to continue.

7106. *Fig.* 920 is one of the bathing machines now so common at all our watering-places. It consists of a small wooden house placed upon four wheels, drawn by a horse,

Fig. 920.



the driver sitting in front. At the back there is a set of large semicircular hoops, having canvass stretched over them that can be lowered by means of hinges into the position represented in the cut. Within the area enclosed by this canvass there are steps from the back of the machine, by which the bather can descend from the interior into the sea without being seen from the shore. When the machine is not in use, these hoops are drawn up, as in the machine represented in the distance.

7107. *The periods of the year* best adapted for sea bathing are the summer and autumn, when the temperature of the water on our shores varies from 55° to 70°. Those who have vigorous constitutions, or, at least, great powers of reaction, may continue to bathe in the sea beyond the autumnal months, and some even in winter; but it will scarcely ever be proper to commence bathing at the latter time.

7108. *The time of day for bathing in the sea* must depend partly upon the locality and state of the tide; but, independently of these considerations, the best time, either as a measure of hygiene or as a remedy, will be about noon, that is, two or three hours after breakfast, when the system is sufficiently recruited by the morning's meal; but should the sun be very powerful at this time, an earlier hour must be chosen. When the constitution is strong, the temperature of the surface high, and the person refreshed and active when he rises from his bed, the bath may be taken before breakfast. The temperature of the water on the seashore will vary with the locality, the hour of the day, and the time of high water. If the shore consist of level sand or shingle, the tide which flows in the afternoon over a large expanse of surface is somewhat heated.

7109. *In cases of relaxed habits,* when there is a tendency to perspiration on slight exertion, or to cold, clammy perspiration in bed, the salt-water bath proves eminently useful, particularly when combined with dry, pure air and a bracing climate, such as are found on the airy downs along the southern shores of our island. It acts as a preventive of the numerous family of catarrhal diseases which are the result of debility, and it strengthens in a peculiar manner the skin and mucous membranes of the air-passages, the relaxation of which is so productive of catarrh on the least change of temperature. With this view, sea bathing should be practised for some time during the summer season, and afterward the shower bath; during the winter it will be proper to employ sponging on the chest and trunk. When considerable irritability of the system is shown by the state of the mental functions and the hypochondriasis of literary persons, cold sea bathing is particularly useful; but in a state of actual indigestion, especially if complicated with sub-acute inflammation of the mucous membranes of the stomach or intestines, cold bathing is very injurious. It is serviceable in cases of torpor and loss of power, and in weakness of the limbs, and after spasms and paralysis.

Simple as the cold bath appears, yet, like all other remedies, it requires caution; in infancy and old age it is less admissible than at other times, and it is quite improper if the debility is great; and hence, previous to entering upon a course of sea bathing, it is prudent to consult a physician resident upon the spot.

7110. *Warm Salt-water Bath.*—Saline impregnations modify the effects of the warm bath. The warm salt-water bath is sensibly more stimulating than the warm bath of fresh water. Accordingly, to those who are strong, after fatigue, much more refreshment is conveyed by a warm sea bath than by an ordinary warm bath; and many of those who are of that exhausted habit that they would be enfeebled by the latter, take the former with benefit and sensible improvement of strength; hence some of the contradictory accounts sometimes given of the effects of warm bathing. Baths with saline impregnations can be borne for a longer period, and are followed by less exhaustion, than those of pure water, and patients are less liable to take cold after the former.

Sect. VI.—air.

7111. The subject of the necessity of breathing good air has been already treated of in Book III., "On Ventilation." We may here state that the air is chiefly contaminated by exhalations from decomposing animal and vegetable substances: the exhalations from animal matters are most abundant in towns, particularly in large manufacturing towns, where there are numerous poor; in such places not only are the habitations uncleanly, but the system of sewerage is imperfect; matters are left to accumulate, instead of being carried off, and poured out into rivers or reservoirs; large dunghills are sometimes seen, on which all the refuse of a neighbourhood is thrown; or, if there be drains, they are uncovered, and their contents stagnate from want of sufficient stream to carry them away. Such a state of things renders those exposed to the effluvia liable to dysentery, diarrhœa, and other bowel complaints; it produces fever, or, at any rate, it aggravates this when present; and, by depressing the general health, it renders all complaints more severe and fatal. In districts in which drainage is very imperfect fever is seldom or never absent, and at particular seasons it rages like a pestilence. These matters have lately occupied much of public attention, and will doubtless soon be remedied; the knowledge of them, however, and the necessity of reform, cannot be too widely diffused.

7112. *The exhalations from decomposing vegetable substances* are evidenced in the effluvia from marshes: they produce agues and remittent fever. It is necessary for the decomposition of plants that there should be a certain degree of moisture, heat, and, of course, atmospheric air; if there be too much moisture, decomposition cannot occur; and very wet places are not so liable to ague as places sometimes wet and sometimes dry: for example, a place in which ague prevails will become free from this when a marsh is converted into a lake; again, a certain degree of moisture is necessary to produce the malaria; and if this be lessened by draining the marsh, agues cease, as in the former case.

7113. *The effluvia from plants* is most abundant in spring and autumn, and for this reason: towards the end of summer plants lose their foliage and their flowers, and scatter their seeds; an immense quantity of dead vegetable matter is thus distributed on the ground; and if the requisite degree of moisture be present, the heats of autumn soon cause decay, and extricate the peculiar substances which produce ague when distributed through the air. Marshes, again, towards the end of summer have lost much water by evaporation, and the water plants which grow in most marshes in prodigious quantity are in a position the most favourable for decomposition. The extrication goes on all the autumn, but is arrested by the frosts of winter, which congeal the water and render decay impossible; but in the spring, when the sun again acquires power, the remnants of the vegetable matter which have escaped decomposition the previous autumn, and which have lain dormant all the winter, are speedily acted upon, and a great quantity of miasma is evolved. When marshes existed over large districts, all complaints were aggravated at these times; and even now it is not uncommon in country places to hear poor people anticipating an increase of their complaints "at the spring or fall of the leaf."

7114. The "*malaria*" is rather peculiar in its transmission; sometimes it is conveyed great distances, at other times it infects only a limited district. In all marshy countries, as a general rule, it is more liable to attack those who are nearest to the marsh; sometimes, however, it will pass over a particular village, and this may sometimes be traced to the presence of woods and foliage between the marsh and village; for it is singular that thick foliage seems occasionally sufficient to arrest its course.

Malaria is more liable to attack new comers, and those unused to it, than inhabitants of fenny countries; it will sometimes not excite ague till the strength of the individual has been accidentally lowered by some cause or other. It seems more powerful in the evening than in the middle of the day; it will attack those sleeping on the ground floor, and pass over those who are at the top of the house; sleeping on the ground in the open air is almost sure to give an attack.

7115. Touching the means of preventing the action of malaria, some have fancied that smoking has much power as a securitive; and in fenny countries some people al ways take spirits before going into the air in the evening; but it is doubtful if these do any good: the best thing is to take two or three grains of *sulphate of quinine* every four or six hours, directly any symptoms of an attack are perceived.

SECT. VII.—TEMPERATURE.

7116. The human frame is capable of a considerable power of accommodation, and can sustain without inconvenience the extremes of temperature: as a means of preserving health, however, a temperature moderate, and not suddenly changeable, is the best; but on this subject we refer the reader to what we have said on "Warming," Book II., and "Ventilation," Book III.

SECT. VIII.—EXERCISE.

7117. Exercise is absolutely necessary to preserve the health; most people will admit this statement, but few know exactly what proper exercise is: by proper exercise is meant the use of all the muscles in the body, not in an immoderate degree, but enough to keep them in full play, and render the discharge of their office easy and pleasant to the person; hardly any kind of exercise by itself can be considered as doing this; even walking, which is, on the whole, the best, exercises the legs much more than the arms, and with walking it is necessary to combine some plan by which we may call into play the muscles of the arms and of the chest: the legs of the professional pedestrian are often beautifully developed, while his arms appear as if made for another person: the arms of the blacksmith, again, are those of a powerful athletic man, while his legs are comparatively small and feeble. Therefore walking, by itself, although extremely useful, does not answer to the definition of *complete* exercise, unless it be combined with the use of the dumb-bells, or with some plan which enlarges the chest and calls into action the muscles of the upper half of the body.

7118. Boating and rowing, again, exercise the chest and arms more than other parts, and in moderation, and combined with walking, no exercise is better than rowing; but if too much indulged in, it is apt to supersede walking, and then the arms are immoderately used; and, from the constant moving of the chest, the heart is made to beat stronger than it should, becomes over-nourished, and at length enlarged, and then perhaps diseased in other ways.

7119. Horse exercise is very good, and in some particular cases remarkably useful, but, like every single form of exercise, it is too partial in its operation, calling into play only a few, comparatively, of the muscles in the body; it should consequently be combined with walking, the use of the dumb-bells, &c.

7120. Carriage exercise is useful chiefly by the fresh air, change of scene, &c., which accompany it.

Among other exercises, particularly in those predisposed to any diseases of the chest, reading aloud is one of the best that can be taken; it calls into play many muscles, and causes a more rapid transmission of the blood through the lungs.

7121. To sum up what we have said in a few words, exercise must be composite; walking must be combined with other forms; horse exercise must not alone be depended on; one set of muscles must not be exercised to the exclusion of other sets.

7122. With regard to the degree and extent of exercise, this must be left to the discretion of each individual. We may make this remark, that great exercise must not be taken *suddenly*, that is to say, a person who for some months has not been able to exercise regularly must not attempt at once to return to the same degree he used before the disuse; he must regain the standard gradually. *Excess* of exercise is indeed very hurtful; many diseases, particularly of the lungs and heart, are brought on by it; the violent rowing which is practised at some of our universities has in several instances been attended with very disastrous consequences.

[The observations of this section are judicious, but incomplete Exercise, to be useful, should be performed in the open air, and it is for this reason that the use of the dumb-bells is not adequate of itself to secure the objects of an invalid. The same objection lies to a reliance upon dancing, since this, also, is mostly performed within doors. Sawing wood for males, and jumping the rope for females, in the open air, when the weather permits, will be found the preferable modes of exercise, calling into action all the muscles of the body, and especially those of the arms and chest.

Invalids should, whenever practicable, be advised to select modes of exercise which are somewhat in the nature of productive labour. To exercise for any length of time merely for the sake of health is found to become a daily toil; while labour in the agricultural or mechanic arts may be made productive, at least in seeing the fruits of their work, and calls off the mind from the existing disease which renders exercise necessary as a remedial agent. Hence those who travel solely for health, having no definite object in view, are seldom benefited by the exercise of riding or sailing, because the mind, instead of being employed on the changing scenery and varied objects of contemplation, reacts upon itself, and pores over the morbid symptoms which impose the journeying as a task, often when rest would be preferred. To have in view some object of business or even to visit distant relatives or friends, should be secured whenever practicable, in order to secure the full advantages of exercise when medically advised.]

CHAPTER IV.

USEFUL INFORMATION IN CASE OF SICKNESS IN THE FAMILY.

7123. Under this head we propose, *first*, to describe some slight disorders which are usually curable without medical aid; *secondly*, to enumerate the circumstances which would lead us to apprehend the approach of certain severe diseases; *thirdly*, to notice the chief accidents which may occur in a family; and, *fourthly*, to detail the management of the sick-room during the prevalence of certain severe affections. The two latter we shall treat of in separate chapters.

SECT. I.—SLIGHT DISORDERS USUALLY CURABLE WITHOUT MEDICAL AID.

SUBSECT. 1.—*Common Cold, Cough.*

7124. *A cold begins* with a little chilliness, and feeling of illness, followed by slight pains in the back of the head, down the neck, or in the back; there is often headache; the nostrils seem dry and stuffed; there is frequent sneezing, and soon afterward discharges from the nose and eyes. Such an attack is often called "a cold in the head;" after remaining at a height for two or three days, or longer in some individuals, these symptoms gradually subside, leaving behind them a little hacking cough with slight expectoration, which continues for two or three weeks.

Treatment of a Cold.—Almost every one possesses some way of curing his own cold. In most cases it is advisable to keep within doors, to take care of draughts, and to leave off animal food for two or three days; the feet may be bathed in warm water, and a pill taken, consisting of a mixture of blue pill (about two grains) and James's powder (about three grains).

If the cold be very severe, if there be considerable fever present, indicated by a hot skin, quick pulse, furred tongue, and thirst, the patient should retire to bed; a brisk aperient should be taken, and at night the warm foot bath used, and the pill above mentioned. After two or three days the violence of the cold subsides, and the cough left is often troublesome: the following draught is useful:

Take of wine of ipecacuanha, 10 or 15 drops; camphorated tincture of opium, 20 drops; camphor mixture, 3 table-spoonfuls. *Draught to be taken night and morning.*

Or this draught is often efficacious, viz.:

Take of tincture of balsam of tolu, 20 drops; compound powder of ipecacuanha, 5 grains; mucilage of acacia as much as may be sufficient; water, 2 table-spoonfuls. Draught to be taken every night for 3 nights running.

For measuring the drops, it is advisable to use a little graduated glass called a *minim* measure, and which can be bought at any druggist's shop. Sometimes a cold is arrested by a plan altogether the reverse of this, viz., eating as usual, and taking a glass or two of wine more than ordinary; and this plan is chiefly successful when there is but little feverishness attending the cold. Another plan by which a cold can sometimes be at once arrested is, taking a dose of tincture of opium (about twenty minims of the tincture) at bedtime, and following it up next morning with an aperient mixture, such as the following:

Take of sulphate of magnesia (Epsom salts) from 2 to 4 drachms; infusion of senna, 3 table-spoonfuls; tincture of senna, 1 drachm (60 minims). Draught to be taken the first thing in the morning.

However, if this plan do not stop the cold, it will increase it; and we do not recommend it unless there be some particular necessity for speedily getting rid of the cold. Another plan has been much recommended by Dr. C. J. B. Williams, and which seems really to be beneficial, particularly in cases where colds are very severe, lasting for 2 or 3 weeks; we allude to the total abstinence from fluids of all kinds for 48 or 60 hours; the lips may be wetted, but no fluid should be swallowed. In 46 or 48 hours the severe symptoms disappear, the eyes no longer smart, the discharges from the nose cease, and the cough disappears; one great advantage of the plan is, that it permits the individual to pursue his ordinary avocations; it does not confine him to the house. But this plan greatly augments fever when it is present.

SUBSECT. 2.—*Influenza.*

7125. This in many respects resembles a severe cold, but with more fever, with greater headache and loss of appetite; the cough is also often very severe, and there is a remarkable loss of strength; the general indisposition is very distressing; there is great thirst, white tongue, with heat of skin and quickened pulse.

7126. *Treatment.*—This is a much more serious complaint than cold, and almost always demands medical aid: the warm bath should be used, and the patient should go to bed, and take the pill formerly mentioned (viz., blue pill and James's powder), and next morning an aperient; if senna be very disagreeable, Epsom salts may be taken in an effervescing draught.

SUBSECT. 3.—*Sore Throat.*

7127. This often accompanies a cold. In a severe form it requires medical attendance; when not so severe, however, it is often relieved by simple gargles, such as solution of gum, with barley water, and by the inhalation of warm, watery vapour.

Individuals are sometimes annoyed with constant recurrences of sore throat. When examined, the throat is seen swollen, but not very red; in fact, it is what is commonly called relaxed sore throat: now it is in these cases that gargles of capsicum and of port wine are useful, but it should be remembered that these gargles, if there be much inflammation, are likely to do more harm than good; and, instead of them, we beg to recommend a gargle of alum directly the soreness and feeling of relaxation begin to appear. This gargle must be saturated with alum, and is best made in the following manner: A piece of alum is pounded finely in a mortar, and then boiling water poured upon this, and rubbed with the alum; or the alum, when powdered, may be put out of the mortar into a glass, and boiling water poured upon it, and the two stirred together with a spoon; then the water must be poured off and left to cool; if any alum is deposited as it cools, it proves that the solution is saturated. The gargle thus prepared should be used every hour or two for several successive times; after the few first times the pain and difficulty of swallowing subside, and gradually altogether disappear.

It is a good plan, when sore throat is a common occurrence, to gargle every morning, or every other morning, with this solution. Solution of salt and water is also a good gargle in such a case.

SUBSECT. 4.—*Stiff Neck.*

7128. A stiff neck is almost always relieved by warm fomentations and the warm bath; warmth may also be applied by means of hot flannels wrapped round the neck. A dose of James's powder (three or four grains) may be taken at bedtime.

SUBSECT. 5.—*Toothache.*

7129. Toothache may be rheumatic, or may be caused by the decay of a tooth and inflammation of its nerve.

In the former case the pain extends to several teeth, and along the jaw; it is duller than the pain of decayed teeth, and does not come on in paroxysms; there are also often pains over the head or down the neck, in fact, rheumatism extending to other parts.

In toothache proceeding from decay the pain is at times dull and gnawing, at times severe and cutting, shooting to the ear, along the jaw, and down the neck: the cause of the pain is an inflammation of the nerve distributed on the pulp of the tooth, and the pain is more or less severe, according to the extent and height of the inflammation. To understand this fully, a few words on the structure of the teeth become necessary. Every one knows that teeth have different shapes: one part is called the body, the other the fang of the tooth; each tooth is composed of a bony matter called the ivory and of a white matter covering this on the crown, very hard and dense, and termed the enamel of the tooth. Within the tooth is a cavity, having somewhat the shape of the tooth itself, and filled with a whitish substance called the pulp; at the end of the fang of the tooth is visible a little opening; into this opening pass numerous little vessels and nerves; they run into the central cavity, and are distributed on the pulp: now when the tooth has decayed somewhat, the food which is taken into the mouth can more easily make an impression upon the nerve; if this impression be sufficiently severe, inflammation follows, and lasts a longer or shorter time.

Several circumstances are at once evident from this statement; it proves how careful everybody should be not to let the teeth decay too far, else it becomes impossible to stop them. The process of stopping consists in scooping out all the decayed part of the tooth, and filling up the hollow with gold leaf or tin foil; if the decay has gone on to near the pulp, there is not sufficient ivory left to be scooped out. Again, it is very evident that the use of dropping laudanum and other sedatives into the tooth results from their action on the nerve itself; laudanum, indeed, is often very successful in alleviating the pain. Besides laudanum, various remedies are applied to a decayed tooth to relieve the pain; *camphorated spirit*, applied on cotton wool, or *creasote*, or *oil of cloves*, are often used with success; these seem to act, not as sedatives, but by exhausting the irritability of the nerves, and then their sensibility being deadened, the pain ceases. It might be expected that we should enlarge here on the subject of dentists, but we think it would be invidious to point out any particular individuals as better than others; and as there are plenty of excellent educated dentists in London and the large provincial towns, it is a man's own fault if he run the hazard of losing his teeth by placing himself in the hands of an empiric. We wish, however, to caution our readers against the use of alloys, amalgams, mineral succedanea, &c., and all the tribe of advertising dentists: some of these substances are made with silver and mercury, and are positively hurtful; others are useless; and though, occasionally, some seem to answer their purpose, the employment of the majority will be attended with disappointment. We believe we may safely add that all the best dentists in London have long given up these compounds. When toothache is very severe and the gum is inflamed, it is often useful to apply one or two leeches to the gum.

SUBSECT. 6.—*Earache.*

7130. This is sometimes merely a nervous affection, and may be relieved by dropping two or three drops of laudanum into the ear, with or without a little sweet oil; but often earache is by no means a trifling affection, and if the laudanum do not relieve the pain, medical assistance should be sought for, as high inflammation may prevail, and hearing may be interfered with—the brain even may be affected; leeches and active treatment, even blood-letting, become necessary.

We take this opportunity of mentioning that in case of any little insects getting into the ear, they will be immediately killed by a few drops of olive oil poured into the ear, if, indeed, the acrid secretions of the passage have not already had that effect. If a child put a seed, a little pebble, or any small body of that nature, into the ear, it may be often extracted by syringing the passage strongly with warm water for some time: if this do not effect its expulsion, the scoop or forceps of the surgeon become necessary.

SUBSECT. 7.—*Headache from Indigestion.*

7131. Headache may arise from numerous causes, with which at present we have nothing to do. We speak now of that kind of headache which people know arises from indigestion; the bowels being a little more costive than usual, the food having been different from the accustomed routine, are circumstances which in particular individuals are often followed by a heavy, tense headache, situated over the eyes, or over one eye and over one temple, or else extending all over the head. There is often a difficulty in casting the eyes up suddenly to the ceiling; the eyes look heavy, and under them is a darkened circle; there is also present a feeling of sickness, uneasiness and weight in the stomach, particularly after meals; the bowels are costive; there is flatulency; the urine is turbid; the tongue is white; the mouth parched or clammy; the breath is often a little fetid, and the food may be tasted for several hours after it has been taken.

7132. *Treatment.*—If there be much nausea, and feeling of weight and distention, an emetic of ipecacuanha becomes necessary. To an adult of twenty years and upward, from fifteen grains to one scruple will be a good dose; for a boy of twelve years, half a scruple will be sufficient. Warm chamomile tea may be drank afterward; it keeps up the sickness, and effectually dislodges all offending matter from the stomach. After the emetic has fully acted, an aperient mixture should be given.

To avoid these headaches, attention to diet and the state of the bowels are the great points to be regarded. The diet should be simple, without fermented liquor; animal food should be taken once a day. To regulate the bowels, nothing is better than dinner pills, containing a little rhubarb, aloes, and compound extract of colocynth; when the bowels are got into a regular state these should be discontinued.

SUBSECT. 8.—*Hysterical Fits and Affections.*

7133. An hysterical fit, although generally a very innocent thing, is sufficiently alarming when seen for the first time. Although most usual in excitable and ill-regulated minds, it may occur in the most sensible and calm-judging person. Sudden shocks, fright, great mental emotion, grief, joy, anger, will produce in any one an hysterical fit of more or less violence.

The fit is often preceded by a feeling of faintness, and of choking, as if a ball were rising in the throat, interfering with swallowing, and even with speech. Then comes on a violent fit of screaming, and sobbing, mingled with wild bursts of laughter; the eyes are closed, the breath is drawn with labour, the face becomes red, and the limbs perhaps convulsed; the throat is grasped violently, or the hair is torn, or the hands or feet are beaten violently against the ground. In fifteen or twenty minutes the fit goes off, and the patient comes to herself, having been unconscious the whole time, or more often retaining a distinct recollection of the occurrences around her, although she may pretend not to do so. During the fit, all that is necessary is to see that the patient does not receive any injury by rolling violently off the bed or sofa. She should be prevented striking and injuring herself, but beyond this there is no reason to employ force to restrain her movements. The sudden dashing of cold water in the face is often of service; some advise salt to be put into the mouth.

If hysteria always assumed this form, it would be a mild and tractable affection, instead of being, as it is, one of the most difficult to treat in the whole range of medicine. But the social position of women diversifies this disease in a hundred different ways. The conventionalities of society; the strife after fashion; the desire of approbation; the intense longing for sympathy; the mortification of failure; the excessive cultivation of the intellect as compared with the physical frame and strength; the excitation of the moral faculties by theatrical exhibitions, and by the innumerable works of imagination which derive their interest from delusive views of life and actual society, all tend to create a struggle and mental contest, which, in the susceptible organization of the educated woman, ends in many instances in one of the numerous forms of hysterical disease.

We make these remarks not in the shape of a crusade against the present system of female education, for this, as far as we know, has improved, and will improve still more; but we wish to point out to the parents of an hysterical patient how valuable, and indeed indispensable, to the medical man is their assistance in the treatment of the complaint. What advantage can medicines give, or the professional attendance for ten minutes a day, if the cause of all the disorder, the important mental process, be left unremedied? If parents will not assist in the treatment of these complaints, the physician cannot restrain them, nor are they "curable by any herbs." The mind must not be left to itself, nor must works of imagination and of absorbing interest be allowed under the idea of amusement. If possible, some pursuit, interesting, yet not exciting, should be inculcated—some plan by which the intellectual and moral faculties are gratified, but not roused into violent and opposing action.

The excitement of mixed society must in many cases be avoided, but the presence of friends is often singularly beneficial, by withdrawing the mind from constant attention to its own thoughts. Too much sympathy must not be given; and, especially in the middle classes, one must guard against that strange fanaticism which, under the semblance of religion, is too frequently an attendant source of hysteria.

Improvement in bodily health will often remove hysterical affections; hence country air, plenty of exercise on foot as well as on horseback, and sea bathing are of essential use. Plain food and warm clothing are also essential.

[Hysteria, as its name implies, is very frequently symptomatic of some irregularity in the function peculiar to the womb, the periodical secretion from that organ being either deficient or in excess; irregular in its recurrence; attended with difficulty and pain; or, as in many cases, morbid in its quality, being rather a discharge of blood than the ordinary flow. To some one of these conditions the severe, protracted, or repeated attacks of hysteria are to be ascribed much oftener than to the mental or moral causes justly named as occasionally productive of the disease. Indeed, many of the mental manifestations of females, which are afflictive to themselves and others, result from physical disease in the reproductive organ, which, at certain periods of life especially, may be regarded as the centre of sympathy, whence a multitude of morbid affections of the nervous system derive their origin. A neglect of recognising the important bearings of this feature in the female economy often results in withholding that sympathetic kindness and physical treatment they need, and a disposition to apply the indefinite term "nervous" to the group of symptoms which, if they do not ultimately prove serious, are for the present the source of much positive suffering.

The counsel of a skilful and experienced physician should always be sought where the earliest domestic remedies fail to relieve the irregularities of females, and especially when hysterical symptoms supervene.]

Subsect. 9.—*Whitlows.*

7134. These are extremely painful affections, arising from the formation of matter under some of the dense structures of the ends of the fingers and thumb. Cold lotions, or a bread poulice, may be applied; but the most effectual, and after a time, if the case be severe, the necessary treatment is, letting out the water with a lancet; and though this little operation is somewhat painful, yet it is much less so than the torment which often attends the disease.

7135. *Severe Whitlow.*—In commencing, laudanum applied constantly by means of a rag dipped in it, and put round the finger, is a good and soothing remedy.

Subsect. 10.—*Boils.*

7136. These are painful swellings of a hard, dense structure, slowly increasing in size, till sometimes they become as large as a pigeon's egg, or larger; after a time matter forms and discharges itself, then the core, as it is vulgarly called, comes away, and the boil heals up. They should be poulticed, and balsam of Peru applied twice a day; when matter forms, the surgeon's lancet will expedite the cure.

Subsect. 11.—*Carbuncle.*

7137. This is a large swelling, occurring chiefly on the back, very painful, and often four or five or more inches in circumference; matter gradually forms and discharges itself by several openings. It is a serious disease, and requires prompt medical aid. Poultices must be applied twice a day. If the patient be old and feeble, the strength must often be supported by animal food, malt liquor, and perhaps wine and Peruvian bark administered.

Subsect. 12.—*Chilblains.*

7138. These generally arise from sudden variation of temperature, particularly in delicate and loosely-clothed children; they are most common on the feet, but may occur on the hands, nose, ears, or other parts of the body. There is a red, painful swelling, which itches very much when in bed; ice or cold water is the best thing, and should be used two or three times a day, or various stimulating applications are resorted to, as camphorated spirits of wine, tincture of myrrh, or spirit of turpentine. The part should be well clothed, and changes of temperature guarded against. If chilblains are not arrested in this way, the red colour becomes blue, and after a time a vesicle rises, which opens, and leaves a sore and painful place. To this a poultice should be applied, or linen rags covered with some simple ointment. If the sore do not improve, certain applications are necessary, but which must not be used without the sanction of the medical attendant.

SUBSECT. 13.—*Piles.*

7139. In many instances this troublesome complaint arises entirely from a want of due attention to the state of the bowels, conjoined with sedentary habits, deficiency of exercise, and over-eating. In many cases the patient receives great relief from gentle exercise on foot and horseback, unless there be so much pain as to render this painful, in which case medical advice is necessary; otherwise inflammation of the parts may ensue, and cause excruciating torment. With regular daily exercise, also, a diet light and digestible must be used, and the bowels kept in a lax and proper state by a mixture of magnesia and sulphur, or a tea-spoonful of the confection of senna, taken every night: if this be not active enough, a drachm of powdered jalap may be added to every ounce of the confection, and a tea-spoonful of this taken. The parts should be well washed once or twice a day with cold water and soap, and afterward an ointment may be applied, made of a drachm or two of powdered gall-nuts, with an ounce of lard or any simple ointment: it is better to begin with a small quantity of gall-nut, and gradually to increase it.

If the confection of senna be not strong enough, half a tea-spoonful of sulphur may be added to every dose. Sometimes, and particularly in sedentary individuals, the lower part of the bowels gets tinged with blood, and relaxed, giving rise to the idea of piles being present; the best treatment is the avoiding constipation by taking the confection of senna mentioned above, and using exercise, gentle at first, and afterward more active.

Respecting the limits of domestic and medical treatment, this must be left to the discretion of each particular person. It is certainly better to be now and then alarmed unnecessarily, than to overlook an important and latent disease: even a common cold, if suffered to run on without checking, brings no inconsiderable evils in its train, and the slightest chilblain, if treated improperly, may become an obstinate and unmanageable sore.

SUBSECT. 14.—*Corns.*

7140. These are chiefly caused by tight shoes; the best plan is to soak the feet in hot water, and then for a corn-cutter, or chiropodist, to cut out the nucleus or core.

SUBSECT. 15.—*Warts.*

7141. These are got rid of in various ways: some tie a thread around their base; but a better plan is to have a piece of thick paper with a hole cut in it the size of the wart; this is put over the wart, and then every morning a drop or two of the strongest acetic acid dropped through the hole upon the wart; if this do not succeed, dropping oil of vitriol (sulphuric acid) in the same way will perhaps answer.

SUBSECT. 16.—*On the Limits of Domestic and Medical Treatment.*

7142. Although disease in many instances cannot be effectually treated without professional assistance, yet the greatest aid in many cases is afforded to the physician by proper apprehension of his treatment, and by judicious fulfilment of his advice: we do not exaggerate when we say that in many severe diseases the prompt and skilful attention of a nurse or mother is of incalculable importance; without it, the best directed efforts of medicine are rendered nugatory; while possessing it, the physician knows that all his endeavours are seconded in the most efficient manner. But this subject will be enlarged upon when we detail the "Management of the Sick-room—Severe Diseases."

SECT. II.—COMMENCEMENT OF CERTAIN SEVERE DISEASES.

7143. It would be of little use to enter upon the detail of all the multitudinous ills which demand medical assistance: we shall select a few of the more important, and bring these only under the attention of the reader.

The commencement of the different *eruptive* fevers (smallpox, scarlatina, measles, &c.) has already been mentioned.

SUBSECT. 1.—*Ague.*

7144. This disease, extremely common in some districts, is scarcely known in others. It is caused by the exhalations of decomposing vegetable substances, and therefore is chiefly witnessed on the borders of marshes and low countries imperfectly drained, or occasionally flooded. In its severe form it is a dangerous disease, as in the fevers of the Campagna of Rome, where a failing civilization has suffered marshes to lie undrained, and have thus produced in modern Italy an intensity of disease unknown in the days of ancient Rome.

The attack of an ague is unfortunately but too well known. At first the patient feels chilly and cold, heavy, and sleepy; then speedily the cold feeling increases, until it becomes intense; the lips and cheeks become blue; the skin becomes rough (goose skin as it is called); rings drop off the fingers, which, as well as the whole body, are shrunk and diminished in size; there is shaking and trembling. After a variable time, the coldness diminishes, and is succeeded by flushes of heat, which speedily become general; the skin is now as hot as it was before cold; the face is red and swollen; the pulse full, quick, with a degree of hardness; the eyes are dry and red; there is often intense headache and pain in the back. These symptoms, having continued at their acme for some time, gradually lessen, the skin becomes moist, and at length there occurs a universal and plentiful perspiration, which reduces the heat of the skin, and, gradually ceasing, leaves the patient free from pain and fever, but languid, inert, incapable of bodily or mental fatigue. Such is a description of a well-marked attack of simple ague; there are numerous variations, which it would be useless to introduce.

The course of an ague is as follows: It has a disposition to return periodically, that is to say, at a determinate period: thus its attack comes on in the morning, and ceases after some hours; but recurs on the following morning at the same hour; then again departs, and again makes its appearance at the same hour on the third day, and so on. Such a disease occurring daily is called, in medical language, a "quotidian ague;" if, instead of returning every day, it comes on every other day, it is a "tertian ague;" and then the attack is usually about noon; if it returns every third day, it is a "quartan ague," and the attack occurs principally towards evening.

7145. *Treatment.*—The treatment of ague is very successful: the influence of *Cinchona bark* has been known for a long time. It is usual now to prescribe, not the bark itself, but its active principle, *quinine*, extracted by chemical agency, and united with *sulphuric acid*, forming the salt called *disulphate of quinine*. The dose of this is from two to eight grains. It should be given between the attacks, in the following form:

Take of the disulphate of quinine, 2 grains; diluted sulphuric acid, 10 minims (or more, if necessary); diluted nitric acid, 5 minims; infusion of roses, 1½ ounces. Make a draught. To be taken every three or four hours.

The attack of ague may sometimes be arrested by giving an emetic. To adults such as the following:

Take of powdered ipecacuanha from 15 to 25 grains. Mix with a little water, and take. For a child, ipecacuanha wine may be given, or 3 or 4 grains of ipecacuanha itself.

Sulphate of quinine being an extremely expensive salt, charitable individuals living in aguish districts are usually anxious to obtain some substitute equally efficacious and less expensive.

The active principle of willow bark, termed by medical men "salicine" (from *Salix*, the botanical name of willow), has been used for this purpose, and may be procured from the London druggists. It has certainly very considerable powers; but, as it is seldom obtained at all pure, its employment has not hitherto been extensive.

Arsenic is another medicine which has a great influence over ague; it forms the chief ingredient in the "tasteless ague drop" of some districts, and has the advantage of being much cheaper than sulphate of quinine. We do not, however, recommend its employment in non-medical hands, as so powerful a remedy may, if overdosed, lead to dangerous consequences. If it be given, it should be in the form of the *Liquor arsenicalis*, or *Fowler's solution*, as it is often termed; and this may be procured from any druggist. Its dose is at first four or six drops; if it cause any pain in the stomach, or sickness, it must be instantly discontinued. When neither cinchona bark nor willow bark can be obtained, as, for instance, when travellers are attacked in out-of-the-way places, other substances must be had recourse to; thus, chamomile flowers, infusion of marsh trefoil, buck-bean, pepper with rum, and the rhizome (underground stem) of the sweet flag (Acarus calamus) have all been celebrated for curing agues, and all seem to possess powers able to do so, though not equal to cinchona bark. It is a good thing to take an emetic about half an hour before the attack comes on, such as ipecacuanha, 20 grains; or sulphate of zinc, 20 grains.

The root of the common Avens (Geum urbanum) also has been used in ague with success; it enters into the composition of the Augsburg beer, which in some parts of Germany is considered a preventive of ague. The root is boiled in water, and three table-spoonfuls of the infusion given every four hours.

Cascarilla bark has also been employed in agues with advantage when cinchona bark could not be got.

SUBSECT. 2.—*Continued Fever.*

7146. This disease has received various names, according to intensity and modifying circumstances; popularly it is often termed *low*, *nervous*, and, in the worst forms, *putrid fever*.

Of all the common diseases, it is at once the most complex to observe and the most difficult to treat.

It has imprinted on it various forms by the season, climate, and epidemic agencies; by habit of body or mode of life; by cleanliness, or the reverse; by good living, or by scarcity of food; by mode of employment and means of subsistence. It is sometimes a mild disease, sometimes most severe and fatal. The early symptoms present to the unpractised eye nothing distinctive. There are at first various feelings of languor, feebleness, and general illness, with cold shiverings, loss of appetite, constipation, and disturbed sleep, and, two or three days afterward, headache, pain in the back, and aching in the limbs. In the course of a day or two, or not for a week, there ensue certain symptoms which are often the first to be observed by the individual himself or his friends; these are nausea and sickness, heat and dryness of skin, great headache, and pain in the limbs, a dry and furred tongue, quick and full pulse, restlessness, and often a great feeling of distress; and with all this often a remarkable trembling, which causes the limbs to shake and totter during walking, and the tongue to quiver when protruded from the mouth.

These symptoms, popularly termed *feverish*, are by no means distinctive; they may accompany almost any acute inflammation, and, though the educated eye of the physician may be able to form a tolerably correct guess as to the nature of the case, we can not expect, by any description, to enable our readers at once to distinguish the disease. We can enable them, however, to determine that they portend the advent of some dangerous disease, for which it is desirable as early as possible to procure medical aid. But before medical aid arrives something can be done; there is great sickness and nausea; an emetic will often remove this, and give a temporary relief. Emetics are of great service; they give present relief, but they also mitigate the disease through all its succeeding stages; that is to say, a fever which, from the violence of its early symptoms, threatened to be severe, after an emetic runs its course mildly.

But then a difficulty arises: an emetic would be very useful in fever; but is the disease, to see which the medical man has been sent for, really fever? May it not be some local inflammation with feverish symptoms, and in which an emetic may do harm? Undoubtedly it may; but against this there is no remedy: the chances must be taken on both sides, and it may be said that even in local inflammation an emetic may be of service if there be much sickness.

But even if there be a fever, there may exist certain symptoms which point out that emetics are improper. To two of these symptoms we shall shortly advert. First, if there be intense pain at the pit of the stomach, with heat, and a red tongue, proving inflammation to exist there, emetics may do more harm than good; and, secondly, if there be extreme affection of the head, not merely headache, but high delirium or stupor, emetics should not be given without medical sanction. After the emetic has operated, the bowels should be opened; to adults, four or five grains of calomel may be given, followed in an hour by a dose of tartrate of soda in senna tea. The farther management of the case must be left to the medical attendant. Under the head "Management of the Sick-room," we shall describe more fully the domestic treatment of a case of fever, and detail the symptoms to be particularly attended to, and to be mentioned to the physician.

SUBSECT. 3.—*Erysipelas.*

7147. This is also a febrile disease; but one of its essential characters is an inflammation of the skin. The skin is red, and this redness rapidly spreads; it is accompanied with swelling, of a variable amount, often very considerable. When it attacks the face, the appearance of the patient is totally altered by the swelling; all the features are confused, the eyes are concealed, the expression distorted; the person would not be recognised by his nearest friends. With all this there is high fever, with quick, full pulse, thirst, vomiting, violent shivering, constipation, and, at a later stage, and in certain forms of the complaint, sinking and exhaustion.

The chief domestic treatment is to obey implicitly the medical directions, particularly as to the *constant* application of warm or cold lotions, as may be recommended. The rags with which such lotions are applied must be constantly wetted; if they are suffered every now and then to become dry, they not only lose their effect, but become positively hurtful. If erysipelas attack the head and face, it is a dangerous disease. Any approach to delirium or stupor, any anxiety as evidenced in the expressions, or any giddiness or faintness, should be looked out for, and should be instantly communicated to the medical man, as inflammation of certain parts within the scull may come on, and be with difficulty restrained.

One of the best topical applications in erysipelas is an acidulated solution of nitrate of silver, as employed by Dr. A. T. Thomson. The solution is made with a drachm of nitrate of silver, ten drops of nitric acid, and an ounce of distilled water. This is pencilled over the inflamed parts, extending to a little beyond them, and leaving it to dry It blackens the skin at the time, but the cuticle exfoliates and leaves the surface health in a few days.

SUBSECT. 4.—*Inflammations of Lungs, Bowels, Eyes, &c.*

7148. This most important class of diseases cannot be described with any effect. Several inflammatory complaints, as croup, inflammation of brain in children, sore throat, &c., have been already mentioned Cough, breathlessness, expectoration, with high fever and anxiety, should arouse apprehension, and lead to the suspicion of *inflammation of lungs*. No time should be lost in seeking medical aid. If, with a short, dry cough and breathlessness, there be a sharp pain in the side, increased by movement, coughing, or a full breath, *pleurisy* may be apprehended, and should be at once attended to. If there be a constant pain over the bowels (abdomen), increased by pressing on them with the hand, and not coming on in paroxysms, *inflammation* may be present *here* also, and the assistance of a medical man in determining the case is necessary. In these cases, before the medical attendant arrives there may be some good effected by opening the bowels. If the affection be in the chest, this may be done by calomel (four, five, or more grains, according to age, strength, and sex), followed by castor oil. If the disorder be in the bowels, it is better to give castor oil alone, till calomel be sanctioned by the physician. In all cases, also, mustard poultices, kept on for twenty minutes or half an hour, are serviceable; and if medical aid cannot be procured for some time, leeches may be applied, and the bleeding promoted by warm bread poultices. Leeches should not be applied on the bowels of children unless a medical man be by, for it is extremely difficult to arrest the bleeding. One plan that will often succeed is, to wipe the blood clean off, and then at once to sprinkle into the little orifices a small quantity of flour; this mixes with the blood, and often stops its flow. Plaster of Paris may be used in the same way, and is still more efficacious.

7149. *Inflammation of the Eyes.*—Inflammation may exist in various parts in the eye. At present we wish merely to describe the inflammation of the external superficial coats.

In *adults*, inflammation always attracts notice; there is heat and running from the eyes, pain, and a feeling as if sand or some gritty substance was lodged in them; they become reddened, or what is popularly called blood-shot; the eyelids adhere to each other in the morning. Warm milk and water applications, and leeches, may be applied on the lids, and at the external part of the eye. Medical directions should be strictly attended to.

In *children*, inflammation of eyes is often very violent, and may occur a few days after birth: there is a yellow discharge from the eyes; the eyelids are swelled, and stick together; the light hurts the eyes, which are with difficulty opened; when opened, they are seen to be very red. Certain local applications become necessary, and are applied by the surgeon; the eyes, also, should be assiduously bathed with tepid water, to which some goulard lotion may be added.

7150. *Scrofulous Inflammation of Eyes.*—The eyes in this case are little reddened, but have a great aversion to the light; the child almost constantly keeps them closed, and the eyelids are spasmodically contracted when they are attempted to be separated. A discharge, often thin and watery, oozes from the eyes, and the eyelids adhere together in the morning. Certain local applications are always applied by the surgeon: the health should be carefully attended to; good and nutrient food plentifully given; and change of air, sea bathing, and tonics are often of essential service. The child should be prevented rubbing the eyes, and in the morning they should be gently bathed with tepid water, or milk and water, before opening them. When examined, the eyes must be turned away from the light.

SUBSECT. 5.—*Apoplexy.*

7151. A person is said to be in an apoplectic fit when he falls down suddenly and lies on the ground without moving, breathing deeply, and in a peculiar manner drawing in the cheeks, and then suddenly puffing out the cheeks and lips; when examined, the eyes are seen to be staring; the pupil much enlarged; the face is often swollen, red, and turgid; the pulse is full, strong, and often slow, and, as it is termed, labouring. If such an attack occurs in a man of matured manhood, of a full body, and accustomed to live well, and particularly if it occurs two or three hours after a meal, the probability of its being apoplexy is very much strengthened. In such an attack a medical man must instantly be sent for; and all that can be done till he arrive is to loosen the neckcloth and raise the head. It is often directed that vomiting be induced by putting the fingers into the throat; this direction, however, is incorrect, for not only is the strain caused by the vomiting likely still more to increase the mischief going on within the head, but as the attack occurs generally not immediately after a full meal, but two or three hours after, when an increased quantity of circulating fluid is added to the blood, such vomiting will not dislodge anything from the stomach, and cannot possibly be of the slightest service. After an attack of apoplexy, when palsy has not resulted, the diet should be carefully attended to; often vegetables alone must be taken; animal food and fermented liquors are inadmissible; the bowels must be regulated by medicines; gentle exercise assiduously taken, and all sudden exertions or movements, or severe mental excitement, cautiously avoided. There are many symptoms which sometimes point out the approach of apoplexy, as giddiness, great drowsiness, loss of sight or hearing, failure of memory, loss of muscular power, or twitchings of muscles, &c. When any or all of these occur, medical aid should be immediately sought for.

SUBSECT. 6.—*Palsy.*

7152. This may remain after an attack of apoplexy, or may occur *per se* suddenly, when it is called a stroke of palsy, or gradually, when it is termed creeping palsy.

When we treat of the sick-room management we shall take an opportunity of describing more fully the domestic management of this disease.

SUBSECT. 7.—*Epilepsy.*

7153. An epileptic fit, when once seen, is not likely to be forgotten. A person suddenly utters a loud and piercing scream, and then stands fixed and rigid, with every muscle in powerful action for a few moments, then falls and becomes quite insensible; the eyes are rolled upward and inward, the hands clenched, the limbs convulsed, the features distorted, the head rolled from side to side, or bowed up and down; there is foaming at the mouth, and the tongue is protruded and bitten. After a time, these symptoms gradually subside, and the patient sinks into a torpid state for some hours, from which he awakens drowsy, heavy, and incapable of exertion. The scream at the commencement is very characteristic; when once heard, it can never be forgotten; on hearing it, a parrot has been known to drop from its perch to the bottom of its cage, as if stupified by terror. It does not occur, however, in all cases, and often attention is first directed to the patient by seeing him fall heavily to the ground. Persons subject to epileptic fits after a time undergo a peculiar change in feature; the face enlarges and grows coarse, the finest countenance becomes plain, the lips and cheeks become bloated, and of a white, unhealthy hue, the eyes look dull and inexpressive, memory is impaired, the finer qualities of the mind are totally lost, and in some cases, after a variable time, insanity in some one of its numerous forms, most frequently in that of imbecility, consigns the unfortunate patient to confinement. During the fit of epilepsy, all that can be done is to loosen the neckcloth, and to lay the patient on the floor or bed in such a way that his struggles may do him least injury; the movements should not be restrained, any attempt to do so often increasing their violence; when the tongue is protruded and bitten, it is always necessary to put pieces of cork or thick pasteboard between the teeth, so as to keep the mouth open; they should be placed near the angles of the mouth, between the large molar teeth.

The treatment of epilepsy between the fits is far too lengthy a subject to be treated here; we shall only remark that the best medical treatment will fail if not assisted by attention to habits and modes of life; there are certain habits of a pernicious kind, to which it is impossible to allude more particularly in this place, which sometimes produce the disease, and always augment its violence; if these are not discontinued, the epilepsy will not cease; "there is no cure for it in the medicine chest, no, not in the best-furnished apothecary's shop."

Besides these, it is necessary to avoid excitement of all kinds, too much study or attention to business; to abstain from the luxuries of the table, to take regular exercise, and to attend to the state of the secretions.

SUBSECT. 8.—*Insanity.*

7154. On this subject it is not our intention to make any remarks. The brief sketch which our space would allow to give to this subject would be more likely to mislead than to instruct; we shall content ourselves with enumerating the three great rules of what is called the "*moral treatment*" of insanity, and which have been laid down with great clearness by an admirable French writer, M. Georget. These rules are:

1. The ideas and passions of lunatics on the subject of their delirium must never be excited; 2. Their unreasonable opinions must never be opposed by argument, opposition, or ridicule: there are some exceptions to this rule, and some cases, unfortunately few in number, which are benefited by a kind and careful discussion; 3. New ideas and affections must, if possible, be excited in their minds, and their attention directed to subjects foreign to their hallucination. Their bodily health must be promoted by the usual means of diet, cleanliness, and exercise, and which will be more alluded to in the Section on "Convalescence."

SUBSECT. 9.—*Gout.*

7155. It seems scarcely necessary to describe an attack of gout. The most usual form is as follows: The attack commences in the night suddenly with a sharp pain in the ball of the great toe; it comes on in twinges, and soon becomes very severe: the toe swells, and the skin becomes red and shining over it; after remaining at a height for several hours, or for two or three days, the pain subsides, and the swelling and redness gradually disappear, and the cuticle peels off. Previous to an attack of gout, certain symptoms occur which are of great importance, because, if taken in time, the approaching attack may be warded off. These symptoms are often those of indigestion; viz., heartburn; pain at the pit of the stomach; a load there after food; acid eructations; a white tongue; costiveness; high-coloured and scanty urine, with a red deposite; wakefulness; and perhaps flying pains in the limbs. If, when these symptoms occur in a person who has previously had gout, the diet were reduced, blood-letting practised, if the habit were full and gross and the pulse strong, and purgatives taken, particularly colchicum, in the doses presently to be mentioned, the approaching attack may be at once arrested.

The most usual form of gout is one that requires abstinence and exercise; even in habits the most predisposed, attention to the circumstances will secure freedom from the disease. When the attack has occurred, its duration and severity are often lessened by medical treatment. Into this subject we cannot enter, but we may remark that if the patient take colchicum without the sanction of his medical attendant, it must be with great caution; the dose should not exceed twenty drops (or minims, measured in the glass formerly recommended), combined with calcined magnesia and with Epsom salts (sulphate of magnesia). The colchicum should not be too frequently repeated, and directly it purges it should be discontinued; it should also be left off if there be great pain at the pit of the stomach.

There is another form of gout, occurring in pale, feeble, and emaciated subjects, and aptly enough termed "poor man's gout." In this case the homely maxim which has been applied to the above-described plethoric gout, viz., "living on sixpence a day, and earning it," will not answer: good food, tonics, and wine are necessary for its cure. When, in long-continued gout, the joints become swelled and painful, and the gout stones are forming, local counter-irritation by means of lunar caustic or ether, covering the part, at the same time, with oiled silk, is often serviceable; but it must be remembered that this is temporary merely, not striking at the root of the evil. If, during an attack of gout, the pain quit the great toe, or knee, or hand, or whatever part it happened to be located in, and the swelling and redness disappear, and if, at the same time, there ensue an agonizing pain in the stomach, coming on in paroxysms, it may be useful to know that laudanum may be of the utmost service in doses of twenty drops every hour, till the medical man come, who will probably give larger doses, and hot bottles should be unceasingly applied to the region of the stomach. If laudanum cannot be procured, strong brandy is the best substitute; but this is a more dangerous remedy, since the pain *may* be inflammatory, and not spasmodic, and in such a case brandy would do much more harm than opium.

SUBSECT. 10.—*Rheumatism.*

7156. This disease is popularly divided into two kinds, the acute and the chronic.

The *acute* variety is commonly known by the name of "*Rheumatic fever:*" there is intense pain in some of the joints, namely, the knees, shoulders, and wrists, which is not stationary in one place, but migratory and wandering, attacking violently one joint, then leaving this and fastening on another, and then passing on to a third, or returning to the one most affected; the painful joint is swollen, and the skin over it is red, although not always; the slightest movement gives excruciating pain: there is high fever; great heat of skin, and thirst; quick, full pulse; white tongue; copious acid perspirations at night; loss of appetite, &c. The pains are almost always worse during the night, and, as a general rule, are increased by heat.

Such a disease, painful as it may be, is rarely fatal; but it has sometimes consequences of a nature so serious, that it becomes one of the diseases which the physician is most anxious to cut short. There is a great tendency to disease of the heart; this is often very insidious, denoted only by violent heating, or not even by that, and the patient may deny that anything at all is the matter with the heart; but the stethoscope, the most valuable addition to modern medicinal science, reveals the mischief, which, never making a sudden impression, nevertheless pursues its sure and dangerous course, and leads eventually to some of the most fatal diseases of the heart; or, in other cases, there is intense pain and inflammation of the heart, producing a state not likely to be overlooked.

We have made these remarks for this reason: these affections of the heart are comparatively rare in the middle and higher classes of society, where medical aid is always at hand, but they display themselves in their greatest violence among the indigent and half destitute inhabitants of large manufacturing towns, and the poor agricultural districts. Those charitable individuals who "go about doing good" in these haunts of misery are quite unaware of this circumstance. Knowing that rheumatic fever has a tendency to remit in two or three weeks, they fancy it is a disease which will be cured without much aid, and thus a complaint which requires the closest attendance is left to inflict its utmost ravages without impediment. Rheumatism, thus left to itself, subsides, in a great degree, in from two to six weeks; the joints are left stiffened and a little swelled, and subject to pains during damp weather and changes of temperature; a second acute attack occurs after a time, and may be again and again repeated. At length comes a time when the affection of the heart begins to display itself in palpitation, faintness, and irregular pulse; and then livid lips and breathlessness, cough, and, from time to time, a bloody expectoration; finally, general dropsy occurs, and other organs become engaged in the disease, and assist in the fatal termination. The other variety of rheumatism, termed "chronic," from the length of time it lasts, may succeed to an attack of rheumatic fever, or may be of the same character from the commencement. It is not nearly so often followed by heart disease, and is altogether a less dangerous complaint; when it affects the small joints (a disease called by some "*Rheumatic gout*"), it thickens them, renders them stiff, and enlarges the ends of the small bones. With regard to the domestic treatment of rheumatism, we shall delay its consideration till we treat of the "Management of the Sick-room."

Subsect. 11.—*Scrofula.*

7157. This is one of those diseases which are transmitted hereditarily, that is to say, if one parent, and still more if both parents have scrofulous tendencies, the children will, in all probability, also be liable to them. But, moreover, in the most healthy children, bad food, want of proper exercise and cleanliness, and, in fact, all debilitating causes, produce the same effect as hereditary predisposition. Scrofula shows itself under a variety of forms, as enlarged glands, sores, rickets, diseases of bone, as of spine, shin bone, &c., or it affects the eyes, as has been already described under the title "Scrofulous Inflammation of the Eyes." Certain diseases are more common in scrofulous children, as water on the brain (*hydrocephalus acutus*), and the disease termed "*tabes mesenterica*," and chronic inflammation of the membrane lining the bowels (chronic peritonitis). All these diseases are of a serious nature, and demand particular treatment; they have this in common, however, that, springing from one common cause, the fundamental principle of treatment is the same, viz., to give strength to the body: but this general principle is modified by others, as, for instance, in scrofulous disease of the spine, which produces a projection backward of one or more of the bones of the spine, rest and counter-irritation are needful, and in chronic peritonitis, leeches, &c., are necessary.

To take one of the common scrofulous diseases, *rickets*; in this case the bones are bent and distorted, the ends enlarged, the breast pigeon-shaped, the spine curved, and the belly enlarged; and this state of things has, in all probability, been the consequence of neglect, bad food, and deficiency of exercise. This disease is often very tractable by regulating the bowels by alteratives, by nutritious food and tonics cautiously given, and, among other tonics, nothing is better than seaside bathing; and by regular exercise the health improves, the bones get straighter and more in proportion, activity and strength are regained, and many persons, rickety in their youth, grow up to be very athletic subjects. For some observations on the proper method of nursing rickety children we refer to Book XXVI., Chap. I.

7158. In another affection, *scrofulous ulcers*, the same general treatment is necessary, viz., good food, sea bathing, regular exercise, and regulation of bowels. Applications are applied to the sores themselves; we prefer these to be of a simple kind, believing more good to be effected by attending to the health generally than to the sore itself.

7159. In *enlarged scrofulous glands* the same general principles are to be carried out, and, in addition, medicines are used internally and externally, to lessen the bulk of the glands. Iodine, in some form or other, is generally employed; but this must be left to the medical attendant.

7160. It is customary to say that *scrofula* is denoted by certain marks, viz., a light, fair complexion, light and glossy hair, a large pupil with a blue iris, a large upper lip, considerable intellectual power, &c.; but a dark, sallow complexion, with long black hair, and a muddy dark eye, are quite as often marks of scrofulous tendency. And it may be fairly stated that a child will possess any or all of the above characters, and yet not be scrofulous in the least degree. If a child be born of scrofulous parents, it may, by proper attention, be brought through the perils of childhood, and the predisposition corrected. For this purpose, it is usually directed that a wet nurse should be employed, and that the mother should not suckle her infant herself: the child should be sponged all over the body every day with cold or tepid salt and water, according to the season and to the strength of the infant; after this it should be well dried, and friction employed plenty of exercise should be taken, and the natural cries and movements of the child should be encouraged, and not repressed; the sleeping apartment should be lofty and well ventilated; and country air is always desirable, or, at least, some time in every year should be spent at the seacoast.

7161. After weaning, the diet should be as nutritious as possible, without overloading the stomach; sea bathing and exercise are as useful, or more so than before; exposure to cold and damp should be avoided; and in children of forward intellect the development of the mind must be rather repressed than forwarded, and the contrary in children of dull and heavy minds.

Subsect. 12.—*Consumption.*

7162. We propose, in this place, to describe only the early symptoms of consumption, and the mode of life requisite in one predisposed to it. Under the head "Management of the Sick-room" we shall enter more fully into the means employed to afford alleviation to those who suffer under the more advanced stages of the disease. Although a knowledge of the first symptoms of consumption is most desirable, as it is only in an early stage that its formidable progress can be stopped, we feel some difficulty in describing these in the short manner which our space renders necessary; we feel that much needless anxiety may be caused, as every one of those early symptoms of consumption, recognisable by a non-medical person, may be present, and yet the individual be free from all taint of disease. Nevertheless, as consumption is so frequent and so fatal a disease in this country, we shall run the risk of occasioning sometimes unnecessary uneasiness in the minds of friends and parents, in order that we may, in some instances, afford assistance in the early detection, and consequent treatment, of this formidable malady. The personal appearance which has been described as indicative, to a certain extent, of scrofula, is also a sign of consumptive tendency; the age most liable to consumption is that between fifteen and thirty; perhaps its most frequent time of appearance is at the period of the cessation of growth.

7163. A short account of the nature of consumption will more clearly than anything else prove to parents what great necessity there is for an early detection of the disease. The complaint consists essentially of the deposition of a new and foreign substance in the material of the lungs. This substance, in an early stage, is often in the form of little grains of a whitish or pearly colour, and it is very remarkable that these are most usually greatest in number at the summit of the lungs; indeed, just at the part where, in young women, the custom of society ordains that the dress shall cease. When these whitish grains are few in number and small in size, they produce no symptoms whatever which can be noticed by a by-stander, except a little hacking cough, with trifling expectoration, and which is most noticeable in the morning, or may appear only at that time; sometimes there are also slight pains in the chest, but not in every case, and occasionally there are feelings of languor and lassitude. Now it is at this time, during the presence of this little hacking cough, when the little grains are few and small, that there is the greatest chance of cure; and it is precisely this stage which is most commonly overlooked. Supposing it to be overlooked, the deposition of these grains continues; they become united, and form masses and knobs of a grayish, dense substance, which acts as a foreign body on the lungs, and causes inflammation, exudation of fluids, and ulceration; the gray substance also becomes yellowish, or a yellowish substance is at once deposited, and this is known by the name of "*tubercle*." At this period there is the continued cough, the breathlessness, the spitting of blood, and the loss of flesh and strength, which, perhaps, for the first time attract attention, and medical aid is sought for; but it must be obvious to every one who has read these remarks, or any others upon the disease, that medicine can have little power over a disease of such extent; the time has been overlooked during which skilful and prompt attendance would have been of the greatest service; the physician cannot undo that which inattention and negligence have suffered to proceed so far; he stands by, a spectator of events he cannot check, and has the additional mortification of hearing his art condemned for errors not its own.

The symptoms which denote the earliest stage, viz., the slight hacking cough, the slight expectoration, which may be altogether wanting, the flying pains in the chest, and the languor and feeling of illness, are, in many cases, merely accidental, and present in those whose lungs are quite free from disease; but they may derive significance and importance from occurring in persons of a weak frame of body, or who have a hereditary liability to consumption: in all cases, but particularly in these latter, it is advisable to have the chest examined by some competent stethescopician; if disease be present, it is in the state most amenable to treatment; if absent, the examination will, at least, have removed painful apprehensions. In some cases spitting of blood is an early symptom; medical aid should always be obtained, and no foolish fear of alarming the patient should prevent the relations from a prompt and satisfactory investigation. There are many other symptoms in the early stage which are less obvious, and consequently less important, recognisable only by the practised eye of the discriminating physician.

Treatment necessary in Persons liable to Consumption.—The treatment is comprehended under the two following general heads: 1. To increase bodily vigour to the utmost; 2. To ward off inflammation of air tubes; and all circumstances which may tend to develop the latent predisposition. The first rule comprehends the usual means which improve health; such as regular exercise, nutritious and unstimulating diet, attention to the bowels; in summer, the cold or tepid bath, sponging the chest with salt and water, and using friction afterward: in persons of pale face and languid habits, steel wine continued for several months is useful; sea bathing may be combined with it, and, in fact, the "tonic regimen" must be employed. It is of great importance to allow the lungs full play; all fancied elegance of person must be sacrificed for health. The use of tight stays should be discontinued; and the dress should reach quite up to the neck, and in winter be lined with flannel; the upper part of the chest should never be left uncovered. Under the second rule we would particularly mention climate; the great use of Madeira, the Cove of Cork, Hastings, Undercliff, &c., is that they are not so subject to those sudden inequalities of temperature which, in susceptible persons, excite constant little recurrences of slight inflammations of the air tubes of the lungs; in consumptive persons every return of such inflammation is productive of harm; the substance, which, when deposited in the lungs, constitutes the disease, has much less chance of removal when every few days a cold, moist wind, or a sudden dry, east wind, sets in and augments the cough by adding little inflammations to the evils already present. A respirator is also useful, by rendering the air entering the lungs of a more equable temperature. Confinement in rooms kept warmed has also this good effect, but this mode of treatment has the disadvantage of diminishing health by want of due exercise, and by the exclusion of fresh air.

These remarks are made in the most general manner, as in every case the medical man must give such directions as are demanded by the particular state of the person; and hardly any two cases of consumption demand exactly the same minutiæ of treatment, although most of them agree in the main points.

Subsect. 13.—*Indigestion or Dyspepsia.*

7164. If one were to enter fully into the subject of indigestion, he might write a volume in the place of a few paragraphs; it would be necessary to consider the various kinds, and the diet and the medicines necessary for each: but as several works on diet and regimen, and which necessarily comprise the subject of indigestion, have been published within the last few years, we shall make no apology for dismissing this disorder in a few lines.

A person is, in common language, said to be dyspeptic when the appetite is impaired or lost, when there is a load and weight at the stomach after taking food, with eructations of gas, and sometimes of an acid fluid, into the mouth; accompanying these symptoms is nausea, and occasionally sickness, with a tense headache at the back of the head, or localized over the eyes; very often also there are dark specks before the eyes, and the eyes themselves look heavy, yellow, with a dark circle beneath. The tongue is red; the papillæ small, but elongated, and the organ itself enlarged, indented by the teeth, or pale and enlarged in the same way, or covered with a white or yellow fur; the bowels are costive; the water high coloured, and with a red, or, more rarely, a whitish sediment. Such are a few of the more prominent symptoms of the different kinds. With regard to the treatment, this must be left to the physician. We may remark that the practice of taking wine and spirits to force appetite cannot be too much condemned; it is as bad as the indiscriminate use of tonics, which used to be the routine practice of the half-educated medical men of former days; in many cases the mucous membrane is in a state approaching to inflammation, and the treatment is by means of leeches, counter-irritants, alterative medicines, and a diet light, unirritating, and strictly adhered to; however, in a certain class of cases, tonics, wine, and a generous diet are to be used; but the discriminating between these two very opposite cases must be left to the physician. We may remark that some very insidious and dangerous chronic abdominal complaints are ushed in by dyspeptic symptoms; these are generally treated by the patient himself, and usually also aggravated by such treatment: we strongly recommend all dyspeptics to apply for competent aid, if they find their complaints to resist their own treatment for two or three weeks.

Subsect. 14.—*Nettle-rash.*

7165. The only diseases of the cutaneous class which we think it necessary to mention are, nettle-rash, ringworm, and the itch. Some persons are much troubled with nettle-rash, a complaint arising from the use of certain articles of food, shell-fish, fruit, &c. In some persons these produce, after a few hours, feelings of tingling of the skin, and then itching and a little burning; soon after the itching has commenced, wheals appear on the skin; these are of a white colour, and the skin around them is often very red; the face is swelled, the eyes closed, and often with all this there is a feeling of nausea and weight at the pit of the stomach. The best treatment is to dislodge the offending matter by an emetic of ipecacuanha (eighteen grains or one scruple of the powder for an adult), and afterward a brisk aperient should be taken; the warm bath often gives much relief: in severe cases, medical aid is necessary.

Subsect. 15.—*Ringworm.*

7166. Many different diseases of the scalp are popularly termed ringworm; to distinguish between these is often a matter of great difficulty, even for a medical man; it is, however, extremely important, as some forms are contagious, that is to say, are transmitted from an affected person to one unaffected; and parents are necessarily very anxious to know whether their children must be separated or not from their play-fellows or ordinary companions. If an eruption be noticed on a child's head, it is very useful to observe exactly its appearance; whether there are little vesicles; whether the fluid in these is clear or white, or light or dark yellow; whether these little vesicles are pointed or flattened, or indented like a section of a honey-comb: all these things must be reported to the physician, as often, before the head is again examined, these vesicles have burst, and the effusion of their contents confounds their characters, and renders it difficult to decide on their real nature. It should also be noticed wheth er the vesicles appear irregularly over a considerable surface, or whether they are at first few in number, and spread as from a common centre. Other things being equal, if the vesicles be round, filled with a clear, not yellow fluid, and irregularly distributed, not spreading in rings from a centre, the chance of its being contagious ringworm is diminished.

Treatment.—Perhaps in all cases it is best to exclude the child from mixing with his companions till the nature of the complaint is made out: the hair should be cut off, but the vesicle should not be broken till the medical attendant has had an opportunity of carefully inspecting the head. If the eruption be clearly the kind mentioned above as being of little importance, a few days will probably remove it. When the case is declared to be ringworm, various remedies are to be tried. Some are useful, but often a remedy will seem to do good at first, and presently appear to lose its effect; various mercurial ointments, strong acetic acid, lunar caustic, alkalies, creasote, antimonial unguents, &c., are among the numerous preparations which are usually employed: we have known some good follow the use of an ointment made with equal parts of powdered gall-nuts and lard; the head should be kept clean, but not be too often shaved. If the disease be obstinate, it is some consolation to know that it often disappears of itself in the course of from two to five years.

Subsect. 16.—*Itch.*

7167. This disease is known by the appearance of pimples and vesicles, which by scratching acquire little black heads. The itching is augmented at night by the warmth of the bed. The disease may generally be known by the peculiarity almost always existing between the fingers, and on the wrists and elbows, when it affects other parts. It never appears on the face. It seldom happens in any but those of dirty habits or trade; common cleanliness will always prevent it.

Treatment.—Among the lower orders sulphur is the grand treatment; it does little good taken internally, but the ointment should be well rubbed in every night and morning. Among the better classes, who occasionally get this disease by accident, the sulphur is usually perfumed. We can recommend another powerful remedy, viz., a strong solution of the iodide of potassium, which should be put over all the affected parts every night, and left to dry on. It has the advantage of having no smell.

CHAPTER V.

ACCIDENTS IN THE FAMILY.

Sect. I.—FRACTURES.

7168. The most inexperienced eye can often detect that a bone is broken, for sometimes the skin is wounded, the muscles are torn, and the bone is plainly seen, with perhaps one end protruding through the wound; but, independent of this, when the skin is not broken, the limb is evidently seen to be deformed, bent, one portion forming an angle with another, and it is obvious that this cannot occur without fracture of the bone. But whether a fracture is plainly discerned or only suspected, the treatment to be employed till the arrival of the medical man is very simple. The limb, if it be a limb, is to be laid in the position easiest to the patient: the easiest position must evidently be that in which the limb is, as nearly as possible, in its natural condition, when the broken bone has no weight to support, and the ends of the bones are prevented from rubbing on each other and the surrounding parts. Therefore, if the leg be broken below the knee, the plan is to put the leg and thigh quite straight, while the patient lies on the back; but if left to itself in this position, the foot must evidently fall to one side or the other, and turn one broken end of the bone upon the other, so it is necessary to keep the foot straight up, either by holding it there, or by means of pillows placed along each side of the limb; and it may be convenient to know that, when the assistance of a surgeon cannot at once be procured, very excellent pillows may be formed extempore, by making some large linen bags, and half filling them with sand, previously dried and sifted; one large bag should be laid under the leg from the knee to beyond the heel, and depressions made in it for the calf and the heel; two or three other bags, longer and less broad, should then be laid on either side of the straightened leg; and by this means the limb is kept quiet, and in a convenient position till such time as the surgeon can arrive and "*set*" the limb by applying splints, which are merely mechanical contrivances, of a less rude kind than the sand pillows described, but serving the same purpose, viz., to keep the ends of the bones together without permitting movement.

Again, when the collar bone is broken, and which may be suspected when the patient cannot raise the hand to the head, it is obviously very important to take off the weight of the arm by means of a sling, and this often gives much relief. A sling should also be used if a fracture of the upper arm is suspected. If a fracture of the lower arm is suspected, the best way is to lie down in bed, and to place the fore arm on the large sand-bag already mentioned, with the arm bent, and the thumb kept up, or, indeed, in any easy position. With regard to all fractures, it is difficult to go wrong, if it be remembered that the principle is to put the limb in the position it would be in were it not broken, and to prevent one end of the broken bone from rubbing upon the other. If the surgeon cannot at once attend, it is often very useful to apply cold water or cold lotions continually to the part, by means of linen rags, to keep down inflammation, in addition to employing the means just mentioned.

Sect. II.—dislocations.

7169. When a limb is out of its socket, it is advisable to replace it as soon as possible, and therefore medical aid should be immediately sought for; beyond this simple remark we shall say nothing, because without much description it would be impossible to tell when a dislocation had occurred; and even then such imperfect knowledge would be dangerous, as a dislocation might be mistaken for, or complicated with, a fracture, and the remedies necessary for the former would do incalculable mischief to the latter.

Sect. III.—contusions, or severe bruises.

7170. In all contusions the dark appearance, and the successive changes of colour which occur in this, are owing to blood poured out from ruptured vessels. In the treatment of contusions, the first thing is to keep down inflammation by means of leeches, cold evaporating lotions (such as one part of spirit of wine and six parts of spirit of Mindererus), and to mitigate pain by laudanum fomentations in the intervals of the applications of the lotions. When the colour begins to change, the absorption of the blood may be accelerated by rubbing the part briskly with camphor liniment, or any common stimulating application.

Sect. IV.—sprains.

7171. In the treatment of sprains the most agreeable remedy is rest, with constant application of warm flannels dipped in laudanum, or warm poppy fomentations; afterward the part may be bandaged with a broad linen roller.

Sect. V.—wounds.

7172. When a severe incised wound (*i. e.*, a cut with a sharp instrument) has been inflicted, and medical attendance cannot immediately be obtained, the attention must first be directed to the bleeding: supposing the wound to be on the arm or leg, if there be a mere oozing, a simple trickling of the blood down the limb, then it will probably soon stop of itself; linen dipped in very cold water may be applied, and it is of great importance to elevate the limb, so that gravity may not assist the flow of blood: thus, if the wound be on the leg, the person should lie on the bed, and the leg be raised high on pillows; if the arm be the part injured, it should be held above the head; but, supposing the flow of blood to be more violent, supposing it to gush out in a large stream, as it would from a large cut vessel, it is necessary to stop such a jet, else so much blood may be lost as to induce alarming fainting; the best plan is to put the finger or fingers boldly into the cut, and press upon the part from which the blood seems to come without any regard to the pain it may give the patient; the finger must not be removed till the surgeon arrive and tie the wounded vessel with a ligature. When the bleeding has stopped, or nearly so, the next object is to bring the sides of the cut into contact, so that they may unite; this is done by means of adhesive plaster, long strips of which are applied, so as not merely to cover the wound, but to draw its sides together; a very little reflection will easily show any one how a particular cut is to be *dressed*, as the covering it with plaster is technically termed. If the wound be not merely a simple cut, but complicated with a severe bruise, the straps of plaster must not be firmly applied, the sides of the cut must not be forcibly pulled together; indeed, if the contusion be very great, and the bleeding moderate, it may be better not to apply plaster at all, but to use warm poppy fomentations for twenty-four or thirty-six hours, or to apply a bread and water poultice.

Sect. VI.—scalds and burns.

7173. *Scalds*, when caused by boiling water, will, it is obvious, be always of the same degree of severity; directly a scald has happened, it is advisable to prevent the action of the air upon it, and this is done by sprinkling it thickly over with flour, or covering it with cotton wool, which must not be removed till the scald is well, which will be probably in ten days or a fortnight. When scalds are caused by water not boiling, the lead liniment recommended for slight burns is the best application.

7174. *Burns* are much more difficult to treat, as they may be of very different degrees of severity; in the slighter kinds, in which there is merely redness and blistering of the skin, cotton wool or flour may be used, as in scalds; or the following liniment may be constantly applied, viz.:

Take of undiluted Goulard's solution of lead (liq. plumb. diacetatis), ½ ounce; olive oil, ½ ounce; water, 8 ounces; mix the oil and lead solution, shake them well together, and add the water; make a liniment, to be applied by a camel's-hair brush to the burned places, or spread upon linen and applied to the parts.

If the burn be more severe, and if a part or the whole of the substance of the skin be destroyed, the turpentine liniment is preferable; if this cannot be obtained from a druggist, then flour should be applied as before. When flour is used to burns and scalds, and the part is kept quiet, the pain soon ceases. If after a burn the face be deadly pale, and the pulse unfelt, a tea-spoonful of wine or brandy, according to the age of child, should be given from time to time.

SECT. VII.—MEANS TO BE USED IN RECOVERY FROM DROWNING AND SUFFOCATION.

7175. When a person has been taken out of the water, and is insensible, he should be conveyed as speedily as possible to the nearest house or cottage; but if there be no residence near, that is to say, within two or three minutes' walk, it is necessary to use the measures for restoring animation on the spot; although recoverable when taken from the water, the patient may die in the ten or fifteen minutes' transit, for want of certain necessary measures. It is necessary that every body should know that death occurs in drowning because the water prevents the entrance of air into the lungs; the small quantity of water which gets into the lungs is of no consequence, and still less that which passes into the stomach which occurs during life, or if the body be not drowned alive; consequently, the direction sometimes given in old books of holding the head down, in order to *drain off* the water, is not only useless, but positively hurtful; but if death occurs from the want of air, it is obvious that the thing needful is to restore air to the lungs as fast as possible, and this is done by artificial inflation. The patient should be laid in the bed, and hot bottles may be applied to the feet; but while these are getting ready inflation must, if possible, be commenced: in the absence of a regular apparatus, it can be readily performed by a pair of bellows; one person should close the mouth, and one the nostril of the patient very accurately, and in the open nostril the muzzle of the bellows should be inserted by another person; then the nostril should be pressed round the muzzle, so that when air is blown it may pass *through* the nose, and not out into the apartment; directly the position is rightly attained, the bellows must be worked, and the air from them will pass into the lungs; the blowing must be very gentle, else some harm may be done to the structure of the lungs; the rising of the ribs will at once announce that the chest is filled with air; then the bellows must be removed, the mouth and nose opened, and the abdomen and ribs pressed upon so as to expel the air; then the bellows must be used again in the manner described, and the series of changes persevered in for a long time, or till recovery occur; during this time warmth may be applied by means of hot bottles, friction, &c. When a house is some way off, and the bellows cannot be procured, inflation may be performed by any person closing the nostrils of the insensible man, and then applying his mouth to that of the patient and blowing into the lungs, then pressing down the ribs as before, to expel the air, and then blowing in again. Before the operator breathes air in, he should make three or four deep inspirations and expirations, so as to change the air in his lungs, and get it as like atmospheric air and as free from carbonic acid gas as possible. These means should be persevered in for a long time; hope should not be given up, for recoveries have occurred under very untoward circumstances.

7176. *Suffocation.*—In many cases the inflation described above is the remedy applicable here also: thus, if a person be suffocated in a brewer's vat, or by any mephitic gas, the body should be brought into the air, and the above-mentioned process must immediately be had recourse to; medical aid, of course, will always be speedily obtained.

[For the recovery of persons drowned, or suffocated by non-respirable gases, experience has shown that to throw suddenly and violently several buckets of water successively against the spine is a mode of concussion which will be found successful if life be not extinct. This method of treatment is of vastly more importance than the inflation of the lungs by bellows, rolling the body upon a barrel, &c., neither of which can be relied on with half the certainty of resuscitation. So soon as by this method the signs of life become unequivocal, by commencing respiration, groans, or involuntary motions of the head or limbs, indicating sensibility to the concussion upon the spine, the body should be wrapped in blankets, and heat applied, as directed in the foregoing section.]

SECT. VIII.—TORPOR FROM COLD.

7177. When a person has been buried under the snow, has been exposed for some time to weather of great severity, or has in any way become half frozen and stupified by excess of cold, the great rule is *to restore heat as gradually as possible:* thus, in some cases, even friction would communicate heat too soon, so friction with snow is employed to ensure a *very slow* development of heat. The person must not be brought into a room with a fire, but be kept in a very cold room, and covered with very light clothes; of course, in the majority of cases, it is not necessary to use frictions of snow; few cases are so severe as to require this. When long-continued friction has partly restored warmth, the individual may be removed to a warmer room, covered with warmer clothes, and the friction made with brandy. When warmth has been still more restored, heat may be more speedily communicated by means of one or two persons getting into bed with the person and warming him with their bodies: warm bottles and cordials must not be used till heat has been restored to a very great degree. The penalties which attend the too rapid production of heat are indeed great; rapid inflammation and mortification of fingers and toes, or even hands, feet, arms, and legs, or nose and ears, ensue, and the person rescued from the cold may be killed by an ill-judging zeal.

The retreat of the French from Moscow affords striking illustrations of the effect of heat too rapidly applied. These unfortunate men, exposed to a degree of cold to which their campaigns in Italy and in Egypt had little inured them, retreated in weather severe even for that cold latitude; their legions, as they marched, left, for those who followed, rows and groups of dead and frozen soldiery; those who were fortunate enough to reach the camp fires at night hastened toward the welcome blaze, and spread out their half-congealed limbs to the heat; in many cases gangrene followed on the instant, and increased so rapidly that its progress could be traced by the eye, or in other instances a kind of fulness of blood pervaded the lungs and brain; the individuals, perhaps, had scarcely breathed the new atmosphere, when, fainting, they staggered back, their limbs swelled enormously, they became devoid of sensibility, and died in two or three hours.

SECT. IX.—ABSTINENCE FROM FOOD.

7178. Here also the return to a natural state of things must be very gradual; if tho abstinence have been of great length, nothing stronger than chicken or veal broth must at first be given, and then by degrees strong beef tea, and after this some light vegetable, or a bread pudding; animal food must not be given for a long time.

SECT. X.—ANTIDOTES TO POISONS.

7179. *Sulphuric Acid, or Oil of Vitriol.*—The children of poor people often accidentally take this acid; it is bought to clean metallic vessels, and children take the half-emptied bottle, standing on the table, and put it to their mouths. The parent is generally at once informed of what has happened; she hears the child cry, and, turning round, sees the bottle in its hand, or, if she has left the room, she easily perceives what has occurred, from the cries of the child, the marks of the acid on its lips, and the empying of the bottle. Of course a surgeon is at once sent for, but it may be useful to know that magnesia or whiting, or chalk mixed up with water, are the best antidotes: the child should drink a good deal of the mixture. If none of these substances can be procured, a piece of soap may be beaten down in water and given, or even common oil, for this sheathes and somewhat protects the stomach from the corrosive effects of the acid.

7180. *Oxalic acid* is sometimes taken by mistake for Epsom salts; the taste is, however, very different, being powerfully acid, and this usually apprizes the person of the mistake he is committing, or if, as sometimes occurs, he has swallowed the draught at a gulp without tasting it, he is convinced that something is wrong from the excruciating and racking pain which almost immediately follows. The great antidote here, also, is chalk, which invaluable fact was first proclaimed by Dr. A. T. Thomson. It should be mixed with a *small* quantity of water, and taken in considerable quantity. Alkalies and soap are, in this case, improper, but carbonate of magnesia is also an excellent antidote.

7181. *Arsenic* is the most common of all poisons; it produces, some little time after it is taken, feelings of heat and pain at the pit of the stomach, which rapidly become agonizing; vomiting soon occurs, first of the contents of the stomach, then of mucus, bile, and blood. Such are the first symptoms, and their occurrence suddenly in a healthy person, and twenty minutes or an hour after a meal or taking anything into the stomach, they excite suspicion of poisoning. The medical man is of course at once sent for, and while he is coming vomiting may be increased, or, if not present, produced by mustard and water, or salt and water; draughts of warm water may also be taken to excite very copious vomiting. If full vomiting, not merely retching, occur, the chance of recovery is greatest. Two tea-spoonfuls of mustard in a glass of hot water will generally make an adult vomit copiously.

7182. *Corrosive Sublimate.*—The early symptoms of this poison are much the same as those of arsenic, but the pain is more violent, and the taste is most acrid and disagreeably metallic. If from these or any other circumstances corrosive sublimate is suspected or known to be the poison, then white of egg beaten with water should be given; it unites chemically with the corrosive sublimate, and the compound formed is quite inert.

7183. *Verdigris.*—If the person be known to have taken copper, or if it be suspected from the smell and the greenish colour of the vomited matters, and from the coppery taste in the mouth, then white of egg, not mixed with water, must be given here *also*.

7184. *Opium and Laudanum.*—These are two poisons very frequently taken by suicides: an overdose of laudanum, or of some preparation of morphia, is also sometimes taken by mistake. It is soon suspected that a person has taken opium; he is found lying in a state of stupor, as if in a fit of apoplexy, breathing heavily, or hardly breathing at all. Now the question is, what is the matter with this person? Has he apoplexy? is it sudden death from some internal disorder, or is it poisoning by opium? Perhaps a bottle or a glass will be found about, and give some clew: the pupils of the eye also are looked at, and found to be much contracted; now in apoplexy they are generally enlarged. The balance, then, is in favour of its being poisoning by opium, and the principles of cure are first to get the opium out of the stomach by emetic—an operation afterward done more effectually by the surgeon with his stomach-pump; or, if the patient can swallow, fifteen or twenty grains of vitriol, "*sulphate of zinc*" (a salt which can be procured from an adjoining druggist), should be given, or mustard and water, as in the case of poisoning by arsenic, or one scruple of the salt called "*carbonate of ammonia*" may be taken, and is a very good emetic. The next thing is to keep off the stupor as much as possible; this is done by making the patient walk about the room, and allowing no sitting down: if the stupor be too deep for walking, two strong men must literally drag the patient round and round the room, so that no repose whatever can take place. Cold water should also be assiduously dashed in the face, and the face and neck flapped suddenly with a wet napkin: this rouses the nervous energy; the patient generally opens his eyes, and he is capable of replying to questions for the space of half a minute or more. The water may be again dashed upon his face and chest as often as he relapses.

CHAPTER VI.

DOMESTIC MANAGEMENT OF THE SICK-ROOM.

7185. *In describing the management of the sick-room*, every circumstance which can contribute to the comfort and convalescence, or, when convalescence may not be possible, to the mitigation of the bodily sufferings of the sick, we have now to consider. These circumstances we shall place under three heads; 1, regarding those of the patient's room and its furniture; 2, of the qualifications of sick nurses; and, 3, of the course they should pursue when attending patients afflicted with severe and tedious or with mortal diseases, such as consumption and palsy.

SECT. I.—OF THE SICK-CHAMBER AND ITS FURNITURE.

7186. *Rooms for the sick*, wherever choice can be exercised, should be of considerable size, lofty, having open fire-places, and, for some cases of disease, a northern aspect.

7187. *Well-ventilated rooms* are, in all cases of illness, indispensable; yet ventilation should be so regulated that no current of air could pass immediately over the patient's bed or chair. It may always be supposed that draughts of air prevail in the direction of the fire-place, from any window or door; and hence in such situations the invalid should not be permitted either to lie or sit. In few cases free circulation of air is of primary importance. A patient in typhus fever suffers seriously from an overheated room; but, when the heat is moderated by the admission of fresh air, he will in a few hours often materially improve, so great an effect does this single circumstance produce.

7188. *In the convalescent stage of scarlatina free ventilation* is no less needful; but even greater care is requisite than in other cases of fever to screen the patient's bed from any current of air; for if the skin of the patient become slowly chilled, its functions are impeded, no reaction takes place, and the peculiar dropsy before mentioned occurs as a sequel to this disease.

7189. *The temperature* of the sick-room should not be below, nor much exceed, 60° of Fahrenheit.

7190. The kind of bedding for invalids is a subject of importance to their comfort. *In some cases* a well-stuffed feather bed is to be preferred to mattresses, which for fever or paralytic patients are not always sufficiently yielding. By the constant pressure of any particular spot on the mattress, the skin becomes inflamed, and a sore sometimes ensues. A feather bed may, however, be too soft, and become easily disarranged; the patient may be too ill to have it daily made and well shaken, and in such case it becomes often lumpy, and more uncomfortable and injurious to the skin than a hair mattress.

7191. *The spring mattresses* are the most unobjectionable of any; they give way easily to pressure, and spring up, by means of their elastic stuffings, as soon as the pressure is removed. They require no daily making, and afford the patient much assistance, from their elasticity, in turning from one side to the other. They are expensive to purchase, but when a long illness occurs in a family the value of one is incalculable.

7192. *The water, or Arnott, bed* is also another valuable contrivance for mitigating the sufferings and weariness of the victims to lingering, yet fatal diseases. In using it, the head and shoulders of the patient must be supported upon some fixed substance, otherwise, being heavier than the limbs, the inclination of the body will be the reverse of that which is natural. On whatever bed a patient lies, it should be large enough to admit of his being removed from one side to the other, to afford changes in the bed linen, as well as to afford relief in posture to the sufferer; or, if the bed be small, a second bed in the room answers the same ends, as well as admitting of daily exposure, for a short period, of the bed and bedding to the air of the room, when it may be again shaken well, made and prepared for the invalid, to whom, when again carried, it will afford renewed relief and refreshment.

7193. *Carpets* in the sick-room are often removed, under the impression of their retaining infection, if the illness be fever; but their removal is sometimes very inconvenient to the patient, causing too much noise, when the nurses are walking upon the bare floors, for the sensitive state of invalids; when this is the case, the carpets should be replaced, and every other means adopted to deaden sound, such as stuffing cotton wool into the window frames, using a wooden poker for the fire, &c.

7194. *Bed curtains*, in febrile cases of illness, should never be entirely closed, nor should the colour of bed hangings be of a vivid description; red is often a painful colour to invalids; green agreeable; so that, when a choice in this particular is possible, the room in which the latter colour is found should be appropriated to the invalid. Curtains should be removed altogether.

Articles useful in the Sick-room.

The minim glass, for the accurate measurement of medicine given in drops, or tea-spoonfuls. (It may be purchased at druggists for 2*s*. or 2*s*. 6*d*. apiece.)

A thermometer, for regulating the warmth of the invalid's room more uniformly than can be done by consult ing either the invalid's feelings or those of the nurse.

Chloride of lime, in cases of illness from fever, should always be kept in a bottle ready for use.

SECT. II.—QUALIFICATIONS OF NURSES FOR THE SICK.

7195. *When a disease is lingering*, or from its character requiring bodily strength in those employed as nurses, the members of a family are often obliged to give up the charge to the *hired sick nurse*, who knows, or ought to know, how to perform many important duties, of which those less accustomed to illness are ignorant. An experienced sick nurse is also quick in noticing changes in the symptoms of the patient's disease, which the relatives, from inexperience, would overlook, and which it may be important for the medical attendant to be informed of. But most sick nurses still require to be superintended by those most interested in the recovery of invalids; they are often inattentive to the needful ventilation of sick-rooms, and to the regulation of their temperature, keeping up the fires, and especially at night; this fault often increases a patient's fever, which it puzzles the physician to account for. Sometimes, also, nurses are careless in omitting, at the precise hours, to give the medicine ordered, and are not always strict in administering the right quantity. In the convalescent stages of fever, they also require to be cautioned in respect to the diet of their patients, which in quantity they are generally disposed to overdo.

7196. *The qualifications of a good nurse should be* good health; strength enough to lift a patient when requisite; activity, wakefulness, cheerfulness, yet with the power of being silent—a noisy nurse being most unfit for sick patients; intelligent enough to understand readily the often indistinctly expressed wishes of an invalid, and educated enough to read the directions attached to the medicines ordered. Her age should not exceed fifty, nor be much less than thirty years. She should be free from any habitual cough, or any habit which might annoy a patient, such as snuff-taking, &c.

7197. A society has been formed in London for the instruction of sick nurses. Those sent out go by the name of the Protestant Sisters of Charity, and are taught to perform all the offices of charity for which the Roman Catholic Sisters of Charity have been so long distinguished. Much good may be expected by the extension of this benevolent institution, for the sisters are engaged to serve the poor as well as the rich; the latter only being expected to afford the pecuniary means of supporting the institution. No money is given to the sisters by the patients or their friends.

SECT. III.—COURSE TO BE PURSUED BY NURSES IN SEVERE AND TEDIOUS SICKNESS.

7198. *During the first week of typhus fever*, in addition to the remedies ordered by the physician, and with which we have nothing to do here, certain things are ordered in the majority of cases, and the performance of which, although most important, is often left to the judgment of an ignorant nurse. For instance, if the skin be hot and the pulse quick, the skin is directed to be bathed night and morning with cold or tepid water, according to the heat of the skin, the age and strength of the patient, and the kind and period of the disease. Now this is a measure not only important as regards ultimate cure, but very important as regards the personal comfort of the patient, since nothing gives more relief and gratification than this bathing of the skin. The best time for doing it is before the bed linen is changed, as at that time it does not matter about any accidental wetting the sheets, but which, with proper management, need scarcely happen. The patient should not be altogether uncovered, but one part should be bathed at a time, and then dried. In bathing the part, it is necessary to use a good deal of water, not merely to rub the body with a wet sponge; the arms, for instance, may be held over a basin, and water freely poured upon them. After free bathing of this kind, the dry and harsh, unpleasant feeling about the skin goes off, and the patient feels relieved and comfortable. This bathing of the skin is still more useful in the early stage of scarlatina, when the skin is usually very hot.

7199. *In cases of typhus* which have continued some time, and in which the patient's strength has been reduced, this free bathing is inadmissible; but if the sponging be ordered in such a case, the physician will probably stand by, and, to prevent any injurious excess in the bathing, see it done himself.

7200. Another remedy, which is almost always used in the early stages of typhus, is the application of cold to the head, in the form of linen cloths soaked in cold water, or evaporating lotion, or ice applied in a way presently to be described. The use of these cold applications to the head is to prevent any congestion and accumulation of blood within it (a circumstance exceedingly common in fevers); or to moderate such accumulation when it does occur; or to keep down any inflammation of the brain or parts belonging to it, for inflammation of the brain or its membranes in various degrees is not unusual in cases of typhus fever. In order to apply cold effectually, it is, in almost all cases, necessary to shave the head, or to cut the hair very short; and to secure the full advantage of cold applications, the finest head of hair must be sacrificed. Parents who, for appearance sake, refuse such a petty sacrifice when life is in peril, are often sufficiently punished by the ill success of the treatment. When the head has been shaved, a cloth dipped in cold water should be applied over as much space as possible; to prevent the pillow being wetted by the water, a piece of common oil silk, which can easily be procured, should be laid under the head upon the pillow. A piece of simple linen is better than soaking a nightcap and puttting it on, as is sometimes done; it is less heavy, and more easily wetted again. The linen cloth should *never* be left on till it is dry; nurses often allow it, when it becomes dry and harsh, and the head gets hotter than before its application. Another way of applying cold water is to fill a large bladder about one third full of water; it moulds itself upon the head, and is not very heavy.

7201. Ice is best applied by pounding it very small, and half filling a large bladder with it; this also moulds itself upon the head, and is a very powerful agent. It should not be suffered to be on the head too long, else it may reduce the heat too much; it should therefore be removed for a few minutes from time to time.

7202. *By letting water fall from some height, drop by drop,* on the forehead of a highly delirious patient, a most powerful effect is sometimes produced; but this is too strong a measure to be had recourse to without the sanction of the medical attendant.

7203. *Another remedy,* often inefficiently attended to, is fomentation of the bowels; this is best done by having two large pieces of flannel, and dipping one into water as hot as can be borne, then wringing it quickly out, placing it on the bowels, and in the course of a few minutes, when it begins to cool, changing it with the other flannel, also dipped and wrung out; and this should be repeated for an hour or more.

7204. *The clothes on the bed* should not be too thick; the physician will of course see to this: if the patient appear cold, hot bottles should be put to the feet; if there be any accumulation of blood in the head, the feet are often cold; in this case they should be wrapped up in flannel, and hot bottles constantly applied.

SUBSECT. 1.—*Early Stages of Fever.*

7205. *During the early stages of fever* there are certain symptoms which must be particularly noticed, and reported without fail to the physician. It should be noticed how much sleep the patient gets, whether this is deep or disturbed, whether there is any confusion or forgetfulness on awakening: this does not of itself prove that delirium is coming on; but as it is really often the commencement of it, it should not be overlooked; during sleep, too, it should be noticed whether the breathing is regular and deep, or whether it is quick and shallow. Any little cough should not be overlooked.

7206. *Again, the nurse should observe whether there is an increase of fever* at any particular time of the day; such increase is denoted by the skin becoming hotter, the pulse quicker by from six to twenty beats; by the face flushing, the eyes becoming more sparkling, and by the patient being thirstier, and complaining more of headache. The number and kinds of the stools, &c., also should be examined into. Patients are often exceedingly thirsty at this period of the fever; they may drink as freely as they like, and of all beverages cold water is the best. Lemonade is not so good, as in such large quantities it tends to disorder the stomach. The patient usually refuses to take any food, and it should not be pressed upon him from any mistaken idea of giving strength, for it is the fever which exhausts as much as the starving, and it is the former which is to be dreaded; get rid of it, and the debility is generally easily remedied; besides, if food be pressed upon a stomach not demanding it, it will do no good; it will not be digested and assimilated properly, but will pass down into, and perhaps stimulate, the intestines, and cause diarrhœa, with certain formidable ulterior consequences. In addition to what has been now said, it is of course essential that such medicines as are ordered should be given regularly at the appointed times, both day and night.

SUBSECT. 2.—*The latter Stages of Fever.*

7207. *In the latter stages of fever* the weakness is the thing with which the nurse has most to do. It is of the highest importance to give the food which is ordered regularly. The patient is perhaps dreadfully emaciated, weakened to the last degree, and, *if left* without nourishment for several hours together, would perhaps fall a victim to debility alone. It is during the night that a person requires most support; it is during this time that such support is most likely to be forgotten. The food should be given frequently, and in small quantities; the exact quantity of food and time of taking it depend upon the weakness and the appetite of the patient, and necessarily vary in each particular case. If wine be ordered also, it should be given frequently, and in small quantities, mixed with water. It should never be forgotten by nurses that wine by itself has no nourishing power; it is only employed by the medical man to sustain the failing strength, by its exciting agency, till such time as the food taken may have, in some degree, restored the tone of the body. If therefore wine flushes the face, quickens the pulse, and excites headache, it is doing too much; the body is over-excited.

7208. *With regard to the kind of food:* at first it must be simple and farinaceous, and afterward a transition may be made to beef tea, veal and chicken broth, &c., to prepare which we refer to the article on "Cooking for Invalids." Also, during the latter stages of fever, great care should be taken to preserve perfect cleanliness—often a very difficult matter, for the discharges are often somewhat decomposed, and of a bad smell; the sheets should be changed every day, or more often if necessary, and when taken off should be immersed immediately in a pail of water ready at the bedroom door, and to which some of *Labarroque's disinfecting liquid* should be added; some of this should also be sprinkled about the room.

7209. *The patient should not be suffered to lie too long in one position*, but should be gently moved from one side to another, because in these long illnesses, if parts be too much pressed upon, they become sore; therefore towards the end of a severe fever the physician generally examines the lower part of the back and the sides of the sick man, to see if there be any appearance of a sore place; if he does not do this, the friends should see to it; this examination should never be left to the nurse alone.

Directly a part appears discoloured, you may be sure it is too much pressed upon; the patient should be placed in some other position, and propped up by pillows; pillows should also be put above and below the part, to take off the pressure. Certain applications are to be used to the part itself; one of the best of these is a solution of nitrate of silver (lunar caustic), the strength of which should be about twenty grains to an ounce of water; a little of this should be painted on with a camel's-hair brush every day. When the spot has gone beyond this slight discoloration, and has become sore, or seems to be on the point of doing so, the most simple ointments are the best, as a mixture of equal parts of lard and oxyde of zinc, or calamine mixed with oil till it acquire a tolerable consistence; these ointments should be spread on linen, and applied constantly over the part; if the sores seem to be spreading, a water bed is often of great service.

7210. *Again, during the latter stages of fever*, everything should be carefully observed; the position of the patient in bed, and whether he spontaneously changes it, is an important point; also the expression of the countenance; the action of the bowels is one of the most important circumstances to be noticed; the stools should always be kept for the physician to see; the mode of breathing and the presence or absence of cough must not be forgotten; it should also be noticed whether the patient is constantly drowsy, and whether, when awake, he be sensible or delirious, or, as it were, childish, which last state is common in convalescence, and goes off as strength returns.

SECT. IV.—COURSE TO BE PURSUED BY NURSES IN CASES OF CONSUMPTION.

7211. It often happens that a patient with consumption will be able to walk in the open air—will, in fact, possess considerable muscular strength till within a short period of death. The chief things which render this period of consumption harassing are the constant cough, the breathlessness, the occasional sharp, flying pains in the chest, the evening fever, which often prevents sleep till towards the approach of morning, and the nocturnal perspirations. When the cough is very severe, certain remedies intended to allay it are always ordered by the medical man, and these often give temporary relief. The chief thing that the non-medical attendant has to do with regard to the cough is to keep the apartment at a temperature tolerably constant, day and night; all sudden changes from hot to cold air, or the reverse, augment the cough; if it be winter, the patient should not proceed from one room to another, and should not go up and down stairs without putting on a respirator. The temperature of the sitting and bed rooms should be comfortably warm, but never very high; towards the evening it should, if anything, be lower than in the morning, as in the majority of cases the pulse gets quicker and the face more flushed towards night; there is, in fact, an accession of fever, and hot rooms are likely to augment this, and, by so doing, add not a little to the discomfort of the patient. When exercise is taken in the open air, it should never be violent; the patient should walk gently, or, at a later period, be wheeled slowly about in a chair; quick walking increases the flow of blood through the lungs, and, as a consequence, augments the cough and the difficulty of breathing. If the weather be tolerably warm, as much outdoor exercise should be taken as can be borne. With regard to the breathlessness, it may be some consolation to know that this is often much less than might be expected from the extent to which the lung is affected; for the system gradually accommodates itself to the means of breathing which still remain to it; and persons who have only a small portion of lung capable of admitting air still may not suffer materially from difficulty of breathing.

The flying pains in the chest, which are sometimes very severe, will, of course, be treated by the physician; mustard poultices may always be applied, and, according to very high authority on this subject (Sir J. Clark), are often of very considerable service.

The fever, which comes on towards evening, *and the night perspirations*, are two very distressing occurrences in many cases; the patient cannot sleep, but tosses about in bed, or occasionally has a short, unquiet doze; towards three or four o'clock in the morning, perhaps, he falls into a deeper sleep, accompanied with great perspiration, and wakens after a few hours, feeling unrefreshed, and weaker than the night before; after an hour or two, however, he gets more comfortable, and returns nearly to the same state he was in on the day before.

7212. *The night perspirations* are, in some degree, under the influence of medicine, particularly some of the mineral acids, as diluted sulphuric acid, &c.; but the feverishness is often very obstinate; it must be tried to be lessened by quiet of mind and body some time before going to bed, and by abstaining from all heating food, or from anything that may stimulate, in the evening.

7213. *In the degree of severity*, consumption varies infinitely in different persons; some are afflicted by pains in the back and abdomen, headache, dreadful paroxysms of cough, and breathlessness, dyspepsia, evinced by loss of appetite, loathing of food, or sickness and pain after taking it, and a load at the pit of the stomach, with acid eructations, and a red, furred tongue, dryness of the mouth, and considerable thirst; in these cases, as in the less severe ones, there may be spitting of blood very copious, or only sufficient to tinge the expectoration; at a later stage there may be excessive pain in the bowels, great headache, delirium, or a kind of stupor, and a most distressing diarrhœa, which speedily exhausts the patient, and reduces him to the last degree of emaciation; and then thrush about the mouth, which ensues, is extremely tormenting. Fortunately, however, consumption does not always have a course so painful to the patient, and so distressing to the witnesses: in some cases, though perhaps not in the majority, the cough is not so constant and violent; the breathlessness is less; the weakness is progressive and sure, but never makes rapid advances; the emaciation goes on slowly; the appetite and the digestion continue good; no diarrhœa or thrush torments the patient; and, as an excellent writer on this subject describes it, "it is an easy descent, *facilis descensus;* the patient sinks step by step, and gentle is the parting of the last filament, when the body sinks to earth, and the soul rises to eternity." (Dr. C. J. B. Williams.)

7214. *One characteristic of consumption* has been often described by medical writers, and noticed with wonder by the attendants; it is an extreme hopefulness of mind: many patients firmly believe they shall recover, even when in the last stage; no amount of experience can eradicate this, and undoubtedly no one could wish to have such a belief eradicated. We have described above two forms of consumption, differing greatly in severity, and our chief object in so doing was to mention that, in many cases, though not in all, it is possible to change a case which at first threatened to be severe into a milder form; of course in many instances, from the great excitability of the patient, the extreme liability to tuberculous deposites, or from the advanced period of the complaint, such a change is impossible; but, fortunately, sometimes, if the diarrhœa and pains in the bowels can be put a stop to, the remainder of life is comparatively tranquil, and free from distressing symptoms. Therefore, if the patient begin to complain of shooting pains in the abdomen, or if there be a diarrhœa commencing, a mustard poultice should be applied, and repeated every six hours, and the physician should be apprized of the state of things: if the pain be in one spot, a small blister, about the size of the palm of the hand, or smaller if the pain occupy less space, may be put on, and this measure sometimes gives great relief. The diet, also, should be changed; animal food, if it be taken, should be left off for a few days, and mild farinaceous articles alone taken; but of course all these details must be left to the attending physician.

7215. *In the latter stages of consumption* thrush often makes its appearance on the lips, tongue, and inside of the cheeks; the appearance of this in children has been already described; and the measures applicable in that case, as borax with honey or water, are useful, also, in this instance. Very little can be done for the delirium or the stupor, both of which are the immediate precursors of death; life seldom continues more than a fortnight after the former has commenced. Many patients have no delirium or stupor, but die suddenly in a paroxysm of coughing.

SECT. V.—COURSE TO BE PURSUED BY NURSES IN CASES OF PALSY.

7216. *In palsy one side of the body loses its power of motion*, either wholly or in great part, and with or without loss of sensation; or the loss of motion may be confined to both the legs, and the rest of the body remain unaffected. The former case (*hemiplegia*) is the more common complaint of the two, although both are far from rare; yet it sometimes follows a stroke of apoplexy, that is to say, when a person recovers from the stupor of apoplexy, he finds he has lost all power over one side of the body, and that his face is drawn to the opposite side; or loss of motion suddenly occurs without loss of consciousness, and this is popularly termed "*a stroke of palsy.*" Palsy may, however, occur gradually, a degree of feebleness being first noticed; and this is called, both popularly and medically, "*creeping palsy.*"

7217. *In this form of the complaint* the patient should at first be kept quiet, and the skin of the affected side should be well washed with warm water every day, and then well dried; and it is a good plan to rub it well with a horse-hair glove, unless there be some particular reason why this should not be done. As soon as possible, the patient should be encouraged to make what use he can of the arm and leg, and if he be quite incapable of any motion, it is a good plan for the nurse or attendants themselves to move the arm and leg every day for about the space of an hour; this prevents the muscles from wasting so rapidly as they would otherwise do from want of use. If a seton be inserted into the back of the neck, the part should, after an hour or two, be covered with a linseed meal poultice; this lessens the irritation caused by the seton.

7218. *In the other form of the disease*, that in which the legs are palsied, (*paraplegia*), and which generally arises from disease of the spinal marrow, the position of the patient must be carefully attended to: if the case be a tedious one, the back is liable to become sore and ulcerated, and this should always be noticed, and if any indications of approaching ulcerations be apparent, the same remedies should be used as were recommended for the same condition in typhus fever. The muscles should be exercised in this case also every day by the attendants. If issues are made in the back, it is necessary to prevent the patient from lying too much on the back, else the issues may become troublesome sores, and nearly impossible to be cured. We shall not describe here the mode of dressing issues, because the surgeon who makes them can explain this in a few words. For farther information the reader is recommended to consult "The Domestic Management of the Sick-room," by Dr. A. T. Thomson.

CHAPTER VII.

CONVALESCENCE.

7219. *The period of recovery is a most important time*, and often requires as much care as the disease itself; the body is weak, susceptible of impression, disposed to take on morbid actions, and, in some instances, a relapse into its previous state may occur from causes which in its healthy condition would not at all affect the body. The management of convalescence is so extensive a subject, so diversified, and requires so much medical knowledge, that it is quite impossible to enter fully into it in a book intended to be popular; our observations, therefore, will be of a simple and general kind.

SECT. I.—DIET IN CONVALESCENCE.

7220. *After a disease has been subdued*, the appetite returns: the object of food is to restore gradually the waste which the body has sustained; the kind of food must be left to the medical attendant, as it will differ in different cases; and for much useful information on this subject we refer to Book VII., "On Food."

The food must be nutritious and easily digestible, but, at the same time, quite unstimulating; in the early days of convalescence wine, spirits, or malt liquor are generally quite inadmissible, except in convalescence from low fevers. In convalescence after fever, but particularly after typhus fever, the quantity of food must at first be very small, and gradually increased; the appetite is usually extremely keen, and relapses are more often brought on by excess in diet than by any other cause. The digestive organs being weakened, and unable fully to perform their office, it is quite impossible that the quantity of food which the patient would take, were it allowed, can be digested; it lies, therefore, in the stomach, causing a load and weight there, and producing sickness and depression, or, passing beyond the stomach, it induces irritation in the intestines, and diarrhœa; when it is known that the intestines are particularly affected in typhus fever, it is at once apparent why an excess of food is so particularly hurtful in convalescence from that complaint.

7221. *In recovery from all fevers* patients must take food frequently, and in very small quantities at a time; they should never be left a whole night without food. When meat is allowed, poultry and game are usually the first things given; the latter is reckoned more stimulating than the former. With regard to the time of taking these, or fish, &c., we shall make no remarks in this place; we wish only to insist on a most important statement, namely, that in recovery from fevers more harm is done by over-feeding than by any other mistake in treatment; people, in general, have a dread of debility, that leads them, without the advice of the physician, to commence stimulating diet, and in their eagerness to escape one evil they fall into another, which has consequences much more dangerous and irretrievable.

Sect. II.—exposure to cold.

7222. This must be particularly avoided in recovery after typhus or scarlatina: in the latter disease it often brings on the dropsy, formerly mentioned.

Sect. III.—exercise.

7223. Exercise must be gradually taken after fevers, and still more care must be employed in recovery from inflammation in the chest; in these latter cases, a warm, sheltered seacoast, as the Cove of Cork, Hastings, or the Undercliff in the Isle of Wight, is the best situation for recovery. We need hardly mention *warm clothing* as essentially necessary to recovery. The advantages of cheerfulness, of forgetfulness of invalid feelings, must be sufficiently obvious. Travelling is useful in some cases of advanced convalescence, and particularly after recovery from disorders of the digestive organs.

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